Building Engineering - Sustainability

Local Government Yorkshire and Humber

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Low carbon and renewable energy capacity in Yorkshire and Humber

Final report

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Executive Summary

1 Executive Summary

This study was commissioned by Local Government Yorkshire and Humber to assess the resource for low carbon and renewable energy generation across the Yorkshire and Humber region. The findings of this study provide an evidence base to assist sub-regional stakeholders and local authorities in the preparation of their own targets, policies and strategies for renewable energy development at the sub-regional and local levels.

1.1 The opportunity

Through the Climate Change Act, the UK has established a legally binding target to reduce carbon emissions by 80% on 1990 levels by 2050. The UK is also committed to generate at least 15% of energy demand from renewable energy sources by 2020. This will require new approaches to the way we generate and supply energy and manage energy demand.

The geographical characteristics of the Yorkshire and Humber region, combined with a comprehensive infrastructure network inherited from its legacy of industry and energy production, means that the region has great potential to exploit a range of renewable energy technologies.

Renewable energy has the benefit of zero net carbon dioxide emissions, and can play an important role in enabling the Yorkshire and Humber region to meet its share of national carbon targets.

Renewable energy can also deliver substantial economic, social and environmental benefits at the local and regional level, by creating jobs, through the manufacture, installation, operation and maintenance of renewable energy technologies, as well as providing a new impetus for rural diversification and regeneration.

1.2 Objectives of the study.

The objectives of this study were:

- To provide an assessment of the potential for low carbon and renewable energy across the region in a clear and justifiable way that is consistent with the other English regions, and meets the requirements of national government for such studies;
- To provide a common and robust evidence base on the potential for renewable energy to inform and support policy making by individual local authorities in the region, as part of developing their local development documents;
- To identify strategic delivery actions, for each of the four sub regions, to tackle strategic barriers and facilitate deployment of renewable energy opportunities.

1.3 Summary of renewable energy resource

This study has found that by 2025 the region has the potential resource to install approximately 5,500 MW of renewable energy generation capacity (around 3,600 MW of renewable electricity plus around 1,900 MW of renewable heat) and generate around 16,100 GWh of renewable energy annually. These figures exclude biomass co-firing in coal fired power stations, large scale power generation from dedicated biomass power stations taking imported biomass as feedstock, and offshore wind and marine renewables.

This would represent nearly a fivefold increase on existing operational and consented capacity. The main contributions to the resource, excluding offshore technologies and biomass co-firing, come from commercial scale wind and biomass energy generation. The resource is spread across the sub regions (see Figure 1 below).

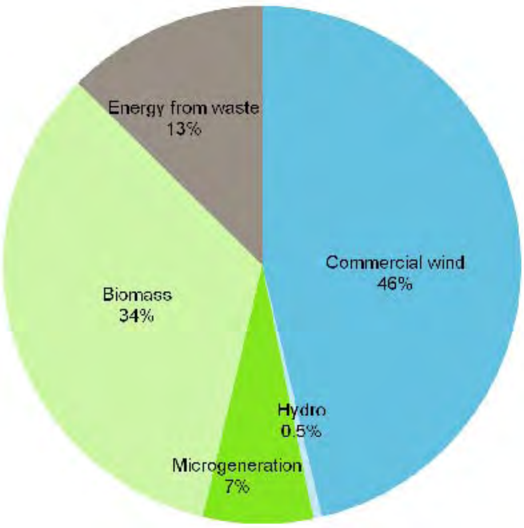

Figure 1 Distribution of potential renewable energy resource (annual energy output) in Yorkshire and Humber by technology

Yorkshire and Humber is currently slightly behind the other English regions in terms of installed renewable energy capacity, but is catching up fast. Further activity to encourage wider understanding of renewable energy amongst planning officers, members and local communities through education and awareness raising could help to increase deployment. Region wide or sub-regional guidance for planning officers on the interpretation of planning application material would be welcomed by developers. Adopting design principles, such as those produced by Scottish Natural Heritage on the cumulative effect of wind farms, could also encourage consistency in assessing applications.

1.4 Larger scale renewable electricity generation

Commercial scale wind energy represents a key opportunity for increasing the renewable energy capacity. Most of the economically viable resource lies in a band going through the centre of the region from north to south and along the east coast of the region in East Riding of Yorkshire.

Hydropower has an important but limited role to play, particularly by bringing Yorkshire's rich heritage of mills back into use and increasing awareness of the benefit of renewables.

The majority of the potential biomass energy resource is located in York and North Yorkshire, where there are particular opportunities for growing energy crops, whilst avoiding any potential conflicts with food security. Straw also represents a significant resource for the region, with a large potential resource in the Hull and Humber Ports sub-region, and there are proposals for several schemes that could utilise this resource.

Biomass co-firing in the three coal fired power stations in the region is a current and future significant source of renewable energy capacity in the region. There is the potential for a proportion of the region's biomass resource to be used for this co-firing, as well as in dedicated biomass power and CHP plants.

In general, the electricity distribution network is sufficiently equipped to deal with the expected increase in renewable energy deployment, although some parts of the network in the Humber area may need to be upgraded to meet demand.

1.5 Larger scale renewable heat generation

There is potential for new biomass and waste energy facilities in the region to be configured and operated in a Combined Heat and Power (CHP) mode, to enable them to supply heat as well as generate electricity. This has the potential to maximise the efficiency of any facility, in terms of the useful energy recovered from the fuel, as well as any carbon savings. However, this requires such facilities to be co-located with heat demands, either residential, commercial or industrial loads that can be supplied heat via a district heating network.

The study has found that district heating with CHP could be viable in the majority of the region's urban settlements. However, installing a district heating network is a major capital investment and there is a limited range of proven stewardship and procurement models. The biomass fuel supply chain in the Yorkshire and Humber region is currently in its infancy and the market conditions are variable. There is a potential role for local authorities to collaborate with the sub-regional bodies to establish a supply chain to provide some degree of long term stability.

At least three energy from waste plants are currently in development in the region. A number of waste disposal contracts are due to be retendered in the short to medium term and these could provide the opportunity to co-locate energy from waste facilities with major heat loads and the opportunity for stakeholders in the region to maximise the energy and carbon benefit of these schemes by stipulating that they supply low carbon heat into local heating networks.

1.6 Production of biogas

Biogas can be produced from anaerobic digestion of crops, segregated food waste, and mixed municipal, commercial and industrial waste streams. Landfill gas and sewage gas production currently represents around 20% of regional renewable energy generation, and it is all used to generate electricity.

With appropriate cleaning techniques, biogas can be injected directly into the existing gas network and used in homes without modification to appliances and avoiding the need for investment in new distribution infrastructure. The region has an extensive and robust gas distribution network but policy needs to provide the necessary incentives in order to encourage synthetic gas production. This will be out of the hands of local authority and sub regional partners, although lobbying of government on the issue may help to form policy development.

1.7 Microgeneration

Microgeneration typically refers to the array of small scale technologies that can be integrated into new building development or retrofitted to existing buildings. The Feed In Tariff has resulted in a dramatic increase in the number of electricity generating, microgeneration technologies installed in the region. The Renewable Heat Incentive is likely have a similar effect on the deployment of heat generating, microgeneration technologies.

Capabilities on project:
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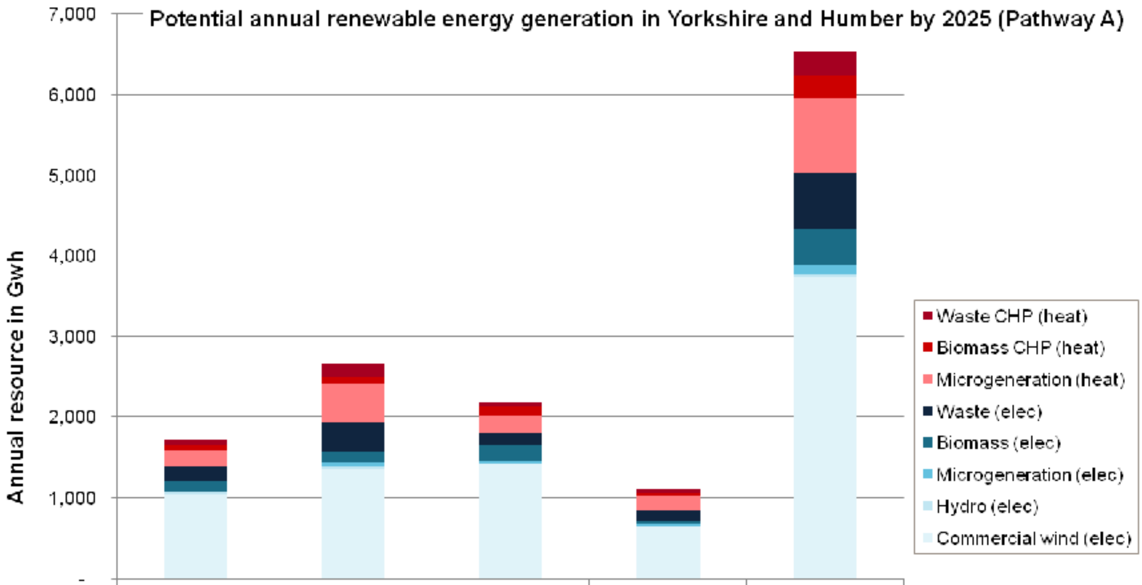

	York and North Yorkshire	Leeds City Region	Hull and Humber Ports City Region	South Yorkshire	Yorkshire and Humber
Waste CHP (heat)	70	162	55	58	296
Biomass CHP (heat)	76	81	123	32	276
Microgeneration (heat)	195	488	207	183	926
Waste (elec)	178	359	160	122	706
Biomass (elec)	122	130	197	52	442
Microgeneration (elec)	16	63	16	25	106
Hydro (elec)	17	34	0	5	44
Commercial wind (elec)	1,050	1,344	1,428	642	3,736

Figure 2 Distribution of renewable energy resource for Yorkshire and Humber by sub region (for renewable energy Pathway A)

1.8 Using the resource effectively

Scenario modelling suggests that with an ambitious but reasonable attempt to increase energy efficiency of the building stock, it should generally be possible for the Yorkshire and Humber region to meet its share of the UK's 15% renewable energy target, mainly due to the significant resource for renewable electricity generation from commercial scale wind energy turbines and the significant contribution from biomass co-firing. Achieving the necessary levels of renewable heat generation is likely to be challenging.

It should also be noted that the available renewable energy resource will be under demand from other sectors, such as transport, agriculture, industry and commerce. A coordinated approach to delivery will be necessary to ensure that the available resource is used as efficiently as possible.

1.9 Using the outputs of the study

A suite of Energy Opportunities Plans has been produced as a resource for assessment and prioritisation of opportunities. These should provide a tool when developing planning policies, targets and delivery mechanisms within the LDF process, and can bring added benefit and support to development plan documents. They can be used to support policies that stipulate requirements for renewable energy, whether these are through the setting of targets that exceed Building Regulations, the requirement for Code for Sustainable Homes or BREEAM, or a requirement for connecting to, or investing in, infrastructure to facilitate district heating.

They can also be used to inform actions in corporate strategies, as well as investment decisions taken by the sub regional bodies and local enterprise partnerships.

Although the Energy Opportunities Plans provide an overview of potentially feasible technologies and systems within the region, they do not replace the need for site specific feasibility studies for proposed sites.

1.10 Keeping the study relevant

Collating data on renewable energy installations has proved to be a major challenge and highlights the need for a coordinated approach to be taken to maintaining up to date information on new installations.

Ideally, the conclusions of the study should evolve to reflect changes in policy and targets. The 2010/11 Climate Change Skills Fund for Yorkshire and Humber could be used to facilitate this process. The quantitative information and spatial datasets should be made available to stakeholders in a live format that can be easily kept up to date. A web-based GIS system would be the most accessible way of presenting the information. It could be linked to the Yorkshire and Humber Renewable Energy toolkit, although questions around ownership of the datasets and maintenance requirements would have to be addressed.

An online forum was set up online to encourage discussion amongst stakeholders. This is located at www.yorkshirehumberrenewables.maxforum.org and could also form part of a dissemination package.

1.11 Strategy for delivery

This study provides an action plan for delivery of low carbon and renewable energy for each of the four functional sub regions, developed in collaboration with key stakeholders.

One of the key challenges facing delivery will be constraints on public spending and the availability of public sector funding for infrastructure. Tightening Building Regulations and zero carbon building policy will create demand for low carbon solutions on new developments. This could create a cost effective opportunity to increase the region's low carbon and renewable energy capacity.

While the study has explored a time horizon of 10-15 years, most of the actions needed to ensure delivery are in the short term. This partly relates to the urgency of mitigating climate change, meeting energy targets and improving security of energy supply, but also to the timing of new development, with many of the major regeneration areas (such as the Aire Valley) already having masterplans or development briefs or in the process of preparing them.

Local authorities and sub regional bodies will also need to ensure that the plans developed take into account the needs and ambitions of the local community and are fully supported. This will require genuine consultation and strong leadership.

1.12 Recommendations

Although there are specific actions and recommendations for each city region/ sub region, there are a number of common key strategic actions to facilitate the deployment of renewable energy. These are as follows:

1. Develop local policies and targets to support renewable energy in the LDF process, including policies for new development and strategic sites (including viability testing).
2. Develop greater understanding of the relationship between renewable energy development and the sub-region's landscape character and natural environment.
3. Educate communities, authorities and members about appropriate technologies for the sub-region.
4. Develop skills in local communities and support mechanisms to help communities deliver renewable energy schemes.
5. Investigate and integrate local manufacture and management of renewable energy technologies within local economic strategies.
6. Identify delivery vehicles, and the role and capacity of local authorities to assist in delivery.
7. Share local knowledge and skills through a coordinated forum.
8. Stimulate the development of regional biomass supply markets.
9. Identify a lead coordinator for activity in the sub-region, who can act as a promotional lead and also coordinate funding to local priorities.
10. Identify opportunities on brownfield land for renewable energy installations in tandem with regeneration and redevelopment initiatives.

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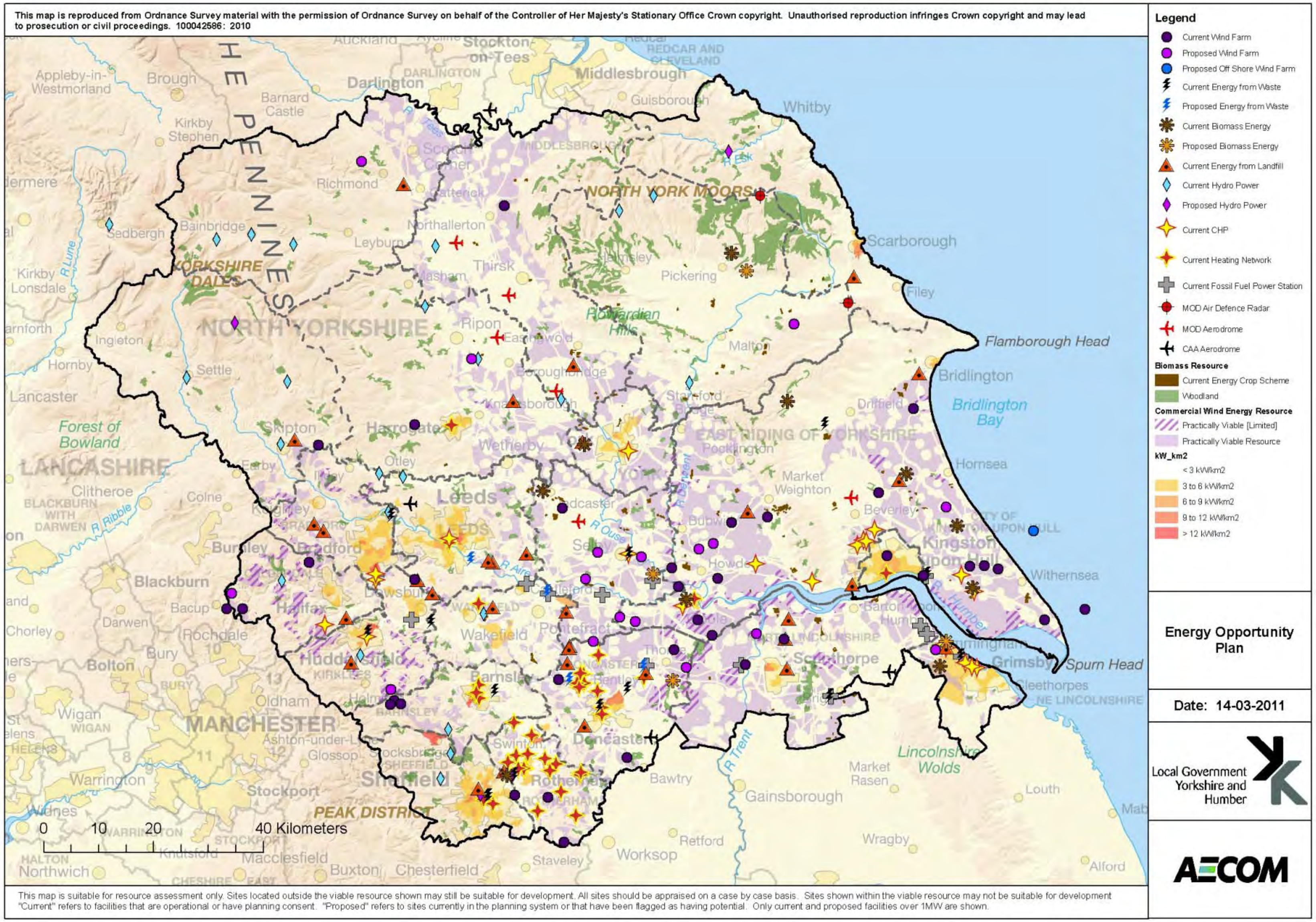

Figure 3 Energy Opportunities Plan for the Yorkshire and Humber region. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed facilities over 1MW are shown. The areas with purple hatched shading described as “Practically viable [Limited]” represent areas where commercial scale wind energy development should be viable but the number of turbines may be restricted due to environmental constraints. Please refer to section 5.14 and appendix A for more details.

Introduction

2 Introduction

AECOM was commissioned by Local Government Yorkshire and Humber to produce a robust evidence base of the potential for low carbon and renewable energy generation in the Yorkshire and Humber region.

2.1 The study area

The local authorities in the region have been working together as functional sub-areas, to share the burden of producing some of the evidence base needed for policy-making and develop an approach to strategic issues which goes beyond local authority boundaries. These were reflected in the preparation of the Yorkshire and Humber Plan to provide a more local context to strategy making and implementation.

Figure 4 Functional sub-regions in the Yorkshire and Humber region (Source: Local Government Yorkshire and Humber, 2010).

Recently these areas have become more formalised as Leeds, Sheffield and Hull and Humber Ports have established themselves as City-Regions and North Yorkshire and York are recognised as a sub-region with a Local Authority Leaders Board. These arrangements have come under further change as a result of the Coalition Government's invitation for groups of Local Authorities to form Local Enterprise Partnerships (LEPs). At the time of writing, Leeds City Region, Sheffield City Region and North Yorkshire and York are at various stages of advancing proposals to become LEPs. The situation in the Hull and Humber Ports City Region is less clear. This study will report on a regional, sub-regional and local authority geography. The sub-regional geography will comprise the sub-regions shown in Figure 4, some of which overlap.

Some of the local authorities that comprise the Sheffield City Region are in the East Midlands Region. Broad conclusions have been made for the City-Region as a whole but the data collected relates primarily to the South Yorkshire authorities only i.e. Sheffield City Council, Rotherham Metropolitan Borough Council, Doncaster Metropolitan Borough Council and Barnsley Metropolitan Borough Council.

2.2 Background to study

This study contributes to the already significant body of research on low carbon and renewable energy generation in Yorkshire and Humber. In particular, it builds upon the Planning for Renewable Energy Targets in Yorkshire and Humber study, completed by AEA Technology in 2004 on behalf of the Government Office for Yorkshire and Humber and the Yorkshire and Humber Assembly and hereafter referred to as "SREATS."

The SREATS study focused on the potential capacity for electricity generation, and did not consider the potential for supplying renewable and low carbon heat. The results identified potential renewable energy targets at a regional, sub-regional and local authority level from 2010 to 2021, which fed into preparation of the Yorkshire and Humber Plan.

2.3 Objectives of the study

The key objectives of this study were:

- To provide an assessment of the potential for low carbon and renewable energy across the region in a clear and justifiable way that is consistent with the other English regions, and meets the requirements of national government for such studies;
- To provide a common and robust evidence base on the potential for renewable energy to inform and support policy making by individual local authorities in the region, as part of developing their local development documents;

- To identify strategic delivery actions, for each of the four sub regions, to tackle strategic barriers and facilitate deployment of renewable energy opportunities.

When the study was originally commissioned at the beginning of 2010, there was more of a focus on identifying potential renewable energy targets at a regional and sub-regional level. However, with the change in Government in May 2010, the focus of the study shifted away from targets, and instead provides an indication of the economically viable renewable energy potential for each local authority. The outputs of the report should provide the flexibility for local authorities to then set evidence based targets if desired.

This means that the study is an evidence base report and does not set policy or targets. Further work by local authorities and on a sub-regional basis is now advised to translate the evidence in this report into Local Development Frameworks and for the purposes of Development Management.

The study has been completed in three stages, with a separate report produced as an output after each stage. The stages were as follows:

Part A: Scoping Study – a gap analysis and review of existing work was carried out in order to refine the approach taken to assessing the resource in the rest of the study.

Part B: Opportunities and Constraints Mapping – this provided an initial assessment of the resource in the region, based on physical and geographical characteristics.

Part C: Delivery – this involved a more detailed assessment of the renewable energy resource for the region. The economic viability, deployment constraints and options for delivery were considered in more detail in order to inform the evidence base for renewable energy policies in local development frameworks.

This report is the output for Part C of the study. The Energy Opportunities Plans presented as part of the Part B report have been updated according to the economic viability constraints affecting the resource. A delivery strategy has also been prepared, which sets out the priority actions for further work and the responsibilities of public and private sector stakeholders in carrying out these actions.

It should be highlighted that whilst the information presented here is appropriate for a strategic regional study, it is not a sufficient basis for planning decisions about individual renewable energy proposals.

2.4 Scope of study

This study assesses the potential for low carbon and renewable energy generation in the Yorkshire and Humber region between 2010 and 2025, which is comparable to the period of influence of most Core Strategies in the region.

The methodology used for this study is derived from the “Renewable and Low Carbon Energy Capacity Methodology for the English Regions” issued by the government department for Energy and Climate Change (DECC) in January 2010. This is referred to throughout this report as the “DECC methodology.”

The methodology used is in line with government policy as currently set out in PPS1 Supplement on Climate Change and PPS22 on Renewable Energy and is designed to be “policy neutral” in that it does not introduce or suggest policy changes.

The low carbon and renewable energy technologies that have been considered are:

- District heating and CHP;
- Commercial scale wind energy;
- Hydro energy (small scale, low head);
- Biomass (including use in co-firing and energy generation from dedicated energy crops, managed woodland, industrial wood waste and agricultural arisings, or straw);
- Energy from waste (including energy generation from slurry, food and drinks waste, poultry litter, municipal solid waste, commercial and industrial waste arisings, landfill gas production and sewage gas production);
- Microgeneration (including small scale wind energy, solar, heat pumps and small scale biomass boilers).

The potential for the development of biofuels was not part of the scope, although it is recognised that these represent an important renewable fuel for transport use.

An assessment of the potential from emerging technologies such as geothermal energy generation and fuel cells was outside of the scope.

An assessment of the impact of demand reduction measures (for example, energy efficiency measures or passive solar design) was outside the scope. However, the rate of uptake of these measures will affect the uptake of renewable energy technologies and should be considered an important element of energy strategies.

The potential from offshore renewables (i.e. offshore wind and marine technologies) was also outside the scope of the study. Strategies for offshore generation are determined at a national level and are beyond the direct influence of regional bodies. An understanding of the implications that offshore wind farm development will have on the region's coastal authorities is recommended as this has implications on transmission infrastructure and the diversity of the economic sector.

Finally, whilst it is acknowledged that there is a link between low carbon and renewable energy deployment and the climate change agenda, this study does not consider the effect of renewable energy generation on carbon emissions in the region. Potential carbon savings will be dependent on the level of fossil fuel generation displaced, which in turn is dependent on the future carbon intensity of the grid. Estimation of future grid carbon emissions would require complex analysis that is outside the scope of this study.

2.5 Using the outputs of the study

The challenges of climate change and increasing renewable and low carbon energy capacity cannot and should not be delivered through planning alone. The planning system has a distinct role to play in promoting decentralised renewable and low carbon energy in the right locations. To assist this process, the opportunities for generating low carbon and renewable energy in each sub-region and local authority have been mapped using GIS. We refer to these maps as 'Energy Opportunities Plans. They have been designed to indicate the spatial distribution of opportunities that are currently available and that will be available in the near future.

The Energy Opportunities Plans and associated evidence base should provide a tool when developing planning policies, targets and delivery mechanisms within the LDF process, and can bring added benefit and support to development plan documents. They can be used to support policies that stipulate requirements for renewable energy, whether these are through the setting of targets that exceed Building Regulations, the requirement for Code for Sustainable Homes or BREEAM, or a requirement for connecting to, or investing in, infrastructure to facilitate district heating.

They can also be used to inform actions in corporate strategies, such as the delivery strategy produced as an output of this study or the Regional Energy Infrastructure Study[1], as well as investment decisions taken by the sub regional bodies and local enterprise partnerships.

It should be noted that although the Energy Opportunities Plans provide an overview of potentially feasible technologies and systems within the region, they do not replace the need for site specific feasibility studies for proposed development sites.

2.6 Structure of the report

The remainder of the report is structured as follows:

Chapter 2 contains a brief overview of the methodology used for resource assessment and strategic delivery strategies.

Chapter 4 contains a brief description of the Yorkshire and Humber region and introduces the major national and regional policies and other drivers influencing the uptake of renewables in the region.

Chapter 5 presents the results of the resource assessment with implications for the region.

Chapter 6 presents the results of modelling of scenarios for use of the renewable energy resource.

Chapter 7 describes existing opportunities and barriers for the implementation and delivery of renewable energy facilities.

Chapter 8 sets out action plans for each sub-region to facilitate the delivery of renewable energy.

Chapter 9 provides a list of recommendations from the study.

Appendix A contains details of the methodology and assumptions used and results of the potential for generating energy from both conventional and from low carbon and renewable sources, by technology.

Appendix B contains results of the renewable energy resource by local authority.

Appendix C contains details of the stakeholder consultation process.

Appendix D is a list of funding sources available for low carbon and renewable technologies.

Appendix E contains a list of the installed renewable energy technologies (larger than 1 MW) across the region.

[1] The Regional Energy Infrastructure Strategy, Regional Energy Forum, February 2007

Methodology for study

3 Methodology for study

This report is the output for Part C of the study, which involved an assessment of the economically viable resource for renewable energy. An overview of the methodology used is described in this chapter. A detailed description of the methodology, with all assumptions, is provided in Appendix A.

3.1 Overview of methodology

The methodology followed for the study is shown below in Figure 5.

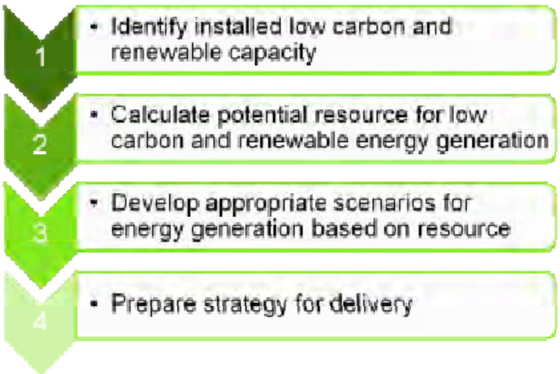

Figure 5 Methodology for study

The conclusions for each sub-region were inferred by aggregating the data for all the local authorities contained in that sub-region. Where a local authority is located within more than one sub-region, the data for that local authority was counted in the summary figures for all sub-regions it was located within. Consequently, the resource for Yorkshire and Humber is not equivalent to the resource for the sum of the sub-regions.

3.1.1 Identification of installed capacity

There is no single source of information on installed renewable energy facilities in Yorkshire and Humber. Where information does exist, it is often out dated or inaccurate. Collating and aggregating the available data within the timeframe of the study has proved to be a major challenge and highlights the need for a coordinated approach to be taken to monitoring new installations.

Information at a national level was combined with information from more local sources such as CO2 Sense. A list of all the renewable energy facilities over 1MW, along with associated data sources, is provided in Appendix E.

3.1.2 Assessment of resource potential

Assessing the resource for low carbon and renewable energy has been a sequential process and has been largely based on the DECC methodology. Constraints have been applied that progressively reduce the natural resource (i.e. the maximum theoretical potential) to what is practically achievable and then economically viable.

The DECC methodology was developed to ensure that a consistent and comparable approach was taken across all English regions. The stages involved are shown in Figure 6. The result of stages 1 to 4 is an assessment of the potential accessible resource and was the subject of Part B of this study.

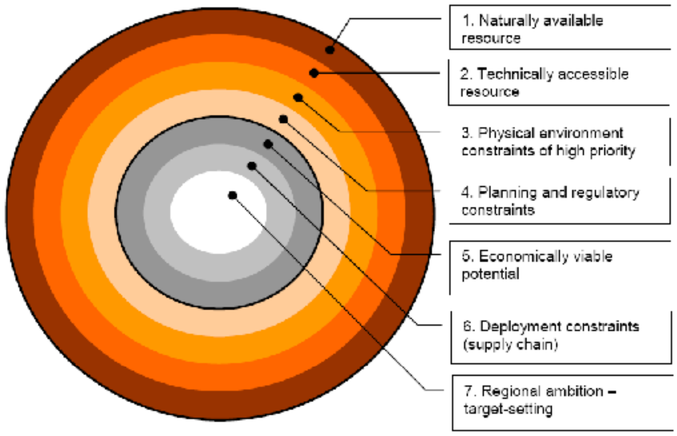

Figure 6 Stages for developing a comprehensive evidence base for renewable energy potential (Source: Renewable and Low-carbon Energy Capacity Methodology for the English Regions, SQW Energy, January 2010)

Part C of the study was dedicated to assessing the economically viable resource (stages 5-6), although an approach for this was not provided in the DECC methodology.

The AECOM project team has developed a bespoke approach, based on extensive experience of advising on renewable energy projects combined with consultation with local stakeholders (section 3.2).

GIS mapping was carried out to assess the economically viable resource for community scale technologies, i.e. those technologies that are usually delivered independently of new development, such as wind farms.

Landscape sensitivity to commercial scale wind turbines was taken into account, based on the categorisations in the SREATs report and in the recent “Landscape Capacity Study for Wind Energy Developments in the South Pennines" report.[2] The resource was then reduced to mitigate the effect of cumulative impact on the visual quality of the landscape. Further details of the commercial scale wind energy assessment are provided in Appendix A section A.7.

Development driven technologies generally comprise the microgeneration technologies and district heating with CHP.

The economically viable resource for the uptake of microgeneration technologies in the existing stock was assessed using an AECOM model that uses a discrete choice methodology based on factors that describe an occupant's "willingness to pay."

The resource for district heating was estimated by assessing the capacity for heat generation for those renewable energy technologies that are likely to be used with CHP to generate both heat and electricity.

For technologies driven by new development, AECOM developed a model that selects the most cost effective combination of technologies that will enable the development to achieve compliance with the Building Regulations standards active at that time.

The approach taken for each technology is described in detail in Appendix A. Where the DECC methodology was unclear as to the assumptions that should be used, AECOM has applied assumptions based on experience in this sector.

3.1.3 Scenario modelling

Scenario modelling was carried out to ascertain the contribution that Yorkshire and Humber could make towards achieving the UK's 2020 renewable energy target. For each scenario, the mix of renewables that could meet the target was assessed.

3.1.4 Preparation of action plans for delivery

The results of the resource assessment, the stakeholder engagement process and the Energy Opportunities Plans were drawn together to produce delivery strategies for each of the four functional sub-regions in Yorkshire and Humber. These set out appropriate actions for the delivery of low carbon and renewable energy technologies, along with recommended timescales, indicators that would imply success and expected outcomes of the actions.

[2] Landscape Capacity Study for Wind Energy Developments in the South Pennines, Julie Martin Associates, January 2010

3.2 Stakeholder engagement

3.2.1 Steering group

The AECOM project team was guided by a steering group, which included representatives from the regional development agency Yorkshire Forward, the local authorities and statutory consultees. A list of the steering group members has been provided below.

- Local Government Yorkshire and Humber
- Government office for Yorkshire and Humber
- Yorkshire Forward
- CO2 Sense
- Environment Agency
- Royal Society for the Protection of Birds (RSPB)
- Energy Saving Trust
- Forestry Commission
- Natural England
- Barnsley Metropolitan Borough Council
- East Riding of Yorkshire Council
- City of York Council
- Leeds City Council
- Kirklees Metropolitan Council
- Calderdale Metropolitan Borough Council
- Sheffield City Council
- Kingston upon Hull City Council

3.2.2 Meetings with experts

The AECOM project team also held discussions (face to face and through email and telephone calls) with a number of technical experts, including representatives of the following organisations:

- Yorkshire Forward
- CO2 Sense
- Microgeneration Partnership
- Natural England
- Environment Agency
- National Farmers Union

- David Farnsworth (Biomass consultant)
- SSE, operators of Ferrybridge "C" power station
- CE Electric (main district network operator for Yorkshire and Humber)
- Banks Renewables (wind energy developers)
- RWE/Npower (wind energy developers)
- Renewable Energy Systems Ltd (wind energy developers)
- Civil Aviation Authority (CAA)
- Osprey Consulting on behalf of Leeds Bradford international airport
- Humberside airport
- Defence Estates on behalf of the Ministry of Defence
- Forestry Commission
- Dalkia (energy from waste developers)

3.2.3 Stakeholder involvement

This study has been completed through collaboration with a range of stakeholders in the region.

A questionnaire was issued to all local authorities at the outset of the study, requesting the following:

- Details of completed local development framework evidence based studies;
- Details of current targets, policies or guidance on renewable and low carbon energy and details relating to any existing installed renewable energy and low carbon schemes, including district heating and CHP);
- Details of local studies into biomass availability;
- Details of local studies into infrastructure delivery plans (energy infrastructure in particular);
- Details of studies investigating landscape sensitivity to wind turbines;
- Details of Waste DPDs in place based on information which amends that the RSS waste forecast.

Drafts of the reports produced after each stage of the study (including this report) were circulated to all local authorities and other relevant stakeholders in the region for comment before issuing.

A final round of consultation on this report was carried out just prior to publication of the report by DECC.

Two workshops were held during the study to harness the views of stakeholders in the region. The first was held in May 2010 and was attended by the members of the steering group (section 3.2.1). The aims were to:

- Introduce the project and get views on the approach taken, including regional priorities and major challenges;
- Ensure that the project team had access to any data and other information necessary for the study. This fed into Part A: Scoping Study.

The second workshop was held in November 2010 and a wider range of stakeholders were invited, including at least one representative from each of the local planning authorities (Appendix C.12). The aims of the workshop were to:

- Obtain information on existing initiatives and to understand the actions needed to overcome current constraints on the delivery of low carbon and renewable energy technologies;
- Test findings from the study such as key opportunities, constraints and scenarios for low carbon and renewable energy deployment;
- Gather local views on key strategic actions needed at a sub-regional level to make the most of opportunities and facilitate deployment;
- Liaise with stakeholders to identify clear priorities for each sub-region, which could inform a final delivery plan.

3.2.4 Online forum

An online forum was set up at the following website to encourage discussion of the strategic barriers and opportunities for renewable energy amongst stakeholders. www.yorkshirehumberrenewables.maxforum.org.

Figure 7 Screenshot of online forum (Source: online forum, website accessed November 2010).

Yorkshire and Humber in Context

4 Yorkshire and Humber in context

The geographical characteristics of the Yorkshire and Humber region, combined with a comprehensive infrastructure network inherited from its legacy of industry and energy production, means that the region has great potential to exploit a range of renewable energy technologies.

This section describes the geographical and socioeconomic factors and policy drivers affecting energy generation in the region.

4.1 The Yorkshire and Humber region

There are 24 local planning authorities in the Yorkshire and Humber region, including the 21 borough or district councils, North Yorkshire County Council, North York Moors National Park and the Yorkshire Dales National Park.

Around 80% of the region is rural in nature and home to 20% of the region's population. The rural areas are very diverse; there are remote rural areas in the north and east parts of the region, more accessible rural areas to the west and south and a large expanse of coastal land to the east.

Figure 8 Location of Yorkshire and Humber with respect to the other English regions (Source: Yorkshire and Humber Plan, Government office for Yorkshire and Humber, May 2008)

4.2 Policy context

4.2.1 National policy context

There is a comprehensive range of legislation at national level which supports the installation of low carbon and renewable energy technologies across the country.

The Climate Change Act (2008) set a legally binding target to reduce UK carbon emissions by 80% by 2050. The Committee on Climate Change is responsible for setting binding 5-year carbon budgets on a pathway to achieve the 2050 target. The first three carbon budgets, announced in the 2009 Budget, aim for carbon savings of 34% by 2020.

The UK Low Carbon Transition Plan[3] sets out an approach to meeting national carbon saving targets. The plan calls for carbon emissions from existing homes to be reduced by 29% by 2020 and emissions from places of work to be reduced by 13% by 2020 (against a 2008 baseline).

The UK is committed to supply 15% of gross energy consumption from renewable sources by 2020. This is part of an EU commitment to increase the proportion of energy supplied from renewables to 20% by 2020. The UK Renewable Energy Strategy[4] anticipates that renewables will need to contribute around 30% of electricity supply, 12% of heating energy and 10% of transport energy to meet this target.

The Coalition: our programme for government (2010)[5] included support for an increase in the EU emission reduction target to 30% by 2020. It also confirmed that the Coalition intends to retain the target of 80% emissions reductions by 2050.

The recently published Consultation on Planning Policy Statement (PPS): Planning for a Low Carbon Future in a Changing Climate (2010) reviews and consolidates the PPS1: Planning and Climate Change[6] and PPS22: Renewable Energy[7]. The consultation encourages local authorities to plan for low carbon and renewable energy on a strategic level through the development of planning policies that encourage the introduction of decentralised energy systems served by low carbon and renewable energy supplies.

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[3] The UK Low Carbon Transition Plan, DECC, July 2009
[4] The UK Renewable Energy Strategy, DECC, July 2009
[5] The Coalition: our programme for government, Cabinet Office, May 2010
[6] Planning Policy Statement: Planning and Climate Change – Supplement to Planning Policy Statement 1, CLG, 2007
[7] Planning Policy Statement 22: Renewable Energy, ODPM, 2004

A principal objective of the Energy Bill 2011[8] is investment in low carbon energy supplies; however, this update did not introduce any new legislation with respect to renewables.

4.2.2 Regional and sub-regional policy context

The Regional Spatial Strategy (RSS), commonly known as the Yorkshire and Humber Plan, was adopted in 2008 and contained a number of policies designed to increase the installed renewable energy capacity in the region. It expected local authorities to set targets for grid-connected renewable energy and set an interim ‘decentralised and renewable or low carbon energy’ target for new developments for the period before Local Development Frameworks are adopted.

The RSS is proposed to be abolished through the Localism Bill, although at the time of writing it remains part of the Development Plan. Whatever the fate of the RSS, there remains a need for strategic planning which transcends local authority boundaries, to ensure that the approach to tackling climate change and increasing the supply of renewable and low carbon energy is both efficient and effective.

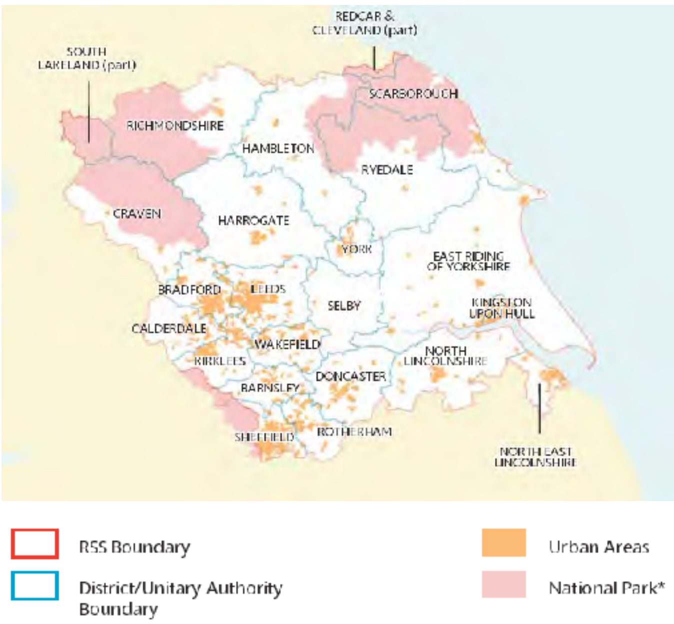

Figure 9 Planning authorities covered within the Yorkshire and Humber region (Source: Yorkshire and Humber Plan, Government office for Yorkshire and Humber, May 2008)

4.3 The trajectory to zero carbon

In the 2008 Budget, the Government announced its ambition that all new non-domestic buildings will be zero carbon from 2019 and all new homes, schools and other public buildings will be zero carbon from 2016.

The requirement for zero carbon status is expected to be administered through the Building Regulations. The policy is expected to drive a significant increase in the installation of onsite microgeneration technologies. The government has introduced the concept of “allowable solutions” for those developments that are unable to reach zero carbon status through onsite carbon reductions. Few details have been announced, but it is understood that allowable solutions may include exports of low carbon or renewable heat from the development to other developments, and investments in low carbon and renewable energy infrastructure.

4.4 Energy security and diversity

The coming decade will see many changes in the UK’s energy mix. Due to the Large Combustion Plants Directive (LCPD), which places strict limits on the emissions of sulphur and nitrogen oxide, approximately 15% of the UK’s electricity generating capacity is scheduled to be shut down by 2016.[9] This will include some generating capacity at Ferrybridge “C” coal power station, one of the region’s major energy generation facilities.

By 2023, further closures may be driven by the proposed EU Industrial Emissions Directive, which consolidates seven environmental directives (including the LCPD), into a single directive and requires even more stringent emissions limits.

Investment in renewable energy technologies will replace the capacity due to close with cleaner technologies and will contribute to more secure energy supplies by moving the UK away from dependence on hydrocarbons.

4.5 The link between energy and waste

All local authorities face the need for a major change in their approach to waste management and the European landfill directive sets out clear targets for each waste disposal authority up to 2020. Energy from waste technologies provide great potential to generate energy, converting the waste stream from a problem into a resource that can bring about a substantial reduction in a local authorities’ carbon emissions.

[8] Energy Bill 2011, DECC, December 2010

[9] Statutory Security of Supply Report, DECC, November 2010

4.6 Financial incentives for low carbon and renewable energy generation

The government has put in place a series of funding mechanisms intended to bring down the cost of low carbon and renewable energy technologies by stimulating the market. To date these have included market mechanisms such as the Renewables Obligation (for electricity) and the Climate Change Levy, and targeted subsidies such as the Low Carbon Buildings and Bioenergy infrastructure programmes. The extension of Permitted Development rights to specific microgeneration technologies was also intended to stimulate the market.

4.6.1 Renewables Obligation Certificates (ROCs)

The Renewables Obligation requires licensed electricity suppliers to source a specific and annually increasing percentage of the electricity they supply from renewable sources. The current level is 11.1% for 2010/11 rising to 15.4% by 2015/16. More information about the Renewables Obligation is provided in Appendix D.

4.6.2 Feed in tariffs

The feed in tariff (FIT) scheme came into effect in April 2010 for installations not exceeding 5 MW and has been designed to incentivise small scale, low carbon electricity generation by providing payments according to the amount of energy produced by householders, communities and businesses. The technologies included are wind, solar PV, hydro, anaerobic digestion and non-renewable micro CHP.

The tariff levels proposed have been calculated to ensure that the total benefits an investor can be expected to achieve (from the generation tariff, the export tariff and/or the offsetting benefit) should compensate the investor for the costs of the installation as well as providing a reasonable rate of return.

4.6.3 Renewable heat incentive

The Government intends to introduce a Renewable Heat Incentive in April 2011. Renewable heat producers of all sizes will receive payments for generation of heat. Unlike FITs, tariffs will be paid not on the basis of a metered number of kWh generated, but instead on a "deemed" number of kWh, namely the reasonable heat requirement (or heat load) that the installation is intended to serve. There is no upper limit to the size of heat equipment eligible under the Renewable Heat Incentive and anyone who installs a renewable energy system producing heat after 15th July 2009 is eligible. The following technologies will be included in the scheme: ground source heat pumps (but not air source heat pumps), anaerobic digestion to produce biogas for heat production, biomass heat generation and CHP, liquid biofuels (but only when replacing oil-fired heating systems), solar thermal heat and hot water and biogas injection into the grid

Tariff levels will be calculated to bridge the financial gap between the cost of conventional and renewable heat systems at all scales, with additional compensation for certain technologies for an element of the non-financial cost and a rate of return of 12% on the additional cost of renewables, with 6% for solar thermal.

4.6.4 Tax incentives

A number of tax measures are in place to help make renewables more attractive. New zero-carbon homes benefit from stamp duty relief. Investment in certain energy-saving plant and machinery benefits from enhanced capital allowances. A reduced rate of VAT applies to professional residential installation of certain microgeneration technologies. Revenue from sales of electricity and ROCs from household microgeneration are exempt from income tax.[10]

[10] The UK Renewable Energy Strategy, DECC, July 2009

Discussion of results

5 Discussion of results

The results of the low carbon and renewable energy resource assessment are presented in this chapter. These are shown at the regional and sub-regional level. Results for individual local authorities can be seen in Appendix B.

5.1 Current energy demand

Annual energy figures for the Yorkshire and Humber region in 2008 are shown in below in Table 1 and in Figure 10. It should be noted that the sub-regions do overlap. Consequently, the demand for Yorkshire and Humber is not equivalent to the sum of the demand of the sub-regions.

The region has around 8.5% of the UK's population and contributes to around 10% of total UK energy demand. Leeds City Region has the highest annual demand, corresponding to over half the demand for the entire region.

North Lincolnshire also has an unusually high relative energy demand, contributing to 18% of total regional demand. This is due to high industrial use from the oil refineries in the port area.

Area	Energy demand (GWh)
Yorkshire and Humber total	110,646
York and North Yorkshire sub-region	14, 781
Leeds City sub-region	50,411
Hull and Humber Ports City sub-region	34,515
South Yorkshire sub-region	23,367

Table 1 Annual energy demand for 2008 for the Yorkshire and Humber region (Source: Total sub-national final energy consumption: 2008 in GWh, DECC website, accessed January 2011).

5.2 Current energy generation

Figure 11 shows the distribution of energy supply and demand in the region. It shows that after oil production used for transport, the mix consists predominantly of centralised energy generation from coal (18% of the region's energy production) and natural gas (16% of the region's energy production). Embedded, or decentralised low carbon and renewable energy generation currently makes up only 1-1.5% of the total mix.

Also of note are the high conversion losses involved in the use of natural gas and coal, particularly for electricity generation. This highlights the opportunity to reduce those losses by increasing the levels of decentralised energy generation.

There are three major coal fired power stations in the region, Drax, Eggborough and Ferrybridge "C" representing around 7,600MW of generating capacity (Table 2). There are two smaller gas-oil fired power stations, one at Drax and one at Ferrybridge, which provide extra capacity and start-up power.

In February 2009, Powerfuel were granted Section 36 planning consent to build a 900MW integrated coal gasification, gas fired power station on the site of Hatfield Colliery in Doncaster. It is due to commence operation in 2012.

Coal Power station	Capacity (MW)
Drax	3,750
Eggborough	1,960
Ferrybridge "C"	1,923
Total	7,633

Table 2 Coal power station capacity in Yorkshire and Humber (Source: Planning for Renewable Energy Targets in Yorkshire and Humber, AEAT, December 2004).

There is approximately 6,300MW of installed gas fired power station capacity in the region, as shown in Table 3.

Gas Power station	Capacity (MW)
Castleford	56
Centrica South Humber Bank	1,285
Conoco	1,180
Glanford Brigg	268
Keadby	735
Killingholme	1,565
Saltend	1,200
Thornhill	42
Total	6,331

Table 3 Gas power station capacity in Yorkshire and Humber (Source: CO2 Sense database)

There are no nuclear power stations in the region. No new sites were identified in the government's most recent announcement into future nuclear power sites.[11]

[11] Press Release: 2010/107 Huhne highlights urgent need for new energy, DECC, October 2010

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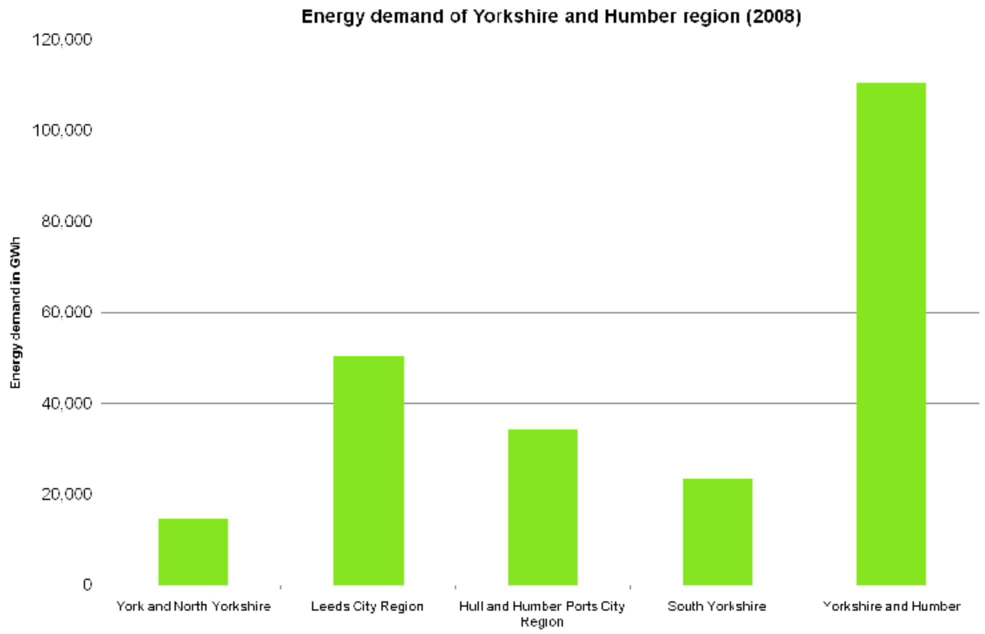

Figure 10 Annual energy demand of Yorkshire and Humber region in 2008 (domestic, industrial and commercial), in GWh

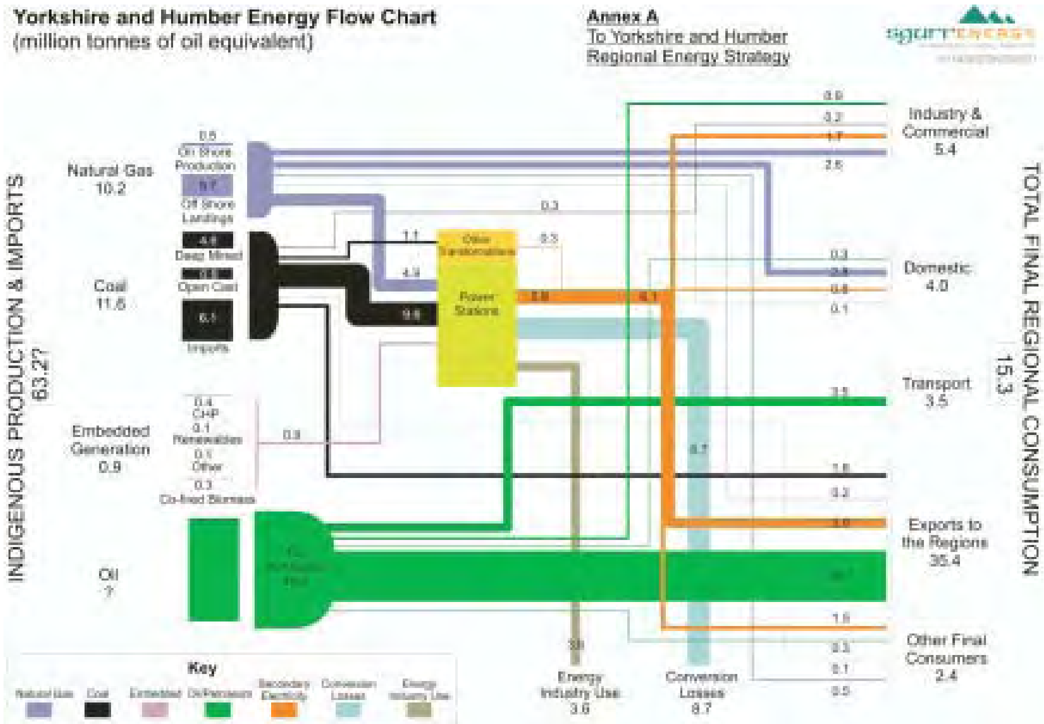

Figure 11 Current flows of energy in the region (million tonnes of oil equivalent) (Source: The Regional Energy Infrastructure Strategy, Regional Energy Forum, February 2007)

5.3 Current energy supply and distribution

5.3.1 Electricity distribution

The main district network operators in the region (DNOs) are NEDL and YEDL. Some responsibility for electricity transmission is held by Electricity North West (ENW) in the west of the region around Craven and Richmondshire and by Central Networks East in the south of the region.

The peak electricity demand in the region is around 4.5 GW. The electrical network is fed through the main 132kV supply which is transformed down to 33kV at bulk supply points. It is then served through primary sub-stations which transform the voltage from 33kV to 11kV and 6.6kV for distribution to local areas. Smaller substations then step down the voltage for use by non-domestic sectors and in homes. A map of the high voltage 132kV network and major substations in the region is shown in Figure 12.

A 2005 "Energy and the RSS" study[12] found technical constraints regarding connection in and around York, Bradford, Sheffield, Driffield and Scunthorpe. Weak capacity areas were identified throughout the region, with the largest areas concentrated in North Yorkshire and towards the western boundary of the region. North Yorkshire in particular was found to have very limited capacity on both 33 and 66kV networks. Significant investigations into reinforcement requirements will be required in North Yorkshire. All 66kV circuits in the rest of the region have sufficient capacity to support the implementation of diversified sources of energy.

Consultation with the major DNOs in the region, YEDL and NEDL, as part of this study confirmed this conclusion, and highlighted that thermal rating of 66 kV lines is an issue north of the Humber.

Regarding the electrical distribution network under responsibility of other DNOs, Arup commented on low carbon and renewable energy generating capacity through Electricity North West networks (ENW), as follows:

'In general, ENW considered that the electricity distribution network in the North West "will not be a barrier to connection of renewable electricity generators. However, with a high rate of connections, there may be delays in providing connections and upstream adaptations to the network to comply with engineering standards... When generators trigger the need for network development, they will be charged a proportion of the costs. The unit cost of connection involving work at 132kV and 400kV would be higher than at 33kV or 11kV." The company suggests that the theoretical maximum level of biomass, hydro, landfill and sewerage schemes "can be accommodated by the distribution network in normal project timescales without delaying the project". No comment is made in relation to onshore wind at this time... "[13]

5.3.2 Gas distribution

National Grid owns and operates the high pressure gas transmission system in England, Scotland and Wales. Gas travels from the National Transmission System and reaches most consumers via Local Distribution Zones (LDZ), which operate at three pressure levels: Intermediate (2 to 7 bar), Medium (75 mbar to 2 bar) and Low (less than 75 mbar). A map of the Medium and Intermediate pressure networks is shown in Figure 13.

There are two Gas Distribution Operators (DOs) in the region; Northern Gas Networks and National Grid Gas. There are four Local Distribution Zones; the North (NO) LDZ; the North East (NE) LDZ; the East Midlands (EM) LDZ; and the North West (NW) LDZ.

In general terms, gas supply is not constrained in the region, as it benefits from a number of connections to the national High Pressure Transmission Network, as well as having an extensive and robust core network around the main urban areas. However, many rural areas have no gas supply.[13]

5.3.3 Potential for renewable gas injection into grid

With appropriate cleaning techniques, synthetic gas or "syngas" generated from renewable energy sources can be injected directly into the existing gas infrastructure network and used in homes without modification to appliances. This can make it efficient to deliver from the plant to the consumer as there is minimal investment in new infrastructure.

Currently, renewable gas production in the form of landfill gas and sewage gas represents around 69 MW of renewable energy generation in Yorkshire and Humber. However due to incentives such as the ROCs (section 4.6.1), all of this gas is used to generate electricity. In order to encourage synthetic gas production, policy needs to provide the necessary incentives.

[12] Yorkshire and Humber Assembly – Energy and the RSS, Enviros, January 2005

[13] Yorkshire and Humber Assembly - Regional Integrated Infrastructure Scoping Study, Arup, September 2008

The Renewable Heat Incentive due for implementation in April 2011 will help in this regard, but it will also be necessary to fund investment in gasification technology and ensure that regulation allows plants to be developed on a commercial scale in areas where injection into the network is close to large load demand.

5.4 Conclusions from assessment of current energy baseline

Electricity provision in the region is adequate to meet growth aspirations up to 2025 but local strategic reinforcements may be needed at some substations. The size and timescales of these would depend upon the scale of new development expected.

The primary challenge for YEDL and other DNOs in the region will be adapting the network to cope with increasing levels of decentralised, renewable energy generation connected to the local electrical distribution network, predominantly in the form of solar PV and wind turbines. This can often be expensive and inefficient, particularly if adopting existing standard connection solutions. Since the existing distribution network has not been designed to incorporate significant levels of decentralised generation, this can lead to non-compliance with network design standards in respect of thermal rating, voltage and fault levels. The typical solution to this is reinforcement of the existing distribution network.

DNOs are obligated to guarantee supply even when the renewable energy plant is not operating (e.g. due to maintenance, breakdown or intermittent operation), hence it needs to provide sufficient network capacity to back-up the supply even though this may only be needed occasionally. This can result in additional costs associated with reinforcing the network.

Ofgem's price controls have placed constraints on DNOs which means that they are not able to invest speculatively in capacity.

The gas network within the region is generally robust and flexible. Northern Gas Networks and National Grid are carrying out major refurbishment programmes of gas mains throughout Yorkshire and Humber as part of their overall asset management plans.

There may be issues with connection of low carbon and renewable energy technologies to the gas network. Connection of gas-fired CHP to the existing gas network can present a particular problem because of the demand requirements, on start-up and shut down which can cause shock waves. It may be possible to connect small CHP units (below 1MW) to the low pressure network but bigger plants need to be connected to the Medium or Intermediate pressure system and very large CHP plants may have to connect to the high pressure transmission system. Hence the reinforcement costs can be significant.

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Figure 12 Electricity network in Yorkshire and Humber

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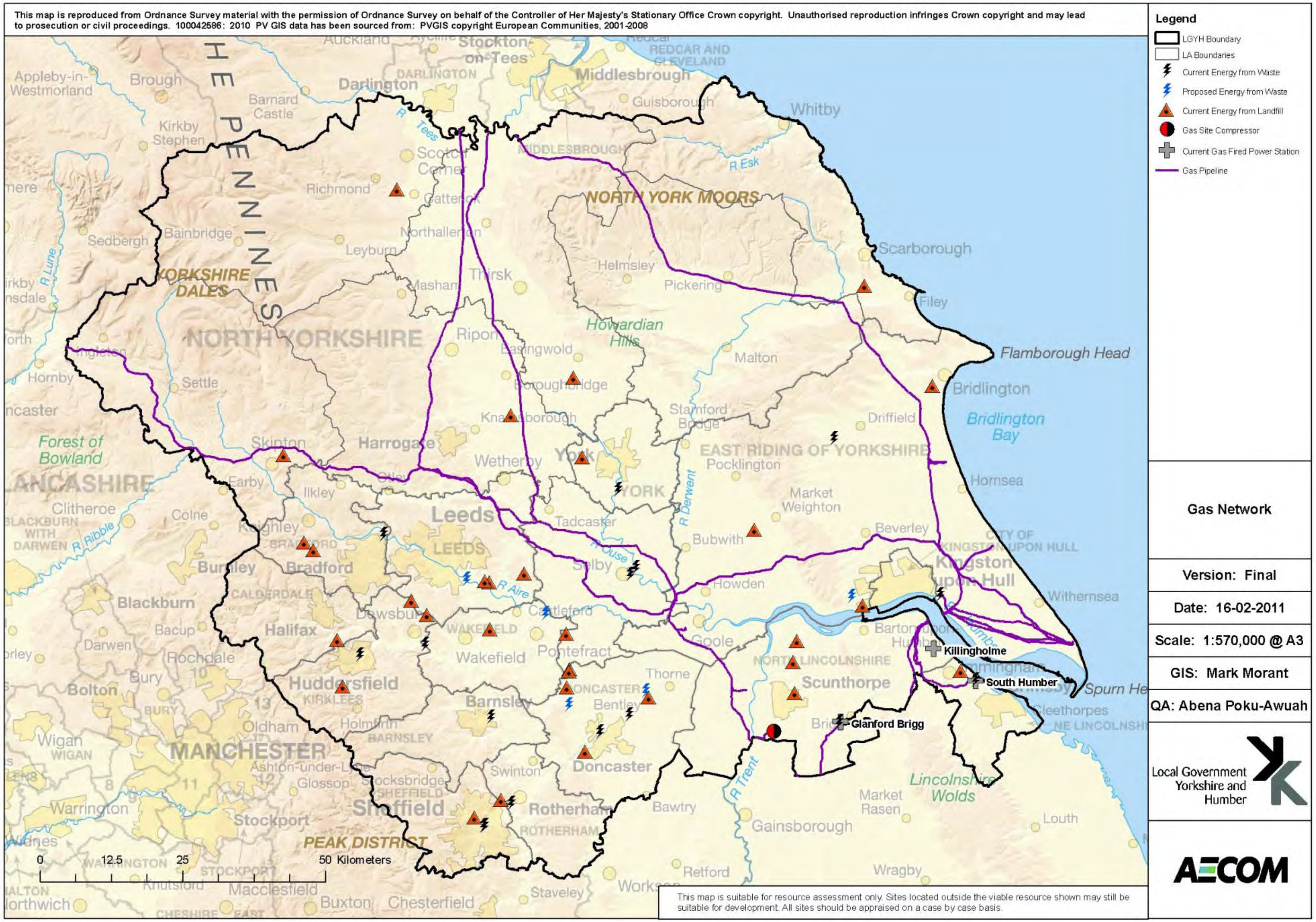

Figure 13 Gas network in Yorkshire and Humber

5.5 Summary of renewable energy resource

This study has found that the region has the capacity to install approximately 5,905 MW and generate around 16,100 GWh of renewable energy annually. The main contributions to the resource come from commercial scale wind and biomass energy generation (Figure 14). The majority of the renewable energy resource is located within the Leeds City region (Figure 16).

A detailed description of the resource by technology is provided in the following sections 5.8 to 5.13. The resource is described in terms of capacity in MW, annual generation potential in GWh and in terms of the energy demand of a typical home. For the purposes of comparison, a typical home has been assumed to have an annual energy demand of 0.015 GWh.[14]

It should be noted that the resource identified represents the maximum economically achievable resource (i.e. not what will actually be delivered). Chapter 6 describes the results of scenario modelling which shows the impact of delivering a proportion of the resource identified.

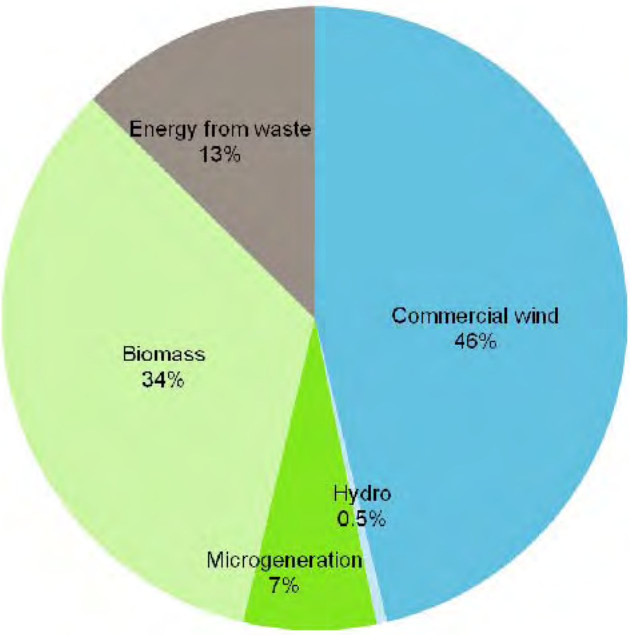

Figure 14 Distribution of renewable energy capacity in Yorkshire and Humber by technology

[14] The challenge of existing UK houses, Boardman, B, IABSE Henderson Colloquium, Cambridge, July 2006

5.6 Overall progress against targets

The SREATs study set out regional targets for some renewable energy technologies which were adopted in the RSS and are shown in Table 4 below, along with the progress made.

Technology	RSS 2010 target MW	YH installed capacity 2010 MW	RSS 2021 target MW
Onshore wind	341	153	725
Offshore wind	240	-	600
Biomass co-firing	100	548	90
Biomass plant	14	10	275
Hydro	4	1.5	4
Solar PV	9	7	138
Marine	-	0.6	30
Total	**708**	**720**	**1,862**

Table 4 SREATs targets for renewable energy generation in the Yorkshire and Humber region (Source: Planning for renewable energy targets in Yorkshire and Humber, AEAT, December 2004)

Based on national energy statistics data, as of 2009 the region had 340MW_e of onshore, installed renewable electricity generating capacity, including biomass co-firing (in coal fired power stations). This compares with the SREATS onshore target of 708MW_e.

This study has found that there was around 301MW of renewable energy generating capacity (both heat and electricity) in the region as of December 2010, excluding the contribution from biomass co-firing. The current biomass co-firing proportion equates to around 548 MW. Around 20% of the installed capacity is comprised of renewable electricity generated from landfill gas, which is unlikely to still be available by 2025.

Figure 15 below shows a comparison of the regional performance against the other English regions, as of the end of 2009. It suggests that the region is somewhat lagging behind others. However, this does not paint the full picture. From the information collected during this study there is approximately 624MW of renewable energy schemes with planning consent but which are still to be constructed. There is around 1,643MW still to be determined in the planning system.

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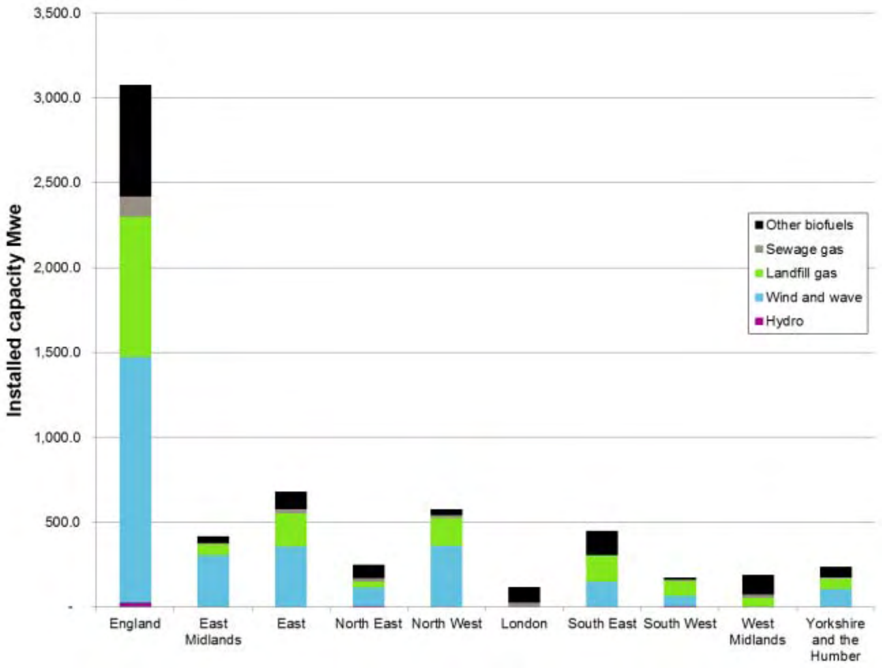

Figure 15 Installed renewable energy capacity in the Yorkshire and Humber region in 2009, relative to the other English regions (Source: DUKES 2009, DECC website, accessed November 2010)

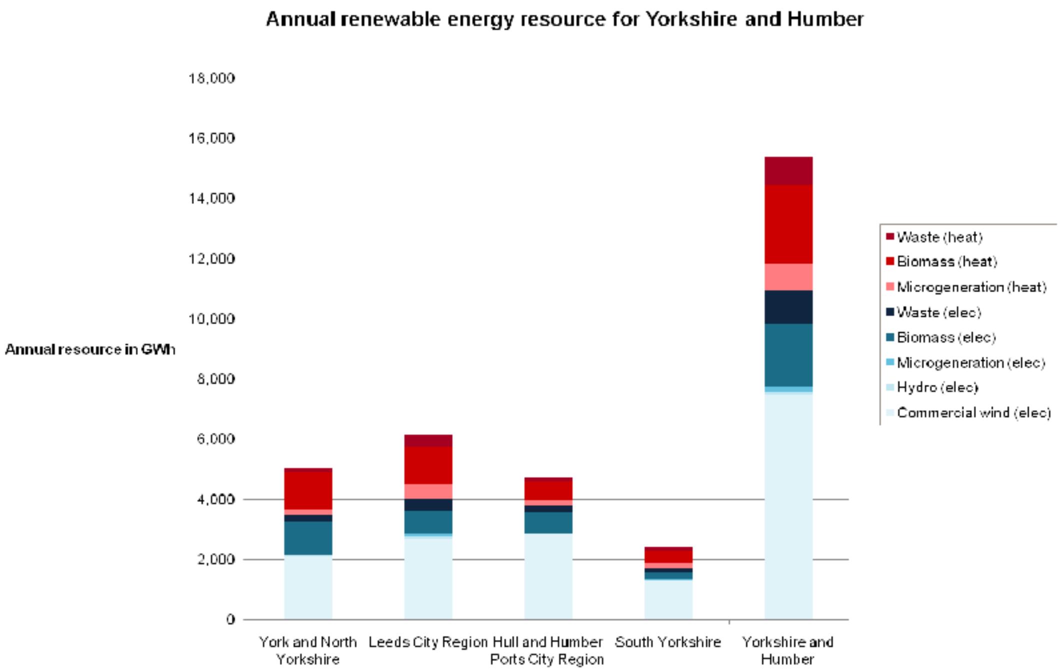

Figure 16 Renewable energy resource in Yorkshire and Humber, in terms of annual GWh of heat and electricity generation (excludes district heating resource).

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5.7 Resource tables

The following tables show the current capacity and potential resource for renewable energy in the Yorkshire and Humber region by technology and by local authority.

Current capacity (MW)	District heating	Commercial wind	Small scale wind	Hydro	Solar PV	SWH	ASHP	GSHP	Biomass energy crops	Biomass woodfuel	Biomass agricultural arisings (straw)	Biomass waste wood	EfW wet	EfW poultry litter	EfW MSW	EfW C&I	EfW landfill gas	EfW sewage gas
Barnsley	0.0	25.8	0.1	0.0	0.8	0.0	0.0	0.0		1.7	0.0		0.0	0.0	0.0		0.0	0.4
Bradford	0.0	0.0	0.3	0.6	0.2	0.0	0.0	0.0		1.1	0.0		0.0	0.0	14.9		2.0	1.5
Calderdale	0.0	36.7	0.9	0.0	0.2	0.0	0.0	0.0		0.1	0.0		0.0	0.0	0.0		1.1	0.0
Craven	0.0	1.3	0.1	0.1	0.0	0.0	0.0	0.0		0.3	0.0		0.0	0.0	0.0		1.1	0.0
Doncaster	0.0	91.0	0.1	0.0	0.7	0.0	0.0	0.0		0.2	8.0		2.0	0.0	9.5		9.7	0.5
East Riding of Yorkshire	0.0	240.0	0.1	0.0	0.2	0.3	0.0	0.1		0.0	30.2		2.0	0.0	0.0		3.5	1.6
Hambleton	0.0	16.0	0.1	1.1	0.1	0.0	0.0	0.1		0.0	0.0		0.0	0.0	0.0		0.3	0.0
Harrogate	0.0	16.0	0.3	0.1	0.1	0.0	0.0	0.2		0.8	0.0		0.0	0.0	0.0		1.0	0.0
Kingston Upon Hull, City of	0.0	2.0	0.1	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	20.0		0.0	0.0
Kirklees	0.0	0.0	0.3	0.0	1.4	0.1	0.0	0.0		0.0	0.0		0.3	0.0	10.0		3.9	1.3
Leeds	0.0	0.0	0.1	0.2	0.5	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0		8.6	0.0
North East Lincolnshire	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	6.0		1.0	0.7
North Lincolnshire	0.0	105.0	0.1	0.0	0.2	0.0	0.0	0.0		0.1	0.0		0.0	14.0	0.0		5.4	0.6
Richmondshire	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0		0.8	0.1
Rotherham	0.0	26.3	0.0	0.0	0.8	0.0	0.0	0.0		0.6	0.0		0.0	0.0	0.0		1.1	0.5
Ryedale	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0		0.8	8.0		0.0	0.0	0.0		0.3	0.1
Scarborough	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0		0.0	0.0		0.0	0.0	0.0		10.0	0.0
Selby	0.0	36.0	0.1	0.0	0.1	0.0	0.0	0.0		0.0	4.7		8.0	0.0	0.0		1.4	0.0
Sheffield	39.0	0.0	0.0	0.5	1.0	0.1	0.0	0.0		2.0	25.0		0.0	0.0	20.0		11.1	0.3
Wakefield	0.0	0.0	0.0	0.4	0.2	0.0	0.0	0.0		0.9	0.0		0.0	0.0	0.0		14.6	0.3
York	0.0	0.0	0.2	0.0	0.2	0.1	0.0	0.0		2.8	2.5		0.0	0.0	0.0		6.6	0.6
York and North Yorkshire	0	69	1	1	1	0	0	0		5	15	0	8	0	0		22	1
Leeds City Region	0	116	2	1	4	0	0	0		8	7	0	8	0	25		40	4
Hull and Humber Ports	0	347	0	0	0	0	0	0		0	30	0	2	14	26		10	3
South Yorkshire	39	143	0	1	3	0	0	0		4	33	0	2	0	30		22	2
Yorkshire and Humber	39	596	3	3	7	1	0	1		12	78	0	12	14	80		83	9
Regional biomass schemes	**65**	**(this comprises the 65MW$_e$ consented biomass Stallingborough, EON scheme in North East Lincolnshire)**																
Co-firing schemes	**548**																	

Table 5 Current renewable energy capacity in the Yorkshire and Humber region, in terms of MW. "Current" refers to facilities that are operational or have planning consent. It has been assumed that all current biomass schemes contribute to the "Biomass woodfuel" capacity and all current EfW schemes contribute to the "EfW MSW" capacity. SWH refers to "Solar Water Heating," ASHP refers to "Air Source Heat Pumps," and GSHP refers to "Ground Source Heat Pumps." Some local authorities are in more than one sub-region, therefore the capacity in Yorkshire and Humber is not equivalent to the sum of the capacity of the sub-regions.

Capabilities on project:
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Potential resource, Electricity capacity (MW)	District heating	Commercial wind	Small scale wind	Hydro	Solar PV	SWH	ASHP	GSHP	Biomass energy crops	Biomass woodfuel	Biomass agricultural arisings (straw)	Biomass waste wood	EfW wet	EfW poultry litter	EfW MSW	EfW C&I	EfW Landfill gas	EfW sewage gas
Barnsley		86	1.3	0.2	11				5.2		1.3	0.8	0.8	0.0	1.1	1.6		0.4
Bradford		70	2.5	4.3	28				2.3		0.0	2.0	1.6	0.0	2.7	4.9		1.4
Calderdale		110	0.6	2.3	7				2.7		0.1	0.5	1.0	0.2	0.9	1.9		0.0
Craven		36	0.6	5.4	2				12.4		0.4	0.2	3.0	2.2	0.4	0.7		0.0
Doncaster		298	1.3	0.3	13				6.5		3.9	0.9	1.2	0.0	1.8	2.5		0.5
East Riding of Yorkshire		652	2.9	0.0	11				26.7		36.0	0.9	4.7	3.9	2.2	2.5		1.6
Hambleton		226	1.3	0.1	3				23.0		7.4	0.2	3.4	2.4	0.6	1.3		0.0
Harrogate		126	0.8	0.8	4				17.1		4.6	0.3	3.4	2.3	1.0	2.2		0.0
Kingston Upon Hull, City of		12	0.5	0.0	9				0.0		0.0	0.7	2.4	0.0	1.5	2.9		0.0
Kirklees		129	1.5	2.3	16				4.0		0.5	1.3	1.4	0.2	2.3	3.9		1.3
Leeds		80	3.0	2.7	44				5.7		1.3	3.2	2.8	0.0	3.5	9.4		0.0
North East Lincolnshire		235	0.3	0.0	5				3.0		2.5	0.4	0.5	2.5	1.0	1.6		0.7
North Lincolnshire		188	1.8	0.0	7				8.9		12.9	0.6	1.1	13.4	1.0	1.8		0.6
Richmondshire		85	0.7	2.4	2				13.7		2.5	0.2	3.3	2.4	0.3	0.3		0.1
Rotherham		91	0.9	0.9	12				3.9		2.4	0.9	1.1	0.0	1.2	2.2		0.5
Ryedale		10	0.6	0.2	2				26.0		6.6	0.2	3.7	2.6	0.3	0.6		0.1
Scarborough		10	0.5	0.3	5				11.2		2.3	0.4	2.0	1.4	0.8	1.0		0.0
Selby		271	0.9	0.9	4				5.4		4.1	0.3	3.4	1.1	0.5	0.8		0.0
Sheffield		14	1.4	1.6	21				0.1		0.0	1.1	1.7	0.0	2.2	4.9		0.3
Wakefield		79	1.7	1.4	16				3.6		1.6	1.2	2.5	0.2	1.8	3.6		0.3
York		35	0.8	0.0	10				3.0		2.3	0.6	0.4	0.0	1.2	2.1		0.6
York and North Yorkshire		799	6	10	31				112		30	2	23	14	5	9		1
Leeds City Region		1,023	14	20	144				62		16	10	20	6	15	31		4
Hull and Humber Ports		1,087	6	0	33				39		51	2	9	20	6	9		3
South Yorkshire		489	5	3	58				16		8	4	5	0	6	11		2
Yorkshire and Humber		2,843	26	26	235				185		93	17	45	35	28	53		8

Table 6 Potential renewable energy electricity generation capacity in the Yorkshire and Humber region, in terms of MW. SWH refers to “Solar Water Heating,” ASHP refers to “Air Source Heat Pumps,” and GSHP refers to “Ground Source Heat Pumps.” Some local authorities are in more than one sub-region, therefore the resource in Yorkshire and Humber is not equivalent to the sum of the resource of the sub-regions.

Capabilities on project:
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Potential resource, Heat capacity (MW)	District heating	Commercial wind	Small scale wind	Hydro	Solar PV	SWH	ASHP	GSHP	Biomass energy crops	Biomass woodfuel	Biomass agricultural arisings (straw)	Biomass waste wood	EfW wet	EfW poultry litter	EfW MSW	EfW C&I	EfW Landfill gas	EfW sewage gas
Barnsley						17	9	1	9.4	27.3	2.5	1.5	0.9		2.3	3.2		
Bradford						37	25	2	4.3	24.0	0.0	4.1	1.9		5.4	9.9		
Calderdale						12	12	1	5.0	10.4	0.3	1.0	1.2		1.7	3.9		
Craven						4	6	4	22.6	6.8	0.8	0.4	3.4		0.7	1.3		
Doncaster						20	11	7	11.8	23.5	7.8	1.8	1.4		3.5	4.9		
East Riding of Yorkshire						20	15	3	48.5	55.3	72.0	1.7	5.4		4.4	4.9		
Hambleton						5	7	2	41.9	13.8	14.7	0.4	4.0		1.1	2.6		
Harrogate						8	9	3	31.2	10.0	9.2	0.6	4.0		2.0	4.5		
Kingston Upon Hull, City of						16	10	20	0.0	2.0	0.0	1.3	2.8		3.0	5.7		
Kirklees						26	21	31	7.3	17.7	1.0	2.6	1.6		4.6	7.9		
Leeds						60	31	4	10.4	33.3	2.6	6.5	3.2		7.0	18.8		
North East Lincolnshire						9	7	12	5.5	3.4	5.0	0.8	0.6		1.9	3.2		
North Lincolnshire						11	8	11	16.1	29.5	25.8	1.1	1.2		2.0	3.5		
Richmondshire						3	6	8	24.8	7.5	4.9	0.3	3.8		0.6	0.6		
Rotherham						18	10	6	7.1	13.6	4.8	1.7	1.3		2.5	4.4		
Ryedale						3	6	5	47.2	6.5	13.3	0.3	4.2		0.7	1.2		
Scarborough						7	12	4	20.3	10.5	4.5	0.8	2.2		1.6	1.9		
Selby						6	3	7	9.9	12.7	8.2	0.7	3.9		1.0	1.6		
Sheffield						34	21	9	0.2	8.9	0.0	2.1	2.0		4.5	9.7		
Wakefield						25	13	12	6.6	40.1	3.2	2.4	2.9		3.7	7.1		
York						13	9	9	5.4	7.2	4.6	1.3	0.4		2.4	4.1		
York and North Yorkshire						48	57	41	203	75	60	5	26		10	18		
Leeds City Region						207	138	74	112	190	32	21	23		31	62		
Hull and Humber Ports						56	39	45	70	90	103	5	10		11	17		
South Yorkshire						89	50	22	29	73	15	7	6		13	22		
Yorkshire and Humber						353	249	159	335	364	185	33	52		57	105		

Table 7 Potential renewable energy heat generation capacity in the Yorkshire and Humber region, in terms of MW. SWH refers to "Solar Water Heating," ASHP refers to "Air Source Heat Pumps," and GSHP refers to "Ground Source Heat Pumps." Some local authorities are in more than one sub-region, therefore the resource in Yorkshire and Humber is not equivalent to the sum of the resource of the sub-regions. The district heating resource has already been included within the potential heat figures from other technologies.

Capabilities on project:
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Total resource (GWh)	District heating	Commercial wind	Small scale wind	Hydro	Solar PV	Solar thermal	Air source heat pumps	Ground source heat pumps	Biomass energy crops	Biomass managed woodfuel	Biomass agricultural arisings (straw)	Biomass waste wood	EfW wet	EfW poultry litter	EfW MSW	EfW C&I	EfW Biogas	EfW sewage gas
Barnsley	0	225	2	1	9	11	14	2	78	72	20	12	8	0	18	26	0	5
Bradford	0	183	3	14	21	22	40	4	35	63	0	32	16	0	43	78	0	14
Calderdale	0	290	1	8	6	8	20	2	41	27	2	8	10	1	14	30	0	4
Craven	0	95	1	18	2	2	9	7	186	18	7	3	30	11	6	11	0	1
Doncaster	0	784	2	1	9	12	17	12	98	62	61	15	13	0	28	39	0	6
East Riding of Yorkshire	0	1,714	4	0	9	12	23	5	399	145	568	14	47	20	34	39	0	6
Hambleton	0	594	2	0	2	3	10	3	345	36	116	3	35	12	9	20	0	1
Harrogate	0	331	1	3	3	5	15	5	257	26	72	5	35	12	16	35	0	2
Kingston Upon Hull, City of	0	32	1	0	7	10	16	37	0	5	0	10	25	0	23	45	0	5
Kirklees	0	339	2	8	12	16	33	56	60	47	8	20	14	1	37	62	0	9
Leeds	0	211	4	9	33	37	49	8	85	87	20	51	28	0	55	148	0	23
North East Lincolnshire	0	618	0	0	4	6	10	21	45	9	39	6	5	13	15	25	0	3
North Lincolnshire	0	493	2	0	5	7	12	19	133	78	203	9	11	69	16	28	0	4
Richmondshire	0	223	1	8	1	2	10	14	204	20	39	2	34	12	5	5	0	1
Rotherham	0	239	1	3	9	11	15	11	59	36	38	14	11	0	20	35	0	6
Ryedale	0	26	1	1	1	2	9	9	389	17	105	2	37	14	5	9	0	1
Scarborough	0	26	1	1	3	4	20	8	167	28	36	7	20	7	12	15	0	3
Selby	0	712	1	3	3	3	4	13	81	33	65	5	34	6	8	13	0	2
Sheffield	0	36	2	5	16	21	32	16	1	23	0	17	18	0	35	77	0	7
Wakefield	0	208	2	5	12	15	20	22	54	105	25	19	26	1	29	56	0	8
York	0	92	1	0	7	8	14	16	45	19	36	10	4	0	19	32	0	4
York and North Yorkshire	0	2,101	8	34	24	29	91	73	1,674	197	475	38	229	74	80	140	0	17
Leeds City Region	0	2,687	18	68	109	127	218	133	922	498	255	165	206	32	244	491	0	73
Hull and Humber Ports	0	2,856	7	0	25	34	62	81	577	237	811	39	88	102	89	137	0	17
South Yorkshire	0	1,284	6	10	44	55	78	41	236	193	119	57	49	0	100	176	0	25
Yorkshire and Humber	0	7,472	34	88	177	217	393	286	2,762	957	1,461	264	461	179	447	828	0	117

Table 8 Potential annual renewable energy generation capacity in the Yorkshire and Humber region by 2025, in terms of GWh. SWH refers to "Solar Water Heating," ASHP refers to "Air Source Heat Pumps," and GSHP refers to "Ground Source Heat Pumps." Some local authorities are in more than one sub-region, therefore the resource in Yorkshire and Humber is not equivalent to the sum of the resource of the sub-regions. The district heating resource has already been included within the potential heat figures from other technologies in Table 7.

5.8 District heating networks and CHP

5.8.1 Introduction

Energy demand has traditionally been met by electricity supplied by the national grid, heating supplied with individual boilers and cooling supplied through chillers. District heating is an alternative method of supplying heat to buildings using a network of pipes to deliver heat to multiple buildings from a central heat source. Building systems are usually connected to the network via a heat exchanger, which replaces individual boilers for space heating and hot water. This is a more efficient method of supplying heat than individual boilers and consequently, district heating is considered to be a low carbon technology that can contribute towards renewable targets.

The traditional method of generating electricity at power stations is inefficient, with at least 50% of the energy in the fuel being wasted. A CHP plant is essentially a localised power station but makes use of the heat that would normally be wasted through cooling towers. This heat can be pumped through district heating networks for use in buildings. Since it is generated closer to where it is needed, electricity losses in transmission are reduced.

The economics of district heating networks and CHP are determined by technical factors including the size of the CHP engine and annual hours of operation (or base load). Ideally, a system would run for at least 4,500 hours per year for a reasonable return on investment which is around 17.5 hours per day, five days per week, or 12.5 hours every day of the year. CHP is therefore most effective when serving a mixture of uses, to guarantee a relatively constant heat load. High energy demand facilities such as hospitals, leisure centres, public buildings and schools can act as anchor loads to form the starting point for a district heating and CHP scheme. These also use most heat during the day, at a time when domestic demand is lower.

The potential for establishing networks to supply electricity and heat at a community scale from local sources is discussed in this section.

5.8.2 Existing heat networks and CHP

The study has not identified many existing district heating networks across the region (Appendix E Table 82). For the most part, these are small scale networks associated with local authority owned housing estates. Rotherham in particular has a number of small networks served by communal boiler houses.

The most well-known network in the region in the Sheffield district heating network, which provides more than 130 buildings around the city centre with energy generated from residual waste. Buildings connected to the network range from offices and public buildings to hotels and residential premises.

5.8.3 Potential for heat networks with CHP

The potential to supply low carbon heat through district heating networks with CHP has been assessed and mapped using a methodology developed by AECOM, as the DECC methodology does not provide an approach for this. Details of the AECOM mapping methodology are provided in Appendix A.2.

The heat mapping exercise has identified areas where there may be sufficient heat demand from existing buildings to support a commercially viable district heating or CHP system and the results are shown in Figure 17. The relative viability of areas in the region for district heating is shown through colours of increasing intensity, from yellow to orange to red.

Due to its largely rural nature and relatively low density of development, the potential for district heating and CHP in the region is limited. Most of the potential is located within or around the major urban centres – Leeds, Sheffield, Doncaster, York and Hull. There are also some smaller areas of potential in Harrogate District, Scarborough, Scunthorpe and around the ports in Immingham.

Numerous buildings within urban centres in the Yorkshire and Humber region could act as anchor loads to reduce risk for investment in district heating networks. These include public buildings, hospitals, leisure centres and new, mixed use development sites and are shown on Figure 17.

There are also a number of “mini-networks” in the region, where electricity is generated at a dedicated power plant and used to serve a nearby industrial load. Examples include the straw burning, energy generation plant at the Tesco Distribution Centre in Goole. There is potential to use these networks to deliver waste heat as well.

5.8.4 Conclusions from heat networks potential assessment

Where there is potential and based on the current grid mix, district heating with biomass CHP is the most cost-effective solution for the supply of low carbon heat in terms of cost per amount of carbon saved.[15] Once networks are in place they can be made flexible in that they have the potential to be served by a range of low carbon fuel sources, which could change over time in response to available incentives and the availability of fuel supply.

Although there is some potential for district heating networks as shown in Figure 17, delivering district heating networks at scale has proved difficult to date and there are a range of timing, planning, financial and technical hurdles to overcome. The barriers include:

- Lack of scale, diversity and security of load to create a viable network. A strategic approach to the planning and phasing of district heating infrastructure and plant is crucial for success;
- Phasing and timing issues, including lack of committed and secure base-loads to attract investment in required infrastructure. Uncertainty around timing and delivery of networks, preventing developers from committing to solutions outside the red line boundary of their own site;
- Varying local authority capacity and commitment to lead and enable delivery. Even where loads can be aggregated there may be reluctance for the private or public sector to invest unless loads can be guaranteed;
- Lack of evidence base required for decision making at a community scale.

[15] The potential and costs of district heating networks, Faber Maunsell and Poyry, April 2009

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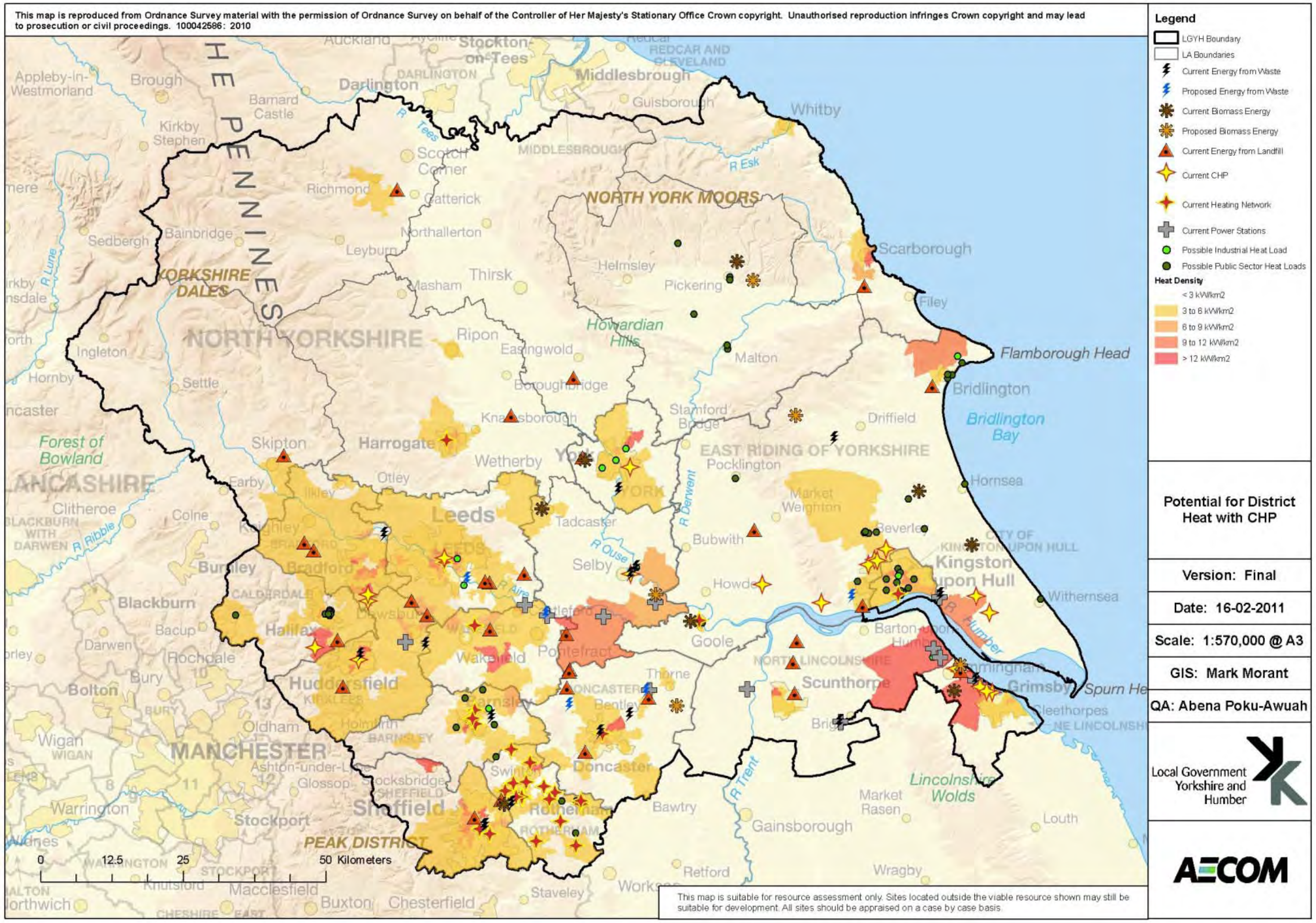

Figure 17 Potential for district heating with CHP, based on heat density. The areas with most potential are shown in red, areas with least potential are shown in yellow.

5.9 Wind energy resource

5.9.1 Introduction

Wind turbines convert the energy contained in the wind into electricity. Large scale, free standing wind turbines have the potential to generate significant amounts of renewable energy.

The potential for renewable energy generation from large scale, onshore wind turbines for commercial energy and supply is described in this section. The potential for offshore wind energy generation has not been included in this assessment.

5.9.2 Existing wind energy capacity

Installed or consented commercial scale, wind energy capacity in the region is around 592 MW. The greatest deployment of wind energy has been in East Riding of Yorkshire, followed by North Lincolnshire. The locations of the wind farms above 1MW capacity are shown as purple dots on Figure 23.

Figure 18 shows the progress of installed wind against the RSS target. Barnsley, Calderdale, Doncaster, East Riding of Yorkshire, Harrogate, Leeds, North Lincolnshire, Rotherham and Selby have exceeded their targets for commercial scale wind.

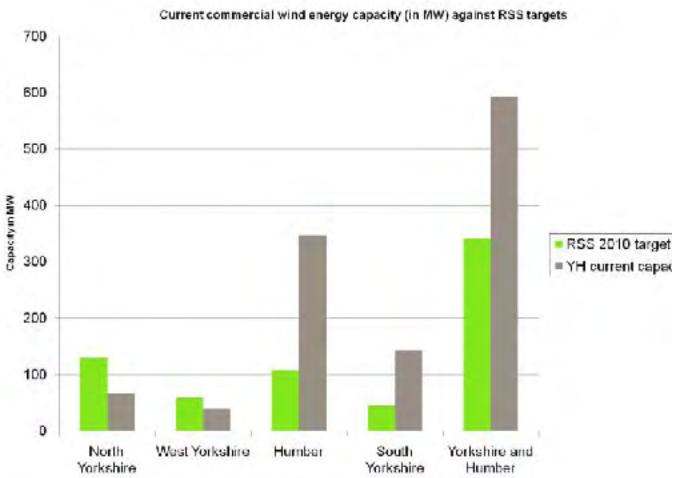

Figure 18 Progress of current commercial wind energy capacity against 2010 RSS targets. "Current" refers to facilities that are operational or have planning consent.

Most new wind farms are in the 10 MW to 50 MW range. Major wind farms include the 85 MW Keadby site in North Lincolnshire and the 66 MW wind farm at Tween Bridge in Doncaster. There are very few wind farms in the north of the region due to the presence of the National Parks and AONBs and the four MoD aerodromes.

There are four offshore wind farms proposed off the Humber, Dogger Bank, Hornsea, Westernmost Rough and the Humber Gateway, which could result in installed capacities of up to 13,000 MW, 4,000 MW, 245 MW and 300 MW respectively.

Figure 19 The 9 MW, 23 turbine, Ovenden Moor Wind Farm in Calderdale. This wind farm has been operational since 1993 and an application has been submitted to planning for repowering of the site with larger turbines. (Source: Nigel Homer, March 2005, retrieved from Wikimedia website, accessed November 2010)

5.9.3 Potential wind energy resource

The UK Wind Speed database shows that wind speeds across the region range from 5 m/s in the lower lying areas to 9 m/s on the North York Moors and Yorkshire Dales National Parks (Figure 22). Wind speeds of at least 6m/s are necessary for commercial viability. Most of the region therefore has sufficient wind speed for commercial scale wind energy generation and the constraints on development tend to come from large areas of high landscape and environmental sensitivity and the presence of a number of MOD sites.

The economically viable capacity of the region for commercial scale wind energy is around 2,800 MW. This has the potential to generate just under 7,500 GWh electricity annually, equivalent to over 6% of regional energy demand in 2008 and the energy use of around 510,000 homes.

Most of the economically viable wind energy resource lies in a band through the centre of the region from Teeside Airport just north of the regional boundary to Scunthorpe in the south, and along the east coast of the region in East Riding of Yorkshire. The local authority with the most potential is East Riding of

Yorkshire. There is relatively little potential in Kingston upon Hull, Scarborough and Sheffield.

5.9.4 Financial implications of wind energy

Wind turbines, when located appropriately in areas of high wind speeds, are one of the most cost effective renewable energy technologies currently available in the UK. Generally the capital cost of wind turbines reduces as the size of the turbine increases. As of February 2009, large scale wind power is projected to cost around £800 per kilowatt installed[16]. A typical cost breakdown is provided in Figure 20. The biggest influence on the cost of projects is the cost of the turbine, which is influenced by the cost of steel (for turbine components) and the exchange rate. The cost of grid connection is around 10% of total project costs.

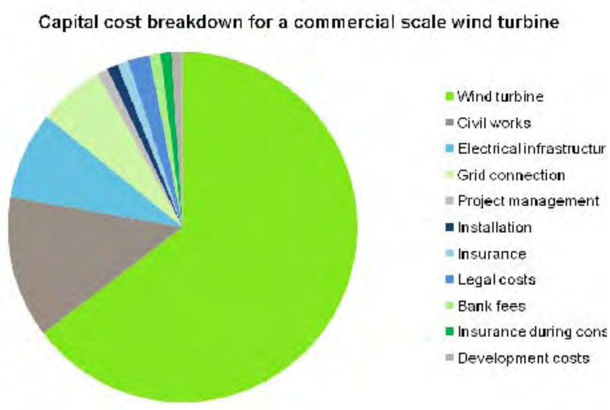

Figure 20 Capital cost breakdown for a large scale wind turbine. (Source: The economics of onshore wind energy; wind energy fact sheet 3, DTI)[17]

5.9.5 Conclusions from wind energy resource assessment

Commercial scale wind energy generation represents one of the most cost effective renewable energy technologies. The relatively high installed capacity and number of planning applications for wind farms across the region shows that the opportunity is being exploited.

This study has applied a number of assumptions to the technically accessible wind energy resource to deduce the resource that is economically viable. Although this can provide a high level indication of the potential, many of the constraints on wind energy development are subjective and have evolved over time. Figure 23 shows that there are wind farms located in areas with characteristics that have been ruled out in other areas. For example, Knabs Ridge Wind Farm is located on the boundary of the Nidderdale AONB. This is encouraging and implies that each site is being assessed on its individual merits.

Discussion with wind farm developers undertaken as part of this study has suggested that the overwhelming barrier to delivery of projects in the region is delays within the planning system. Obtaining planning permission for new sites is taking approximately 2 years. Stakeholders have commented on lack of consistency in decisions by consultees and a lack of knowledge of the technicalities of delivery in planning departments.

Further activity to encourage wider understanding of renewable energy through education and awareness raising has been suggested as a key recommendation to increase deployment of wind energy. Region wide or sub-regional guidance for planning officers on the interpretation of visual information such as zone of visual influence maps would be welcomed by developers. It was also suggested that adopting design principles, such as those produced by Scottish Natural Heritage on the cumulative effect of wind farms[18], would encourage consistency in assessing applications.

The effect of large wind turbines on landscape amenity remains an emotive issue. This study has reduced the economically viable potential for wind energy due to landscape constraints, on the basis of discussion with Natural England and other relevant stakeholders. An assessment of landscape sensitivity was outside of the scope of this study and the studies that have been already out (such as the South Pennines study[19]) were extremely useful. It is recommended that an assessment of the sensitivity of the landscape to objects such as large wind turbines is carried out for the whole region, either at a sub-regional or local level.

The cumulative impact of wind farms in relatively close proximity will become an important visual amenity issue for the region, particularly in areas such as East Riding of Yorkshire or Hull, where there are already many turbines. The methodology for this study has considered cumulative impact to be a specific constraint on development (separate to development in visually

[16] BWEA Small Wind Turbine FAQ (BWEA website, accessed September 2009)
[17] The economics of onshore wind energy; wind energy fact sheet 3 (DTI, June 2001)
[18] Cumulative effect of wind farms, Scottish Natural Heritage, April 2005
[19] Landscape Capacity Study for Wind Energy Developments in the South Pennines, Julie Martin Associates, January 2010

sensitive landscapes) and has reduced the economically viable potential accordingly.

The possible detrimental effect of large scale wind farms on military and aviation radar operation has also been a constraint for wind energy development in the region, as with the rest of the country. In 2008, around 47% of wind farm applications in the UK were rejected on radar grounds.[20] Turbines within line of sight of the radar will generally have the most effect, which can be a major issue for military air defence radar such as the instrument at Staxton Wold, which can have a range over large swathes of the region, up to 200 km in some cases.

Discussion with stakeholders has suggested that there are mitigation solutions available that are currently at the research stage but are likely to come forward in the short to medium term. These include the "Raytheon" solution which can be applied to NATs equipment, a 3D holographic solution proposed by Cambridge Consultants[21] and "Verifye" developed by Qinetiq.[22] AECOM is aware of one solution due to be implemented at Robin Hood airport in Doncaster, which should open up the area in the vicinity of the airport to commercial wind energy generation. Requirements for mitigation can also be included within the conditions for planning approval.

In our judgement, whilst radar mitigation has been a significant issue in the past, major issues should be resolved within 5-10 years. Consequently we have not reduced the economically viable potential because of radar concerns.

The capacity of the electrical network may also become a constraint on commercial scale wind energy development. Wind farms typically connect into the 33kV network. The cumulative impact of clustering of wind farms may become an issue, particularly in East Riding which is a light load area.

[20] Resolution of radar operation objections to wind farm developments W/45/00663/00/0, BERR, 2008
[21] "Wind farms vs. radar – seeing through the clutter", presentation by Cambridge Consultants, October 2008
[22] Vertical radar speeds up planning applications, Qinetiq website, accessed January 2011 http://www.qinetiq.com/home/markets/energy_environment/wind_energy/maximum_radar_coverage.html

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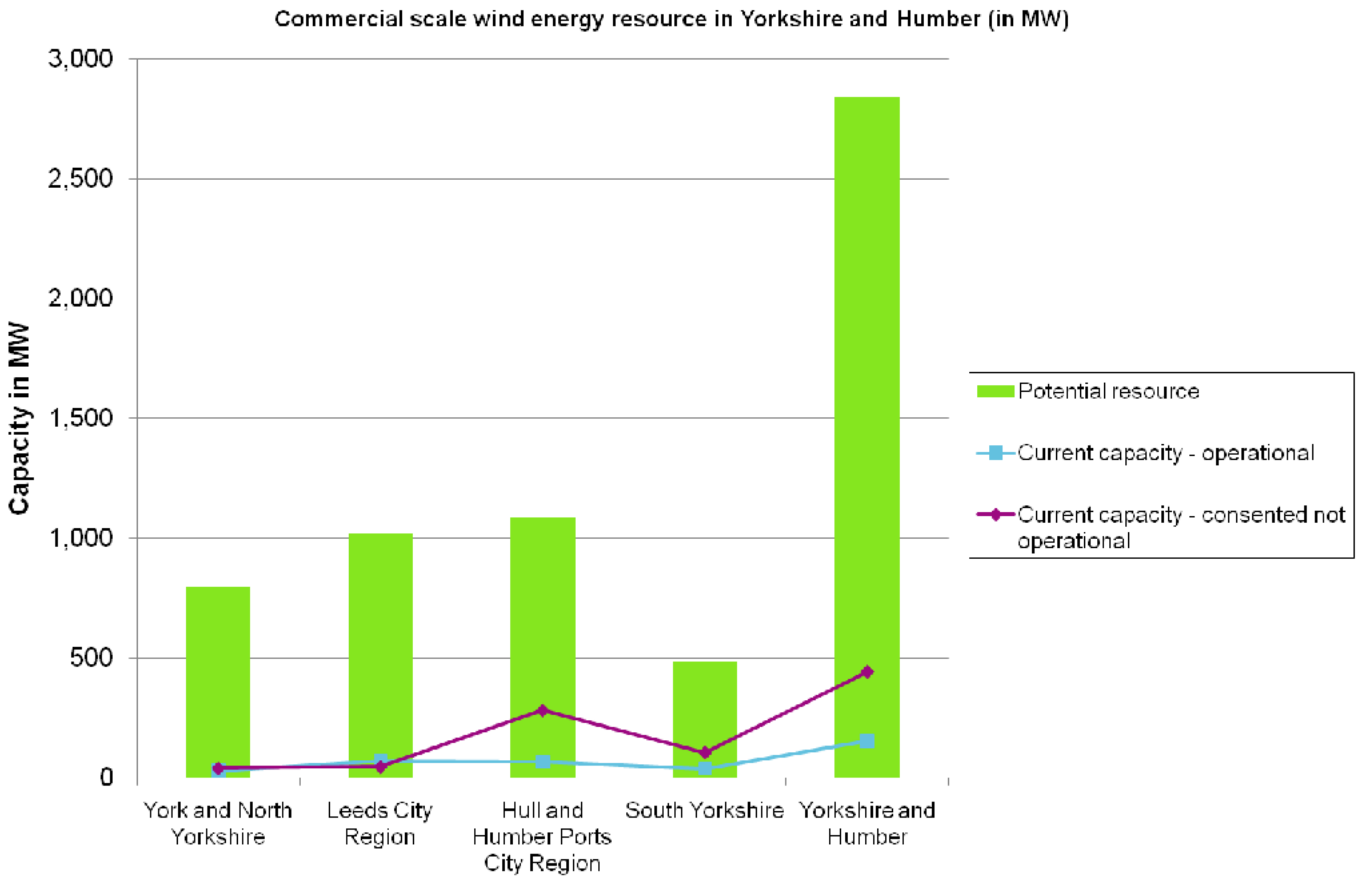

Figure 21 Commercial scale wind energy resource in Yorkshire and Humber, by sub region, in terms of potential MW.

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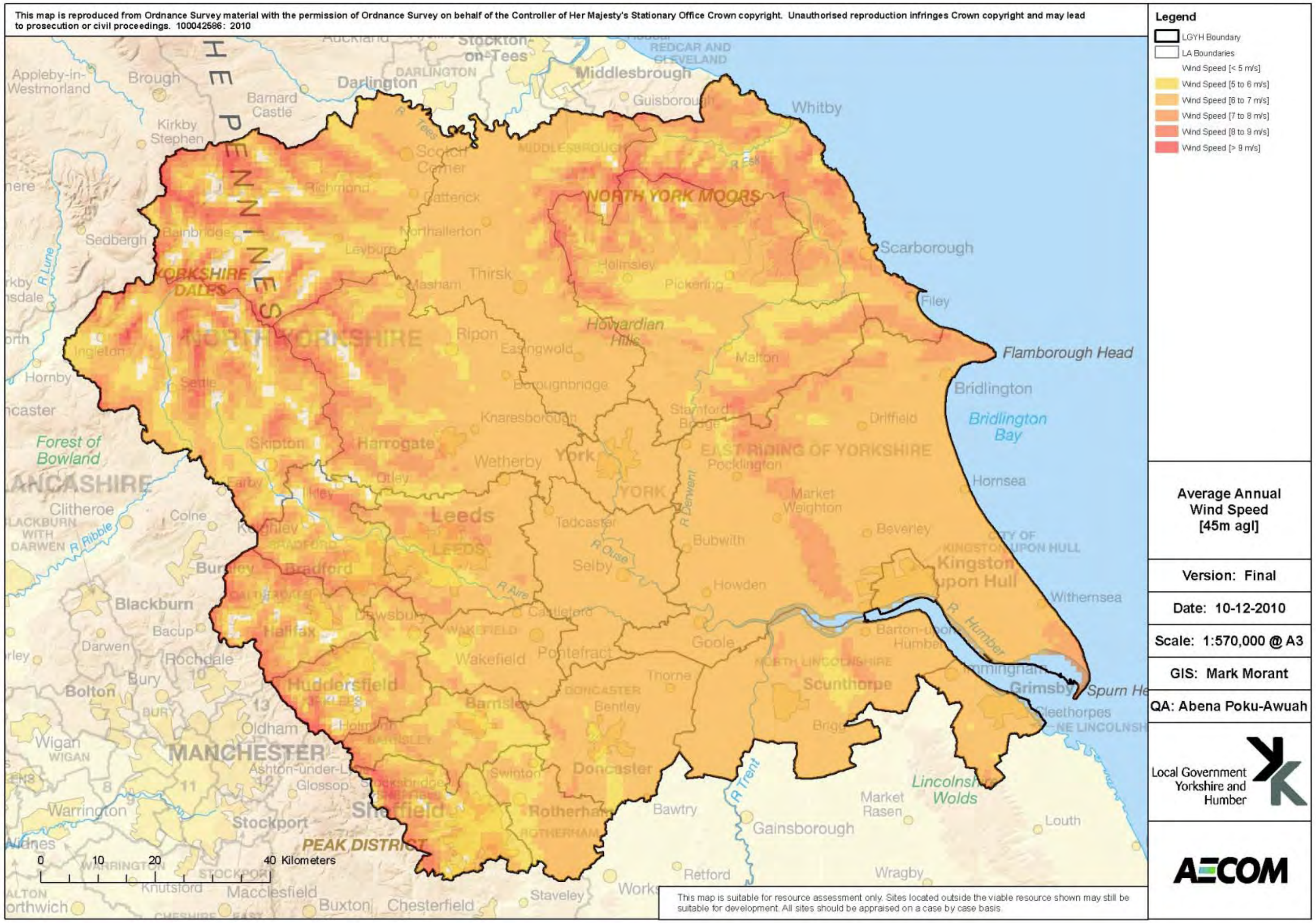

Figure 22 Annual average wind speed in Yorkshire and Humber in m/s, at 45 m height above ground level (Source: UK Wind Speed Database, accessed November 2010).

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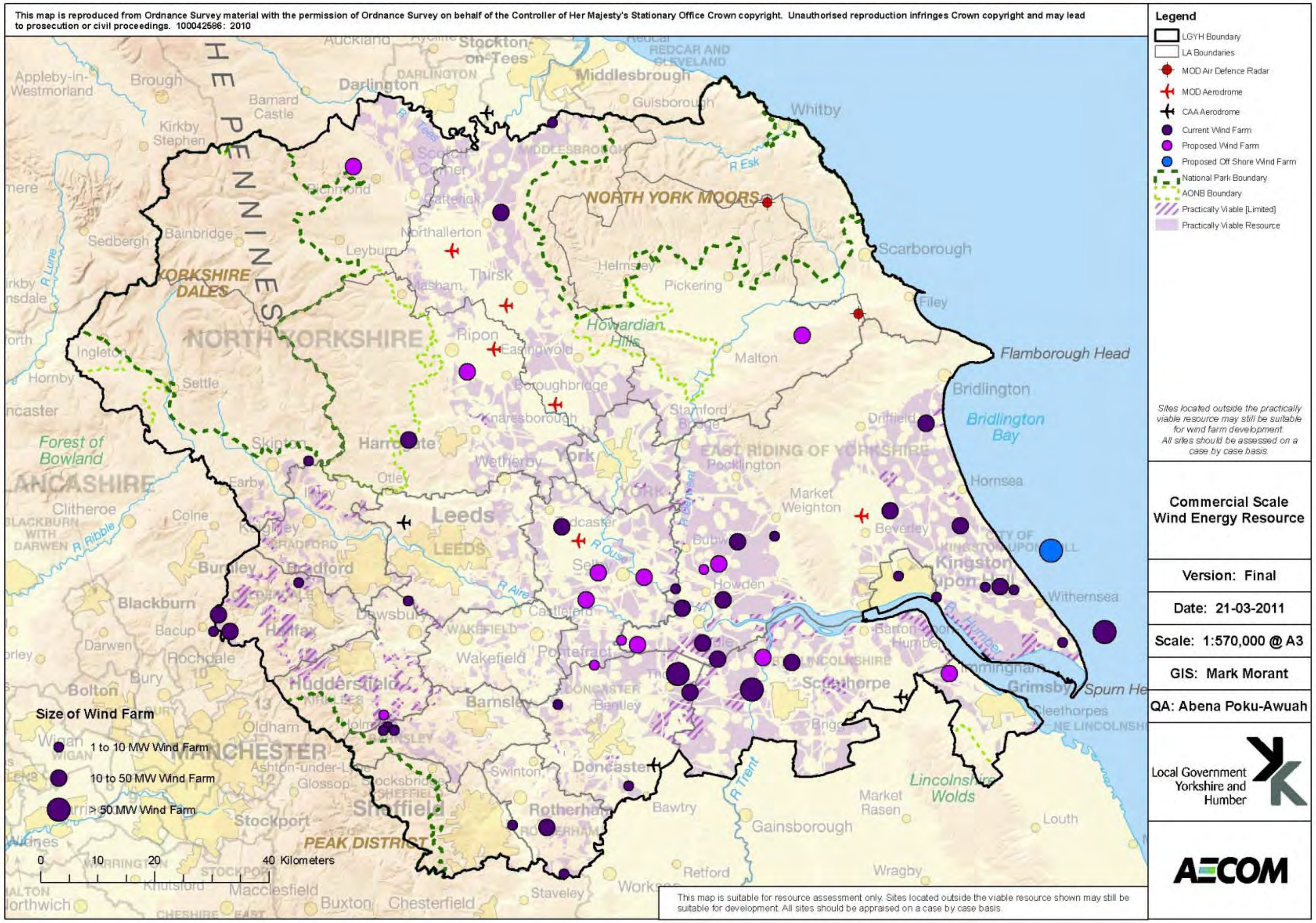

Figure 23 Commercial scale wind energy resource in Yorkshire and Humber. There are two further offshore wind farms in planning off the east coast (beyond boundary of map), Dogger Bank and Hornsea. “Current Wind Farm” refers to facilities that are operational or have planning consent. “Proposed Wind Farm” refers to facilities currently in the planning system or sites that have been flagged as having potential. Only current and proposed facilities over 1MW are shown. The areas shaded as “Practically viable [Limited]” represent areas where commercial scale wind energy development should be viable but the number of turbines may be restricted due to environmental constraints. Please refer to appendix A.2.3 for more details.

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5.10 Hydro resource

5.10.1 Introduction

Hydro power involves the generation of electricity from passing water (from rivers, or stored in reservoirs) through turbines. The energy extracted from the water depends on the flow rate and on the vertical drop through which the water falls at the site, the head.

5.10.2 Existing hydro energy capacity

Analysis of the British Hydro Association database and installed installations under the FIT scheme shows that there is around 3 MW of hydro energy capacity consented or installed in the region as of 2010. This is primarily located in the Hambleton district, which has a third of the region's capacity and is home to the largest consented scheme in the region, the 1MW Linton Lock facility. It should be noted that although it has been granted planning consent, the Linton Lock scheme has yet to be constructed (Figure 25).

Figure 24 Bonfield Ghyll hydro facility in the North York Moors National Park (Source: Case study, Mann Power Consulting Ltd)

Figure 25 Linton Lock hydro energy site (Source: Our heritage and the changing climate: Yorkshire and the Humber, Natural England, 2008)

Figure 26 shows the progress of installed and consented hydro schemes against the RSS targets. It shows that if the consented schemes are actually built then the majority of local authorities in the region will have exceeded the targets set in the RSS for hydro power.

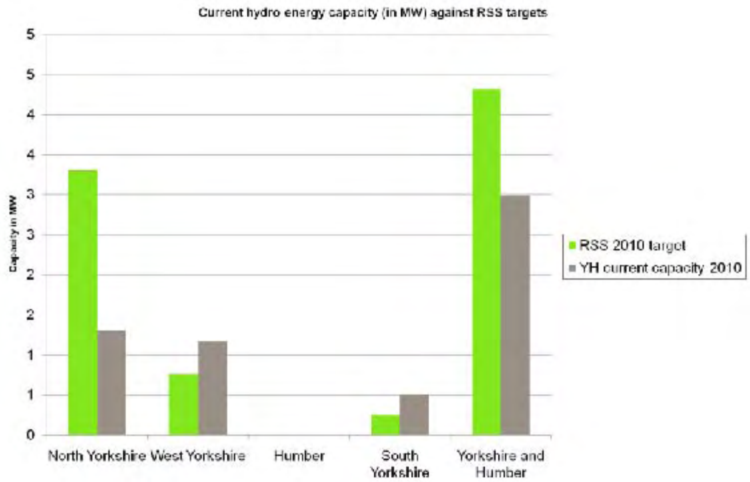

Figure 26 Progress of current hydro power schemes against 2010 RSS target. "Current" refers to facilities that are operational or have planning consent.

5.10.3 Potential hydro resource

The hydro energy resource has been identified through engagement with the Environment Agency. This identified all existing barriers within rivers in England and Wales. These represented sites where there is sufficient height in river level to provide a hydropower opportunity. These sites are mostly weirs, but could be other man-made structures, or natural features such as a waterfall.

Sites with high environmental sensitivity or where the power output would be less than 10kW were then removed from further consideration. The remaining sites are shown spatially on Figure 30. We then reduced the overall resource by 75%, to represent the constraints that typically arise at the feasibility study stage.

The economically viable capacity for hydro energy is around 26 MW, primarily located in the west within the Leeds City Region. This has the potential to generate around 88 GWh electricity annually, equivalent to the energy use of 6,000 homes, or the output from 13 commercial scale wind turbines. The Hull and Humber Ports sub-region has practically no potential for hydro energy generation.

5.10.4 Financial implications of hydro energy

The most important parameter in dictating the overall viability of a low-head scheme is the available head. Generally, the lower the head, the higher the cost per kW of the scheme. Expert opinion within the hydro industry suggests that sites where the head is below 2 metres and/or below 100kW in size are difficult to make cost-effective using standard methods and consequently only projects offering installed capacities greater than 15kW are likely to be developed[23].

The cost of developing a hydro scheme is currently around £7,000 per kW installed, although the constraints on individual sites can cause the cost to vary greatly between sites.

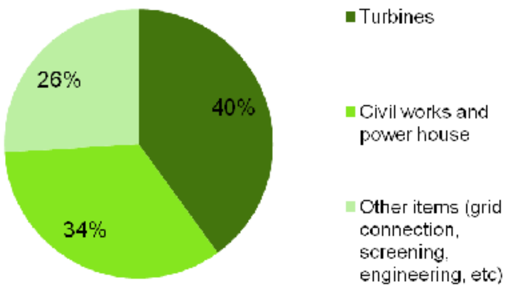

Figure 27 Typical cost breakdown for a hydro energy scheme (Source: Sustainability at the Cutting Edge, Smith, F, 2007)

5.10.5 Conclusions from hydro resource assessment

The assessment of the hydro resource suggests that small-scale hydropower has an important but limited role to play in renewable energy generation. Whilst not particularly cost-effective in comparison to other renewable energy technologies, hydro schemes could play a useful role in education and increasing awareness of the benefit of renewables. Yorkshire has a rich heritage of hydro schemes, used to power mills before coal. Although many of the original buildings, weirs and mill ponds have fallen into various states of disrepair, the many derelict mill sites that once captured the energy in water for operating machinery could be revitalised as micro and small-scale electricity generators.

Ideally, hydro development should not impact rivers in a negative way - small-scale schemes, which do not involve collecting water behind dams or in reservoirs, have very little impact on the environment. Hydro schemes do not necessarily have to be detrimental to the environment and there are “win win sites” where connectivity of rivers and ecology can be improved with hydro schemes.

High level feasibility studies are good for whetting the appetite of local authorities. However, it is not really possible to assess feasibility at a lower level without expensive site visits. Bureaucracy and regulations are also a barrier to development at the moment, i.e. the process of obtaining Environment Agency consents, construction licences, river consents, fish pass consents, etc. The Environment Agency is actively trying to streamline this process and is also in the midst of a follow up study on UK hydro schemes which should filter out sites that are probably unviable.

[23] Low Head Hydro Power in the South-East of England –A Review of the Resource and Associated Technical, Environmental and Socio-Economic Issues, TV Energy and MWH, February 2004

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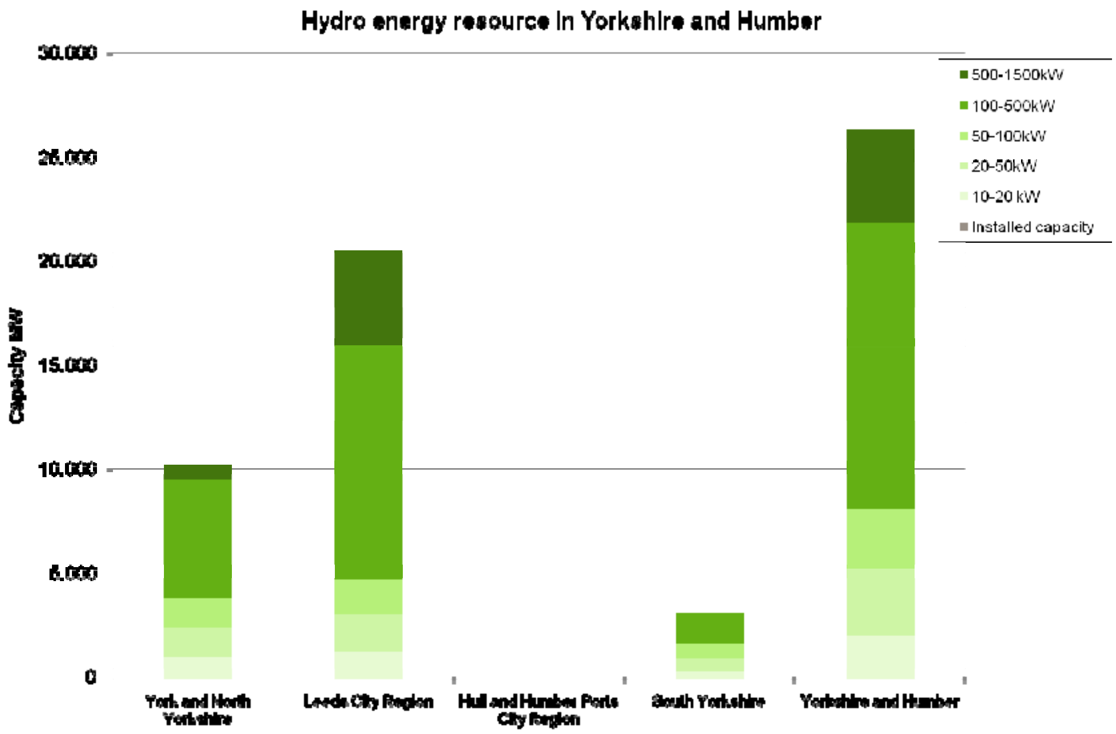

Figure 28 Hydro energy resource in Yorkshire and Humber by sub-region, in terms of potential MW. "Current" refers to facilities that are operational or have planning consent.

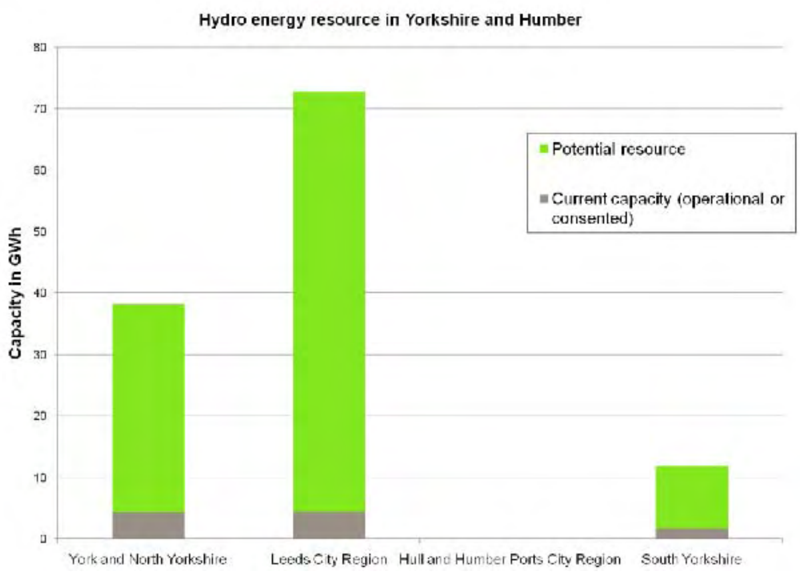

Figure 29 Hydro energy resource in Yorkshire and Humber, in terms of potential annual energy generation in GWh. "Current" refers to facilities that are operational or have planning consent.

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Figure 30 Hydro energy resource in Yorkshire and Humber. “Current Hydro Energy” refers to facilities that are operational or have planning consent. “Proposed Wind Farm” refers to facilities currently in the planning system.

5.11 Biomass resource

5.11.1 Introduction

Biomass is a collective term for all plant and animal material. It is normally considered to be a renewable fuel, as the carbon emissions emitted during combustion have been (relatively) recently absorbed from the atmosphere by photosynthesis.

The potential for energy generation from dedicated energy crops, managed woodland, industrial woody waste and agricultural arisings (straw) is described in this section.

Arboricultural arisings from the pruning of trees have not been included in the assessment since this resource is difficult to quantify and logistically difficult to source.

The potential for energy generation from other animal waste products (such as poultry litter) is described in section 5.12.

5.11.2 Co-firing of biomass

Under the Renewables Obligation, co-firing of biomass with coal or oil in large scale power generation is encouraged.

In order to stimulate the development of a supply chain, large scale power generators receive twice the level of support if they co-fire with energy crops rather than other forms of biomass. There is a limit on electricity suppliers for how much of their obligation they can meet from purchasing or claiming ROCs from co-firing from non-energy crops biomass, without CHP. However, this limit does not apply to co-firing from energy crops or to co-firing with CHP, and there are no restrictions on whether the biomass crops have to be sourced locally.

All three major coal-fired power stations in the region are currently co-firing with biomass. The main factors affecting the level of co-firing are the cost of fuel and whether the fuel is physically compatible with the rest of the fuel stream.

Prior to 2010, Drax had about 100MW of co-firing capacity, up to about 2.5% of installed capacity, based on putting biomass through the same mills as the coal. In 2010, the plant installed 400MW of biomass direct injection plant which enables a greater proportion of biomass to be used. This brings the current installed co-firing capacity to 500MW, or 12.5% of total capacity, with the potential to co-fire up to 1.5 million tonnes of biomass per year. Drax believes that this now makes them the largest co-firing facility in the world.[24] A range of fuels are being used, both from the UK and imported, including energy crops, wood and tall oil. Drax has built a straw pelleting plant in Goole which became operational in 2009, and can process 100,000 tonnes of pellets per annum. Drax also secured planning consent in 2010 to build a second straw pelting plant, with a capacity of 150,000 tonnes per annum, at Somerby Park in Gainsborough, Lincolnshire.

Imported olive pellets are used as biomass co-firing material at Ferrybridge "C" power station. The biomass capacity of the plant peaked at about 2.9%, or 58MW, in 2005/6, but fell to 1.3% (26MW) in 2007/8. Ferrybridge did invest in some dedicated biomass burners in 2006, but with the financial incentives currently available, their operation is not economically viable at present. Currently the plant is limited to the maximum amount of biomass it can put through the coal mills, without causing clogging of the mills. This limit is about 3% by mass, or about 1.5% of output. However, this amount will halve from 2016 when a proportion of Ferrybridge's generating capacity (1 GW) is scheduled to close under the LCPD (see section 4.4 for details).

Olive pellets are the main source of biomass co-firing material at Eggborough power station. Almost 18,000 tonnes are used annually.[25] Analysis of ROC data shows that in 2008/9 about 1.1% (22MW) of the output of the plant came from co-firing. Eggborough is not planning to reduce any of its coal fired capacity and all of its capacity will be LCPD compliant.

5.11.3 Existing biomass capacity (non co-firing)

There are only a few examples of operational biomass power or CHP schemes in the region. These are:

- The 4.7MW_e facility at John Smith's brewery, Tadcaster in Selby district. This is fuelled by spent grain and locally sourced wood chip and supplies steam and electricity for process use;
- The 2.5MW_e biomass facility at Sandfield Heat and Power in Brandesburton, in East Riding. This is fuelled by waste wood. This scheme was developed by Bioflame, who are based in Pickering, Ryedale. Bioflame also have a 0.5MWe demonstration scheme at their Pickering site;
- The 2MW_e biomass facility operated at Bioflame at South View Farm in Ryedale.

However, there are a significant number of other schemes that have either received planning consent or are currently in

[24] Biomass Growth Strategy, Drax group PLC, October 2008

[25] Sustainability Report on biomass fuelled generating stations, Ofgem,

planning. These are covered under the “potential” section 5.11.4 below.

In terms of current biomass heating (wood fuel) installations, these, along with their potential uptake, are considered under the microgeneration section later in this report (section 5.13.2).

Figure 31 Delivery of biomass at Sheffield Road flats, Barnsley (Source: Case study – Sheffield Road – Barnsley MBC)

5.11.4 Potential biomass resource

Straw

The resource assessment showed that there were about 0.56 million tonnes of straw per annum available for energy generation in the region, after allowing for 50% of the resource being left on the fields for fertiliser. The majority of this resource is in East Riding and North Lincolnshire, with a significant contribution also from North Yorkshire districts. This could support 93MW_e of installed capacity, equivalent to the energy use of around 43,300 homes.

Given the size of this resource, it is perhaps surprising that there are currently no operational straw combustion facilities in the region. However, there are three straw burning CHP schemes that have been granted planning consent in recent years, all in East Riding district, with a total capacity of 30MW_e. These are:

- Tansterne straw burning plant in Flinton, developed by GB-Bio, 10MWe, which will supply heat and CO_2 to glasshouses;
- Tesco distribution centre in Goole, 5MW_e, where some of the heat will be used for buildings;
- Gameslack farm, Wetwang, 15MW_e.

As mentioned under the co-firing section 5.11.2, some of this resource is likely to also be pelletised for use in co-firing, at the pellet mill in Goole, for example.

A planning application was also submitted in 2009 for a 40MW_e straw burning plant at the former British Sugar works in Brigg, North Lincolnshire. This was refused planning consent in 2010, but at the time of writing was due to go to appeal in Spring 2011.

Energy crops

The resource assessment showed that for the medium scenario defined within the DECC methodology, where energy crops are only grown on land not used for arable crops (see appendix A.9.2), there is the potential for planting about 64,000 hectares (ha) of energy crops, which could yield about 1.1 million oven dried tonnes of fuel per annum by 2020. The analysis found that this was made up of 8,339 ha of short rotation coppice (SRC) and 55,832 ha of miscanthus.

The majority of this resource is in North Yorkshire, but there is also significant potential in East Riding and North Lincolnshire. If all of this were to be used for biomass electricity generation and CHP facilities, this could support an installed capacity of about 185 MW_e, equivalent to the energy use of around 86,200 homes. In practice, a significant proportion of this resource may be used for co-firing. It may also be grown for wood fuel, particular on farms and estates where they have installed their own wood fuel boilers.

Currently, there is just under 1800 ha of energy crops planted in the region[26], i.e. just under 3% of this resource. There are areas of the region with fertile, peaty soil that should be beneficial for growing short rotation coppice (SRC), especially with impact of higher temperatures expected from climate change. On the other hand, these crops may be more at risk of flood damage. Natural England has advised that they would expect schemes that avoid peaty soils as advised in the Best Practice Guide to growing Short Rotation Coppice.[27]

Imported biomass

Over the last few years there has been considerable interest in developing large scale biomass power stations on the Humber that would be fuelled mainly by biomass imported by sea. Drax has announced plans for a 290MW facility at Immingham, North Lincolnshire. A section 36 application was lodged with the Department for Energy and Climate Change towards the

[26] Based on data from the UK Government Energy Crop Scheme
[27] Growing Short Rotation Coppice, DEFRA, August 2004

end of 2009. Able UK has also announced plans for a 300MW_e biomass facility for the south bank of the Humber, although it is not clear if a formal application has yet been lodged. In addition, Drax also lodged a section 36 application for a second 290MW_e facility in Selby. At the time of writing, it is unclear whether or not DECC has approved the Drax applications, nor whether Drax intend to continue developing them. In early 2010, Dong Energy also announced plans for a biomass power station at Queen Elizabeth dock in East Hull. However, they subsequently withdrew these proposals later in 2010.

A proposed 65MW_e scheme at Stallingborough, on the south side of the Humber, was granted planning consent by the Secretary of State in 2008, under a section 36 application. Formerly this was owned by Helius Energy, but has since been bought by RWE. The scheme has yet to be built.

Waste wood

Based on the DECC methodology, the amount of wood waste that could be available in the region from the construction sector by 2020 was estimated to be about 100,000 odt per annum. This assumes that only 50% of the resource would be available due to competing uses. If all of this went to electricity production, or CHP, this could support 17MW_e of biomass generation capacity, equivalent to the energy use of around 7,800 homes.

It is acknowledged that there are also potentially significant additional volumes of wood waste within the commercial and industrial mixed waste stream. A 2009 study for Resource Efficiency Yorkshire[28] found that there was potentially up to 318,000 tonnes per annum of wood waste being produced by the commercial and industrial sectors in the region.

However, for this study, we have considered this resource as part of the biodegradable proportion of the potential for energy generation from waste, which is covered later in this report (section 5.12.1).

As mentioned above, there are already a few (pioneering) operating examples of energy generation from wood waste in the region, in Ryedale and East Riding. A proposal by EON for a 25MW_e scheme at Blackburn Meadows in Sheffield also received planning consent in 2008, but this has yet to be built. Futhermore, Dalkia has submitted proposals to the Secretary of State (under section 36) for a 56MW_e scheme located at Pollington airfield, in Selby. The wood waste would be transported to the site via the Aire and Calder canal. At the time of writing, it is not known whether the scheme has received approval.

It is worth noting that not all of the wood waste would necessarily be used for dedicated electricity generation or CHP plants. Clean wood waste may be pelleted to be used as wood fuel or for co-firing. In 2010, Dalkia commissioned a waste wood pelleting facility at Pollington airfield in Selby which can produce up to 50,000 tonnes per year of pellets.

Figure 32 Woodpile at Smithies Depot, Barnsley where waste wood is collected. (Source: Climate Change Case Study: Barnsley Metropolitan Borough Council, Efficiency North)

Managed woodland

Data from the Forestry Commission suggests that there could be only a fairly limited amount of 22,000 odt of wood fuel available per annum from thinnings and fellings from woodland management in the region, by 2020. This would be from both Forestry Commission and private sector woodland over 2 ha in size. This estimate is an upper limit as it does not take account of whether it would be economically viable to extract timber or thinnings from all of this woodland.

This figure is based on only stemwood of 14cm in diameter or less going into the woodfuel market, as larger sizes would tend to go into the sawn timber market where they would receive a higher price. The figure also assumes that only conifer residues would go for chipped wood fuel, as broadleaf residues would tend to be used for logs.

The Forestry Commission for the region already has a contract to supply 100,000 tonnes of forestry residues per year (which presumably also includes stemwood with a diameter greater than 14cm) to the 30MW_e Wilton biomass power scheme run by Sembcorp in the Tees Valley. This is a ten year contract

[28] Calculation of the Wood Fraction of C&I waste in Yorkshire & Humber, July 2009, Urban Mines

which began in 2008. Therefore, this may preclude the Forestry Commission from entering into any other large scale wood fuel supply contracts in the region for the next ten years.

5.11.5 Financial implications of biomass

Forest residues, whilst abundant, are produced at a cost which varies depending upon market conditions, type of plantation, size, and location. Typical production costs for a range of products is £30 - £45 per tonne, this includes £5/per tonne for transport costs for local supply.

Establishment of energy crops is estimated to cost approximately £2000/hectare (Table 9), which equates to around £1,200 per kilowatt of electricity generated by CHP. Details on grants available for establishing crops are presented in Appendix D.17. A recent analysis of the potential income from both willow SRC and miscanthus suggested that for medium yield land (i.e. Grade 3), the average annual income would be £187 to £360 per hectare. Energy crops are relatively expensive compared to some other biomass fuels but do have the potential to provide very significant volumes of fuel.

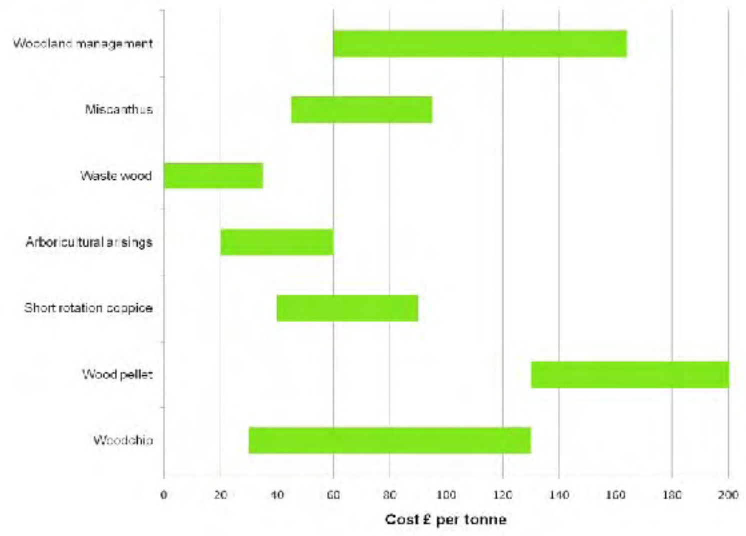

Figure 33 Guideline costs for different biomass fuels. (Source: Biomass heating, A practical guide for potential users CTG012, Carbon Trust, January 2009)

Activity	Cost per hectare
Ground preparation (herbicides, labour, ploughing and power harrowing)	£133
Planting (15,000 cuttings, hire of planter and team)	£1,068
Pre-emergence spraying (herbicide and labour)	£107
Year 1 management costs (cut back, herbicides, labour)	£112
Harvesting	£170
Local use (production, bale shredder, tractor and trailer)	£378
Total	**£1,968**

Table 9 Indicative costs of establishing willow SRC energy crops, exclusive of payments from grants or growing on set aside land. Costs for miscanthus SRC are expected to be broadly comparable (Source: Energy Crops, CALU and Economics of Short Rotation Coppice, Willow for Wales) 29, 30

[29] Economics of short rotation coppice (Willow for Wales, July 2007)
[30] Energy Crops, Economics of miscanthus and SRC production (CALU, November 2006)

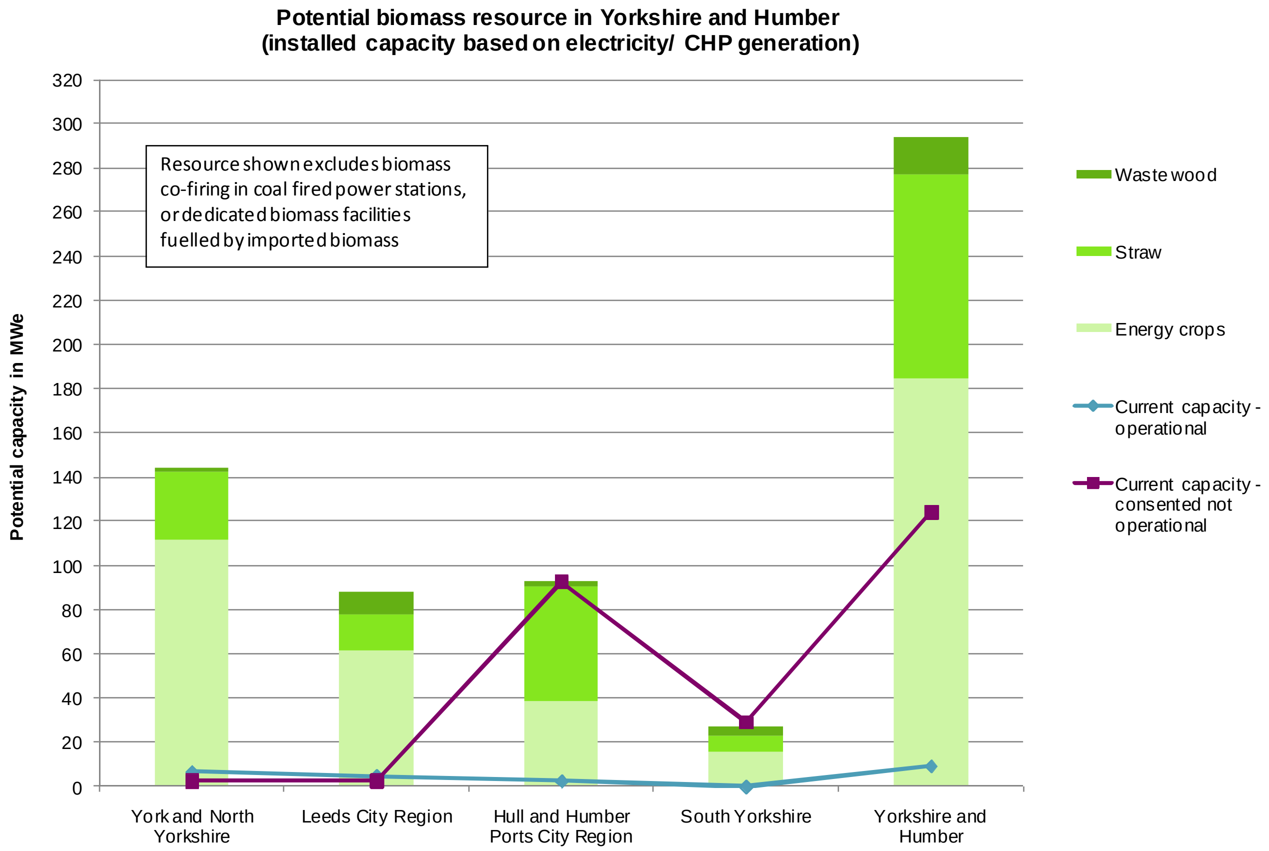

Figure 34 Biomass resource in Yorkshire and Humber, by sub region, in terms of potential MW. "Current" refers to facilities that are operational or have planning consent. The 129MWe of consented schemes for the region includes the 65MWe Stallingborough scheme, on the Humber which would run off imported biomass, and the 25MWe Blackburn Meadows waste wood scheme in Sheffield.

5.11.6 Conclusions from biomass resource assessment

This study has identified biomass as a significant resource for renewable energy generation in the region. At the large and medium plant scale, there are few physical environmental or planning factors that could seriously constrain the deployment of biomass. Biomass boilers for large scale use such as in district heating networks are an option but district heating schemes are still relatively rare in UK.

The majority of the biomass energy resource is located in the largely rural sub-region of York and North Yorkshire, where there are particular opportunities for energy crops grown on land no longer needed for food production, animal waste and straw.

The biomass fuel supply chain in the Yorkshire and Humber region is currently in its infancy and the market conditions are extremely variable. This makes the long-term forecasting of biomass system costs extremely difficult. For example, biomass fuel, particularly waste wood, has in the past been either free of charge or attracted a gate fee (where the supplier pays the user a fee which is lower than the alternative disposal cost). However, as the market for biomass increases with additional biomass electricity, heat, and CHP capacity being installed, the demand will increase and the fuel will command a higher premium. It will be important to consider the longer term potential market conditions for new developments and there is a potential role for local authorities to collaborate with the sub-regional bodies to establish a supply chain to provide some degree of long term stability.

The major constraint to the use of locally sourced biomass is likely to be financial. Feedback received as part of this study suggests that the economically viable potential for growing energy crops in the region will ultimately depend on the price of wheat. There is potential to use the region's relatively large straw resource for biomass energy generation.

At present, the biomass heating sector is quite separate from the co-firing sector and there is no real competition for resources between the heat and co-firing markets.

Securing finance for schemes has been suggested as a major barrier. Stakeholders have highlighted that uncertainty over incentive mechanisms is significantly affecting the viability of new biomass plants and that grandfathering provisions are needed to provide certainty for investment decisions. ROC bands are subject to review every four years and there is no clarity on the level of ROC support that plants accredited after April 2013 (the date of implementation of the next ROC bands) will receive. The commercial viability of using biomass boilers is likely to depend upon the introduction of the Renewable Heat Incentive.

Other constraints on biomass energy production include the amount of land available for crop production and the need to consider environmental issues such as biodiversity issues, for example, if substantial areas of set aside or temporary grassland are used for energy crops.

Greater use of biomass as fuel raises some considerations about increased CO_2 emissions associated with transport of material. A recent report by the Environment Agency provides data which suggests an increase in CO_2 emissions of between 5% (wood chip) and 18% (wood pellets) for European imports. The data is not clear for transport within the UK, but the overall carbon savings are likely to outweigh the transport energy costs, particularly where water borne transport is used. The costs for water borne transport were also shown to be substantially reduced, although these costs would clearly be dependent on the number of transfers required between modes. [31]

In addition, major growth in the use of biomass fuel could have implications for air quality. Planning should ensure that this is considered for areas where Air Quality Management Areas (AQMAs) have been defined.

[31] Feasibility Study into the Potential for Non-Building Integrated Wind and Biomass Plants in London: Final Biomass Report, February 2006.

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Figure 35 Biomass resource in Yorkshire and Humber.

5.12 Potential for energy generation from waste

5.12.1 Introduction

The organic fraction in waste streams can be used to generate energy through direct combustion, anaerobic digestion, pyrolysis or gasification. The potential for energy generation from waste is described in this section. It covers the following renewable energy resources. A full list of the energy from waste facilities in the region larger than $1MW_e$ is provided in Appendix E.

- *Animal manures or slurry from pigs and cattle* - This wet organic waste can be treated using anaerobic digestion (AD) to produce biogas. The biogas can then either be burnt directly to produce heat, or burnt in a gas engine to produce electricity and heat.
- *Food waste* - This can stem directly from waste from the food and drinks processing industry or it could be food waste from the general household and commercial waste stream. If this waste is separated, it can be treated using AD, as described above. If it is not separated, then it instead forms part of the general waste stream described below.
- *Poultry litter* - This is a drier from of organic waste and can be burnt to raise steam to drive a steam turbine to generate electricity and potentially useful heat if there is a use for the latter.
- *Sewage from sewage treatment works* - This can be treated using AD to produce biogas, (or sewage gas) as described above for animal manure.
- *Municipal Solid Waste (MSW) and Commercial and Industrial (C&I) waste* - Rather than going to landfill, any residual waste that is left after re-use, recycling and composting or AD, can go for other forms of secondary treatment.

  This can consist of some form of thermal treatment, where the waste is combusted to raise steam to drive a steam turbine, which can generate electricity, and also heat if in CHP mode. This could consist of either mass burn incineration, or some form of "advanced thermal treatment" using pyrolysis or gasification or both and is commonly referred to as Energy from Waste (EfW). Or it can go through some form of Mechanical Biological Treatment (MBT), which produces Solid Recovered Fuel (SRF) pellets. These pellets can then themselves be combusted for energy production, again using a variety of approaches.

  Only the biodegradable fraction of this resource is classed as renewable, under the definitions of the EU Renewables Directive.
- *Landfill gas.* Over time, the organic fraction of waste buried in landfill breaks down, through anaerobic digestion, to release methane gas. This gas can be captured, via underground pipes, and the gas then burnt in a gas engine to generate electricity. All of the output from landfill gas is classed as renewable.

Waste wood is not covered in this section, but is covered under the biomass resource section in the previous section 5.11.

5.12.2 Existing energy from waste capacity

AD of wet organic waste (food/animal waste)
There are currently no operational generators in the region. However, there are three food waste facilities currently under construction, and due to become operational in 2011. The first is GWE Biogas, in Kirkburn, East Riding, which will be a $2MW_e$ facility, taking, initially, commercial food waste. The second is also a $2MW_e$ facility in Doncaster, to be operated by ReFood UK, which is a joint venture involving Prosper De Mulder (PDM), and will take retail food waste. Each plant will process about 50,000 tonnes of food waste each year. The third is a $0.3MW_e$ facility at Clayton Hall farm in Emley, Kirklees, which will also take commercial food waste as the feedstock.

Dry organic waste (poultry litter)
The $14MW_e$ Glanford Power Station in North Lincolnshire is the only facility identified that can process poultry litter. This facility is believed to currently process meat and bone meal.

Sewage gas
Sewage treatment for the region is provided predominantly by Yorkshire Water, although Anglian Water are responsible for sewage treatment in North East Lincolnshire (at Pyewipe WWTW in Grimsby), and Severn Trent Water are responsible for North Lincolnshire (at Yaddlethorpe WWTW near Scunthrope).

From discussion with Yorkshire Water, they process about 150,000 tonnes (dry weight) of sewage per year, at about 20 sites. Currently, the majority of this (about 60%) is processed using AD at the larger sites to produce biogas which is then used for electricity generation in gas engines. This gives a current installed capacity for electricity generation of $7.3MW_e$ in the region. All of the heat from the gas engines is used as part of drying the sludge. The remaining sewage sludge is currently incinerated. In addition, the Anglian water and Severn Trent Water schemes in North and North East Lincolnshire have an installed capacity of 1.3MWe. This gives a total installed sewage gas capacity for the region of 8.6MW_e.

Energy from MSW and C&I waste

Currently, there are three energy from waste facilities generating electricity in the region, with a total installed capacity of about 33MW_e. These are the Sheffield Energy Recovery facility (20MW_e), the Huddersfield facility in Kirklees (10MW_e), and the Newlincs facility in Grimsby, North East Lincolnshire (3MW_e). These facilities are predominantly taking MSW waste, and they involve PFI type contracts between waste management companies and the local authorities.

Only the biodegradable fraction of the waste stream is regarded as being renewable. Nominally, this is currently about 50%, giving an installed renewable capacity of 16.5MW_e for the region.

The Sheffield scheme also provides up to 39 MW_{th} of heat into the city's district heating network, and the Newlincs scheme supplies up to 3 MW_{th} of heat to a neighbouring industrial customer.

Landfill gas

There are a number of landfills in the region where energy is recovered from methane gas. These represent nearly 76MW_e of electricity generation capacity. However, most of these facilities will have reached the end of their operational lives by 2025, due to a combination of the quantity of gas tailing off and the life of the generation plant.

5.12.3 Potential for energy from waste

AD of wet organic (food/animal) waste

Based on data from the Food and Drink Federation and DEFRA (for 2008), the amount of food waste available in the region from the food and drink industry is about 47,000 tonnes per annum. Assuming only 50% of this could be used for energy generation, due to competing uses, then this could support an installed AD generation capacity of about 0.7MWe, which is a very limited resource.

However, there is a much greater potential if the amount of food waste available from more general commercial and retail businesses is considered, as well as domestic food waste. Discussions with stakeholders has suggested that up to 500,000 tonnes of food waste could be available for energy generation in the region from these sources, by 2020. This could support up to 16MW_e of installed capacity. As mentioned above, about 4.3MW_e of this resource is being harnessed by operational or near operational facilities. There is also a scheme currently in planning for a 0.7MW_e facility in Thirsk, Hambleton, which would take commercial food waste as the feedstock.

This leaves the potential for an additional 11MW_e of capacity to come forward over the next few years, which could amount to 5-10 or more schemes.

In terms of slurry from cattle and pigs, there is the potential for nearly 30 MW_e of installed capacity, with the majority of this (20MW_e) in North Yorkshire, due to its predominantly rural nature. However, the likelihood of this waste being harnessed for energy production appears to be low. There are no current schemes in operation in the region that take wet animal waste as the feedstock and there are none in planning.

This is because the economic viability of AD plants appears to be driven by the value to operators of being paid gate fees by food waste producers, in order to meet the requirement to pasteurise such waste under the EU Animal Byproducts Directive.

Dry organic (poultry litter)

The assessment found that there is the potential for around 35 MW_e of poultry litter, based on the number of poultry broiler birds in each local authority area. The greatest concentration of this (about 13MW_e) is in North Lincolnshire, which already has the 14MW_e Glanford facility. Therefore, the potential for additional new capacity is up to 21MW_e, which could consist of one or two facilities.

Sewage gas

Yorkshire Water indicated that the current AD capacity is unlikely to decrease by 2020. There is a possibility that it may increase, if they look to digest rather than incinerate some of the remaining sludge. However, at the time of writing there were no definite plans for this. Therefore, we have assumed that by 2020-25 the installed capacity of AD from sewage sludge in the region remains at the current level of 7MW_e.

Energy from MSW

There are 15 local government authorities in the Yorkshire and Humber region which act as Waste Disposal Authorities (WDAs) for MSW. Some of these have joined together, resulting in 10 separate partnerships, as shown in appendix E.4. Several proposals are now in development for energy from waste plants, both thermal treatment and AD. However, WDAs in the region have reached very different stages in the preparation of waste DPDs. The procurement of the necessary new treatment facilities and contractual arrangements are also at varying stages of progress and often linked to DPD progress.

The MSW resource for 2020 has been assessed using the waste projections developed by Enviros for the RSS. The projections have been adjusted by including the actual MSW figures for 2007/8, as reported in the Annual Monitoring report for the region for that year. The data for North Yorkshire County has been broken down to district level by assigning the waste on a pro-rata basis according to the number of households.

The Waste Strategy for England[32] sets out a target that 75% of all MSW should be recovered (i.e. not sent to landfill) by 2020 and 50% should be re-used, recycled or composted. Therefore, to avoid any conflict with the waste hierarchy, and in line with the targets, we have assumed that 25% of MSW (i.e. the balance of the 75%) would be available for energy recovery by 2020. This amounts to about 810,000 tonnes of residual waste which could support up to $81MW_e$ of generation capacity. We have assumed that by 2020-25 only 35% of this residual waste would be biodegradable (due to higher recycling rates), therefore the potential renewable capacity would be 28MWe.

About 420,000 tonnes of MSW is already being utilised in the three operational EfW schemes mentioned above. This leaves the potential for an additional 390,000 tonnes to be treated. A number of local authorities in the region have plans for new energy recovery facilities to treat their residual MSW waste. The proposed Allerton Waste recovery centre in Harrogate would recover energy from about 200,000 tonnes per annum, for the York and North Yorkshire authorities.

Leeds City Council is also currently going through a tendering process to procure an energy from waste facility to process a similar amount of MSW. Other WDAs in the region are also considering energy recovery options for residual MSW. There is also the Saltend energy recovery facility in Hull, which was to treat the MSW for Hull and East Riding Councils and which has been granted planning consent, but that we understand is no longer going to proceed.

[32] Waste Strategy for England 2007, DEFRA, May 2007

Therefore, this suggests that the potential of $81MW_e$ of energy recovery from MSW by 2020-25 (of which $28MW_e$ would be renewable) is likely to be delivered, as long as projects can secure planning consent.

Energy from C&I

Assessing the C&I waste resource for the region is more complex than for MSW. This is due in part to uncertainty over the level of C&I activity in the region by 2020. It is also due to the fact that a lot of industrial waste is "inert", such as combustion residues and metallic wastes, and therefore would not be suitable as a feedstock for an EfW facility.

We have taken data on the total levels of C&I waste projected for the region by 2020 from the report prepared for CO2 Sense Yorkshire by Urban Mines. This provided a projection for C&I waste for each local authority in the region, based on employment projections from the Regional Econometric Model and waste arisings data from surveys in other regions to estimate arisings for different employment sectors.

A related report by Urban Mines provided a breakdown of the waste stream for each major sector. Using this data, we estimated the C&I waste that could be available for energy recovery by identifying only the waste that fell into the following categories:

- Animal and vegetable waste
- Mixed ordinary wastes
- Non-metallic wastes

We then assumed that all of the waste in the first category would be recovered preferentially via composting or anaerobic digestion, i.e. not for EfW. We assumed that for the two other categories, about 50% could be recycled, from an estimate given for mixed waste in the Environment Agency mass balance study for the region, leaving the other 50% as available for energy recovery. This gave a total of 1.5 million tonnes by 2020. This could give a potential energy generation capacity of 150MWe. Again, as with MSW, assuming that only 35% of this is biodegradable would yield a renewable capacity of 53MWe.

There are two energy from waste facilities that have planning consent in the region that would process C&I waste. These are schemes that are not underpinned by an MSW contract from a local authority, but rather are "merchant" facilities that would charge a gate fee to take commercial waste from waste management. They are the two Energos gasification facilities, one in Bradford, and one in Doncaster (Kirk Sandhall energy recovery facility), which would process about 280,000 tonnes, and have an installed capacity of about 26MWe

In addition, there are proposals in planning for several other energy recovery facilities that could take up to 1 million tonnes per annum of C&I waste, namely:

- Skelton Grange energy recovery facility, on the site of a former power station, Leeds (300,000 tonnes per annum);
- Doncaster energy from waste project, next to Hatfield colliery (up to 400,000 tonnes per annum);
- Ferrybridge multi-fuel proposal, on the site of Ferrybridge power station (300,000 tonnes per annum).

This suggests that the potential for 150MWe (53MWe renewable) of energy from waste capacity from C&I waste could be deliverable by 2020, assuming that planning consent can be obtained for projects.

Figure 36 Huddersfield energy from waste plant in Kirklees (Source: © Copyright David Ward and licensed for reuse under this Creative Commons Licence, website accessed January 2011 www.geograph.org.uk/photo/489160)

5.12.4 Conclusions from energy from waste assessment

With a current installed capacity of 75MW_e in the region, energy from landfill gas represents the largest operational source of energy from waste and second only to wind power in terms of overall capacity. However, much of this plant is over 10 years old and the output is decreasing over time as the production of methane from the landfill sites tails off. Therefore, this technology is expected to make little if any contribution to any renewable energy targets by 2025.

Another well developed technology in the region is electricity generation from sewage gas, produced at sewage and waste water treatment works across the region. This current level of capacity is expected to remain through to 2025, and may increase slightly.

Energy production from the AD of food waste is a growing technology in the region. There are several facilities due to come on-line in the near future, taking commercial food waste as feedstock. There is the potential for developing several further facilities in the region. There is a role for local authorities to support this opportunity through the way they procure solutions to manage their biodegradable municipal waste. There is also a potential role for stakeholders in the region to provide support with extracting food waste from the general M&I waste stream. If the UK Government decides that C&I waste should fall under the Landfill Allowance Trading Scheme (LATS) this could provide a major boost for such AD facilities.

Although there are significant quantities of animal slurry available in the rural areas of the region, from pigs and cattle, most of the animal slurry, from livestock, is being spread back on the land in the region, and as such is displacing the use of inorganic fertiliser. It is not a problem waste that farmers are looking to get rid of. As a feedstock it does have the advantage of being homogenous, but has lower biogas yield than food waste and also does not attract gate fees as it does not fall under the animal byproducts directive (ABD). Therefore there do not appear to be strong enough drivers in place for this resource to be used for energy production at any significant scale.

Disposal of MSW is a statutory responsibility of local authorities and generally tied into long term management contracts. For residual MSW, only three out of the 15 WDAs in the region have the long term infrastructure in place to divert enough waste from landfill to meet their obligations. Some authorities, such as Kirklees, North East Lincolnshire and Sheffield, have modern waste infrastructure up and running, centred on recycling with energy recovery from residual waste. Kirklees, with its Energy from Waste incinerator in Huddersfield, which has been in operation since 2000, is considered to be a beacon authority in its waste management and energy practices. [33]

[33] State of the nation briefing: waste and resource management, ICE

The Sheffield energy recovery facility provides a (national) good example of how the overall efficiency and carbons savings from an energy recovery scheme can be maximised through supplying heat into a district heating network. The Newlincs energy recovery facility in North east Lincolnshire is a good example of a smaller scale recovery facility where the facility is co-located with an industrial heat user who can take heat from the facility as well as electricity being supplied into the grid.

For the remainder of the local authorities in the region, slow but steady progress is being made in securing new infrastructure for MSW, with authorities having to overcome procurement and planning issues. Two have contracts and are in the infrastructure planning/development stage, and 10 authorities are in procurement for their new residual waste infrastructure contracts.

It may be too late for to influence Waste Strategies which are at an advanced stage of preparation. However, a number of actions could be considered for those DPDs which are not yet complete:

- There is potential to use heat from energy from waste plants in the existing building stock and for industrial loads. A number of waste disposal contracts are due to be re-tendered in the short to medium term, such as the East Riding and Hull contract in 2013. The co-location of energy from waste facilities with major heat loads, and the opportunity to use district heating networks to make use of waste heat should be a key consideration within these contracts.
- The opportunity to partner with organisations that may have similar waste management and/or energy needs should also be considered.

In terms of C&I waste, no coherent strategy exists for commercial waste management in the region but the rising landfill tax escalator is pushing up the cost of landfill disposal and creating an incentive for investment in new privately funded infrastructure. This means that there may be several new energy recovery facilities coming on-line over the next few years taking C&I waste as their feedstock. A key opportunity for stakeholders in the region is to work to try to maximise the energy and carbon benefit of these schemes by having them "CHP enabled" so that they can supply low carbon heat into local heating networks as well as providing electricity into the grid.

The graph in below summarises the existing capacity for energy generation from waste in the region as well as the maximum potential resource by 2025. The capacity shown for MSW and C&I waste is for the biodegradable fraction only, and not the total installed generation capacity. This fraction is assumed to be 50% for currently operational facilities, and 35% for consented schemes and future potential by 2025. The landfill gas resource is assumed be zero by 2025.

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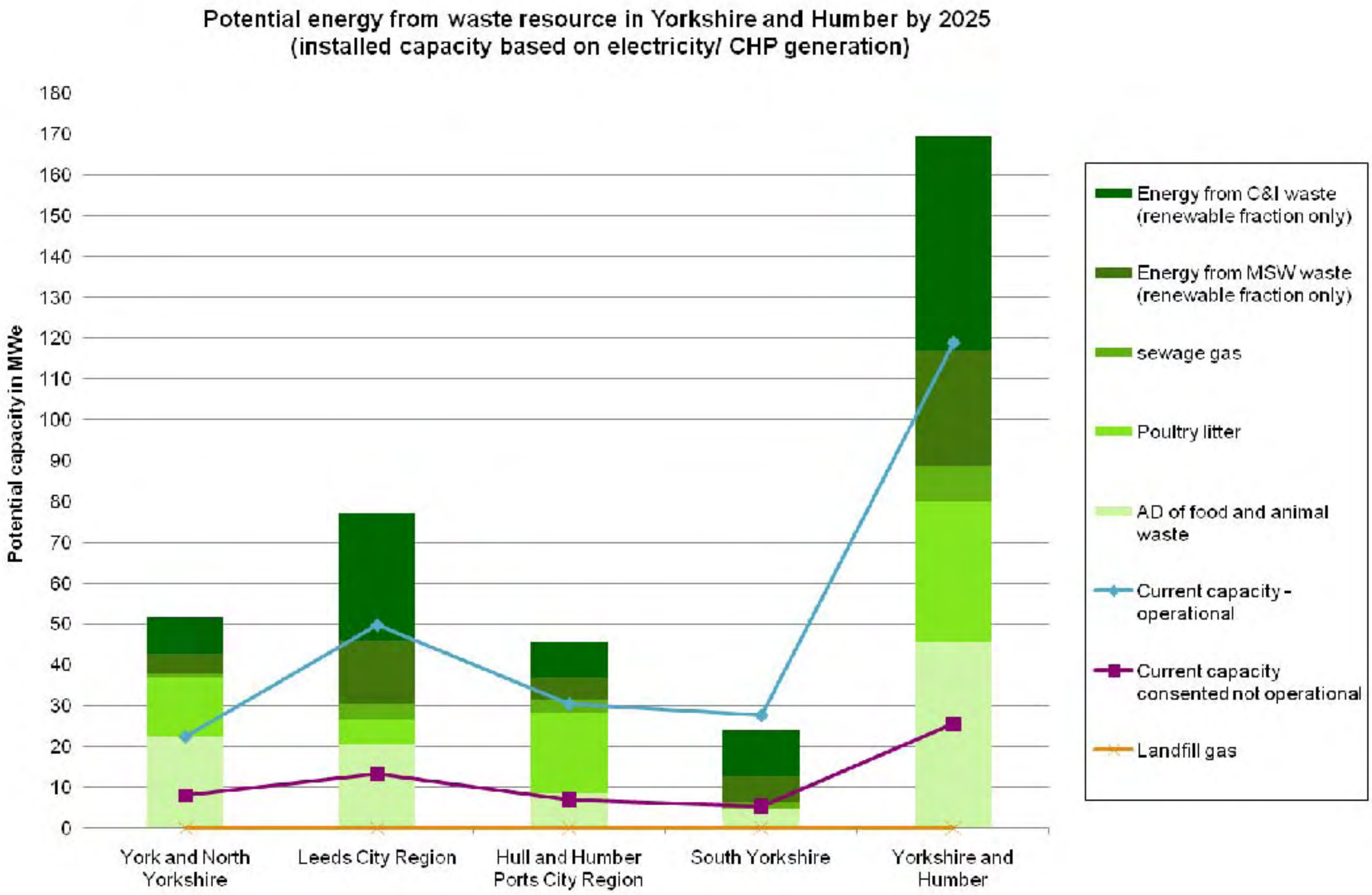

Figure 37 Energy from waste resource in Yorkshire and Humber, by sub region, in terms of potential installed electricity generation capacity in MW. The stacked columns illustrate the potential resource by 2025, whilst the lines show the current operational and consented capacity.

Capabilities on project:
Building Engineering - Sustainability

5.13 Microgeneration uptake

5.13.1 Introduction

The potential for energy generation from the solar resource, air source and ground source heat pumps and small scale wind turbines is presented in this section.

There are two main technologies that can directly exploit the solar resource. Solar photovoltaic panels (PV) use semi-conducting cells to convert sunlight into electricity. Solar water heating panels convert solar energy into stored heat and are used primarily to provide hot water. Solar water heating supplements and does not replace existing heating systems.

Air source heat pumps use the refrigeration cycle to extract low grade heat from the outside air and deliver it as higher grade heat to a building.

Ground source heat pump systems operate in a similar way by taking low grade heat from the ground and delivering it as higher grade heat to a building.

Small scale wind energy schemes have different characteristics to commercial scale wind farms. They can be freestanding or integrated into the design of buildings and are viable at lower wind speeds. They are typically installed as part of development and supply the on-site demand. Consequently, their viability is usually dependent on the number of buildings or sites rather than the amount of land available.

5.13.2 Existing microgeneration capacity

Most microgeneration schemes do not require planning permission and therefore there is no consistent way to monitor installations. This study has found, based on analysis of data from the Low Carbon Building programme (Energy Saving Trust), the feed-in-tariff (Ofgem) and consultation with stakeholders, that there was around 12 MW of microgeneration capacity (i.e. small scale wind, solar PV, solar thermal, heat pumps and biomass boilers) installed in the Yorkshire and Humber region as of 2010. About 60% of this is comprised of solar PV, installed in the last year presumably as a direct result of the recent introduction of the feed in tariff.

It is acknowledged that it has not been possible to capture details of every microgeneration installation in the region for this study. However, the level of installed capacity is so low that installations that have been missed will make a negligible difference to the overall resource identified.

5.13.3 Financial implications of microgeneration

There are two standard types of solar water heating collectors: flat plate and evacuated tube collectors. Generally, evacuated tubes are more expensive to manufacture and therefore purchase, but achieve higher efficiencies and are more flexible in terms of the locations they can be used. Recent advances in evacuated tube collector design have achieved near parity in terms of cost per unit of energy generated. Solar PV is eligible for the feed in tariff and solar water heating systems are eligible for the Renewable Heat Incentive.

There is a wide variation in costs for ground source heat pumps at the 20-100kW scale, principally due to differences in the cost of the ground works. The cost of the heat pumps themselves is also dependent on size as commercial systems are usually made up of multiple smaller units rather than a single heat pump. Due to these variations, heat pumps in the 20-100kW range are shown with an indicative cost of £1,000 per kW installed. A borehole ground source heat pump system is more costly due to a high drilling cost of £30 per metre. A typical 70m borehole provides 3-5kW of heat output, giving a drilling cost of £4200 for an 8kW system[34]

Air source heat pumps are around half the installed cost of ground source, albeit with a lower efficiency. For air source heat pumps, retrofit costs are slightly higher than new build to allow for increases in plumbing and electrical work.

Costs for a selection of small scale wind turbines are shown in Table 13. These are in the region of £1,267,000 per MW installed. These costs are based on an installed cost of £51,000 for one 15 kW turbine and include civil works for an average site.

Figure 38 Building mounted wind turbine at Dalby Visitor centre in Ryedale (Source: Green design at Dalby visitor centre case study, Forestry Commission, 2010)

[34] The Growth Potential for Microgeneration in England, Wales and Scotland (Element Energy for BERR, June 2008)

Technology	Solar water heating	Solar PV
Approximate size required	~4 m^2 per dwelling	~8 m^2 per dwelling
Total cost of system	£2,500 for new build homes (2 kW system) £5,000 for existing homes (2.8 kW system) £1,000/kW for new build non-domestic £1,600/kW for existing non-domestic	£5,500 for new build homes (1 kWp system) £6,000 for existing homes (1 kWp system) £4,500/kW for new build non-domestic £5,000/kW for existing non-domestic

Table 10 indicative costs for solar energy technologies. Costs are approximate and represent prices in 2009. (Source: AECOM modelling)

Technology	Air Source Heat Pump	Ground Source Heat Pump
Approximate size required	5 kW	5kW trench system for new build 11kW trench system for existing
Total cost of system	£5,000 for new build £7,000 for existing £500/kW for non domestic	£8,000 for new build £12,000 for existing £1,000/kW for non domestic

Table 11 Indicative costs of heat pumps (2007 costs). (Source: The Growth Potential for Microgeneration in England, Wales and Scotland, Element Energy for BERR, 2008)

Technology	Small scale biomass boiler
Approximate size required	8.8 kW for homes
Capital cost of system	£9,000 for new build homes £11,000 for existing homes

Table 12 indicative costs for biomass technologies. Costs are approximate and represent prices in 2009. (Source: AECOM modelling)

Turbine model	Rating (kW)	Cost
Proven 11	6 kW	£19,647
Proven 35-2	15 kW	£44,886
Proven 35	15 kW	£50,886
Sirocco Eoltec	6 kW	£18, 880

Table 13 Indicative prices of small wind turbines. Exchange rate of £1=1.18 EUR applied, based on exchange rates in November 2010. (Source: Proven Energy website http://www.provenenergy.co.uk/our_products.php and All Small Wind turbines website, http://www.allsmallwindturbines.com/, both accessed November 2010)

5.13.4 Potential microgeneration resource

The assessment of the likely uptake in microgeneration technologies has been driven by AECOM modelling as described in Appendix A.3. This study has found that there is the potential to exploit a range of microgeneration technologies across the region. The economically viable capacity for microgeneration technologies in Yorkshire and Humber is around 1,705 MW, equivalent to around 1,136 GWh annual energy generation, or the energy use of 75,700 homes. In most cases the potential is not spatially determined but is instead constrained by the size of the existing and future building stock. Urban centres such as Leeds, where there are numerous roofs to install solar arrays, have a particularly large resource.

The expected uptake of microgeneration technologies in the existing and new build stock is shown in Figure 40. The high take-up of renewable heat technologies depends heavily on the introduction of renewable heat incentive (RHI) (section 4.6.3). The modelling assumes that RHI is introduced in 2011, with the tariffs as published in the 2010 consultation.

Solar water heating

The economically viable capacity for solar water heating in the region is around 353 MW, equivalent to around 217 GWh annual energy generation, or the energy use of around 14,500 homes.

The RHI is specifically designed to provide lower rates of return for solar water heating than for other renewable heating technologies. But the model projects large numbers of solar water heating installations under these circumstances, more than installations of other technologies. This is because the choice model reflects consumer preferences for low capital costs independent of all but the fastest paybacks (very high discount rates), and for low maintenance. A slightly lower rate of return for solar water heating (the RHI consultation was based on 6% compared to 9% for other technologies) is less significant than the cost differences and low annual maintenance cost assumed.

Biomass

The economically viable capacity for biomass heating in the region is around 389MW, equivalent to around 1,021GWh annual energy generation, or the energy use of around 68,000 homes.

Woodchip boiler take-up is driven by the numbers of rural homes and non-domestic buildings and pellet boilers by urban homes. Districts with more rural homes and non-residential buildings will have proportionately higher forecasts for woodchip boiler take-up. Very large numbers of urban homes are needed before the model forecasts any take-up of pellet boilers. This is because pellet boilers have longer paybacks than wood chip boilers because of the higher fuel price for pellets.

Solar PV

The economically viable capacity for solar PV in the region is around 235MW, equivalent to around 206GWh annual energy generation, or the energy use of 13,700 homes.

The model assumes that solar PV is applicable to all buildings except flats. However, forecast uptake (numbers of installations) is typically much lower than the uptake of solar water heating. This difference in uptake reflects the aversion of private homeowners to high up-front costs: while long term returns are higher for PV, a PV system typically costs thousands of pounds more than fitting a solar hot water system to the same building.

Small scale wind

The economically viable capacity for small scale wind turbines in the region is around 26MW, equivalent to around 34 GWh annual energy generation, or the energy use of 2,200 homes.

Small scale wind turbine take-up is driven by the numbers of rural homes and buildings. Districts with more rural homes will have higher forecasts for micro-wind take-up. Districts with more rural non-residential buildings will have higher forecasts for small wind take-up.

Heat pumps

The economically viable capacity for heat pumps in the region is around 408MW, equivalent to around 679GWh annual energy generation, or the energy use of 45,000 homes. Only the renewable proportion of energy use of the heat pump has been accounted for in this resource assessment.

In deciding the applicability of technologies to each type of building, AECOM judged that heat pumps should not be considered generally applicable to pre-1980 homes. This is because older homes built to previous Building Regulations standards have higher heat demands, which would tend to make the installation of heat pump equipment impractical. As such, potential uptake is limited to the typically ~20% of post-1980 homes. Air source heat pump take up is initially very low because there are few post-1980 homes with primary heating systems more than 16 years old and being considered for replacement. Ground source heat pump uptake is even lower and is essentially zero because of the cost and disruption associated with digging up a garden to install heat exchange pipework.

Ground source heat pump uptake in new build development is comparatively high due to the potential for meeting carbon targets in new development.

5.13.5 Conclusions from microgeneration resource assessment

The potential for microgeneration technologies is very large, and is only limited in technical terms by the size of the existing building stock.

For the existing stock, the variation in forecast renewables take-up between districts depends entirely on the number and profile of homes and non-domestic buildings.

Figure 39 A PV installation at Sackville Street, Ravensthorpe, in Kirklees. (Source: Renewable Energy Initiatives In Kirklees, Kirklees Metropolitan Council, September 2005)

Our modelling predicts that a proportion of homeowners will fit microgeneration technologies either to replace primary heating systems or as discretionary installations. The number opting for renewable microgenerators increases as the financial case improves, e.g. as a result of feed in tariffs and the prospective renewable heat incentive. However, owner-occupiers and private landlords dislike making up-front investments to achieve future savings (i.e. their discount rate is high). Furthermore they prefer cheap options (low capital cost) to expensive options independent of rates of return over the long term. And finally, they are less likely to fit unfamiliar technologies that cause disruption and have ongoing maintenance costs. Social landlords and businesses are more willing to invest against future savings (their discount rate is lower than private homeowners).

The increased uptake of certain technologies in the existing stock may conflict with the desire to maintain the character of certain landscapes within the region, for example, conservation areas. Roof mounted technologies are likely to be the most concerning from a conservation perspective, though it should be noted that other roof-mounted objects such as TV aerials are allowable in conservation areas. Roof mounted microgeneration technologies that may be of concern include solar PV, solar thermal, flues associated with wood-burning stoves/boilers and CHP and building mounted wind turbines.

Planning should ensure that the volume of delivery and the positioning of technologies does not adversely affect the value of the conservation area as a whole. Where possible, roof mounted technologies should be placed so that they are not viewable from public realm. Solar panels and wind turbines can be installed in private gardens out of view of the public realm. Solar PV panels have now been developed that look similar to roof tiles and may be more attractive in areas of the region where aesthetics are important. At present these are up to £2,000/kW more expensive than conventional PV. [35]

In the new build stock, the main driver for increased contribution from microgeneration technologies is likely to be the progressive tightening of the Building Regulations, up to and including the introduction of the zero carbon requirement for homes in 2016 and for other buildings in 2019 (section 4.3). The role of regional, sub-regional and local bodies is therefore limited beyond specifying more stringent policy to achieve this. Setting planning policy targets for carbon reduction or for a minimum contribution from renewable or low carbon technologies would add to the complexity of the planning and development control process, with potentially little impact on generating capacity. Furthermore, planning policy targets of this nature would only have a short term impact, as they would effectively be superseded by the Building Regulations zero carbon requirement.

Post 2016, allowable solutions will place emphasis on local authorities to identify and support delivery of community scale solutions. It may therefore be more productive for regional and sub-regional bodies to begin to focus on identifying and

[35] The Growth Potential for Microgeneration in England, Wales and Scotland (Element Energy for BERR, June 2008)

delivering community scale energy opportunities which go beyond site boundaries, and obtaining an appropriate financial or delivery contribution from developers towards this.

A key finding, on discussion with the industry, is that a primary obstacle to the deployment of microgeneration technologies is the bureaucracy involved in accreditation of installers, meaning there is a tremendous shortfall in the industry's capacity to develop feed in tariff compliant schemes, even though they might be an attractive investment. The Renewable Heat Incentive is likely to result in a similar increase in the deployment of heat generating, microgeneration technologies such as biomass boilers and heat pumps and stakeholder consultation implies that installers in the region are unprepared for this increased demand.

Investors are increasingly looking at large PV arrays, known as PV farms. Recent moves to allow local authorities to receive payment from selling electricity have transformed the financial performance of medium to large municipal schemes – for example, a 2 MW local authority wind scheme that would previously have received an IRR of 3.6% will now achieve an IRR of around 10%. Tariffs are high enough to allow public bodies and housing associations, which can finance schemes relatively cheaply, to allow the electricity produced to be used free by tenants and still receive enough return from the tariff payments to make investment worthwhile. It should be noted that the attractiveness of such schemes may reduce after 2012, when the feed in tariff is likely to degress.

At commercial scale, the impact of such schemes, such as effect on visual amenity, must be carefully considered.

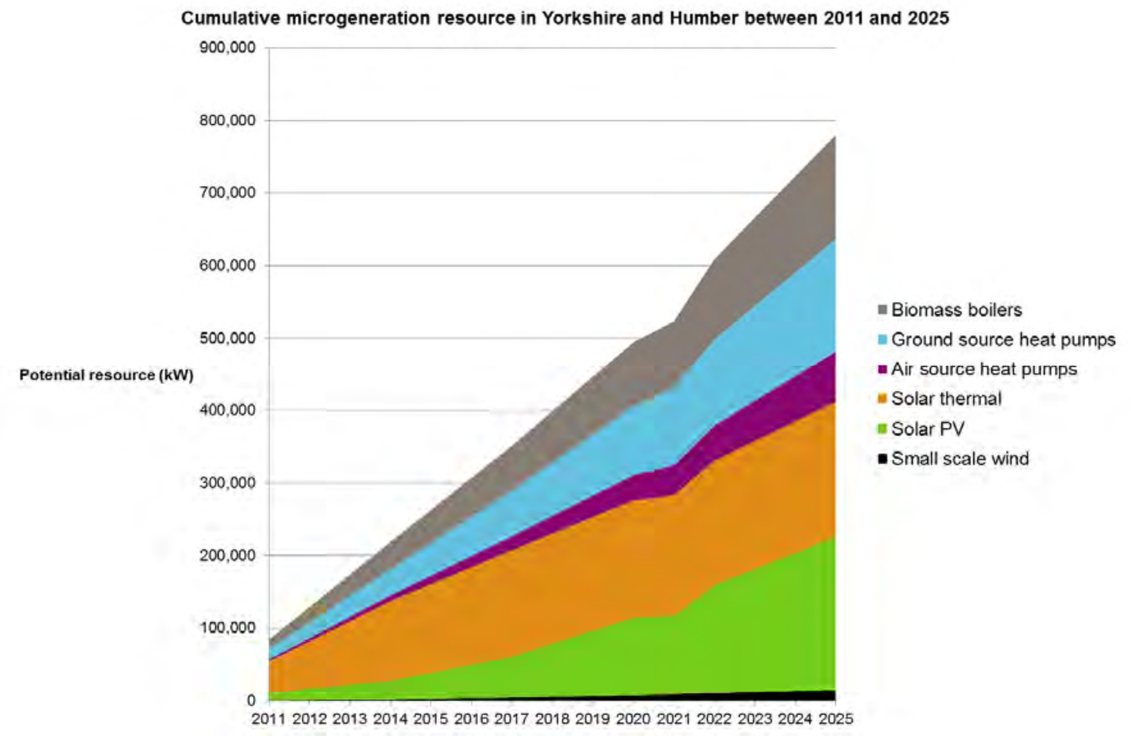

Figure 40 Cumulative microgeneration resource in Yorkshire and Humber between 2011 and 2025, in kW.

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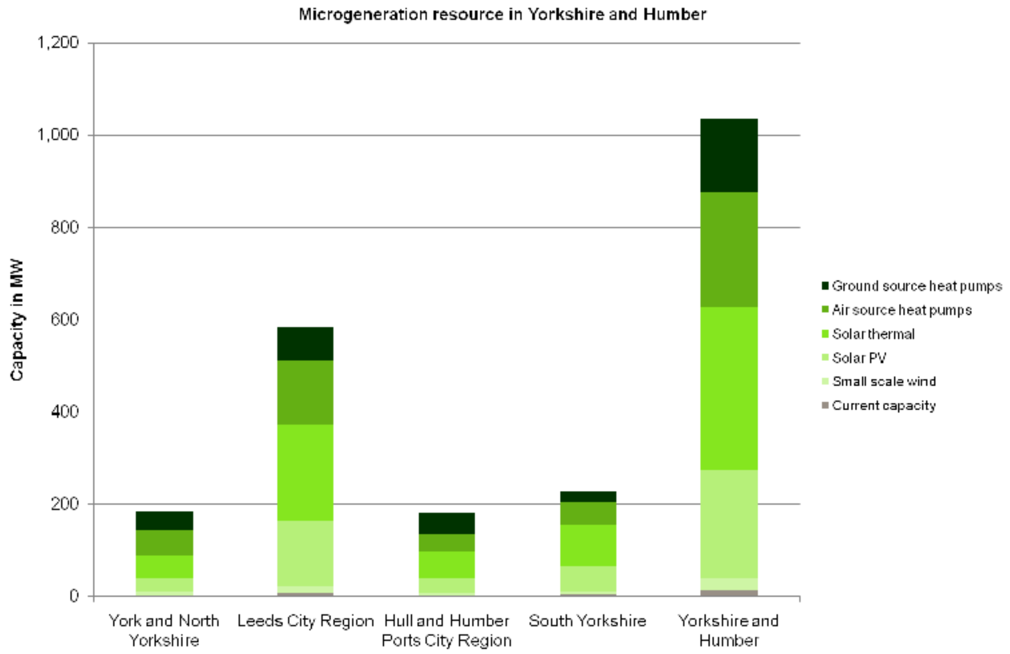


Figure 41 Microgeneration resource in Yorkshire and Humber, by sub region, in terms of potential MW. “Current” refers to facilities that are operational or have planning consent.

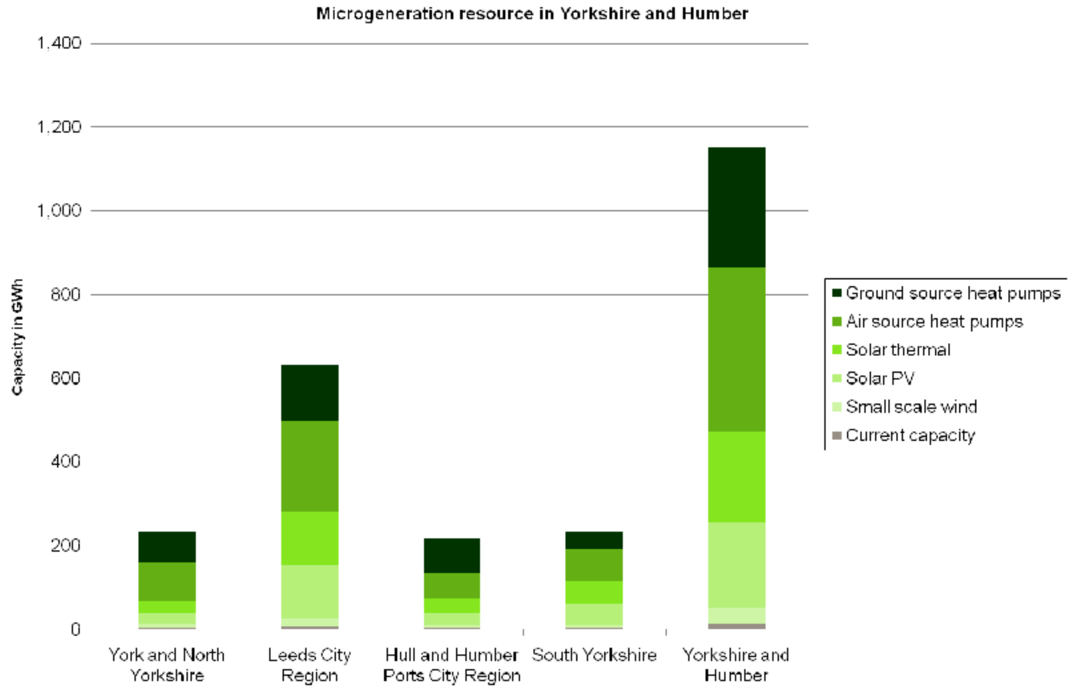


Figure 42 Microgeneration resource in Yorkshire and Humber, by sub region, in terms of annual energy generation in GWh. “Current” refers to facilities that are operational or have planning consent.

5.14 Energy Opportunities Plans

A set of Energy Opportunities Plans has been produced to act as spatial planning tools that will allow assessment and prioritisation of energy opportunities. They show the economically viable resource for those renewable energy technologies that are restricted by geographical constraints. They should assist in developing planning policies, targets and delivery mechanisms within the LDF process of local authorities, and can bring added benefit and support to regional and sub-regional strategy and policies and related corporate documents.

It should be emphasised that although the Energy Opportunities Plans provide an overview of potentially feasible technologies and systems within an area, they do not replace the need for site specific feasibility studies for proposed development sites.

The following information is shown on the Energy Opportunities Plans:

- Current fossil fuel power plants over 1MW (grey cross symbols).
- Current and proposed energy from waste plants over 1MW (black and blue lightning bolt symbols).
- Current and proposed wind farms over 1MW (purple circle symbols).
- Current and proposed biomass plants over 1MW (brown asterisk symbols). Sites where biofuels could be produced are not shown as assessment of these are outside the scope of the study.
- Current landfill sites (orange triangle symbols).
- Current CHP plants over 1MW (yellow star symbols).
- Current district heating or communal heating networks (red star symbols).
- Areas of woodland that could provide biomass (dark green shading).
- Areas of existing energy crop schemes that could provide biomass (brown shading).
- Areas where commercial scale wind turbines could be economically viable (purple shading).
- Areas where commercial scale wind turbines could be economically viable, but the size and scale of turbines may be restricted due to landscape sensitivity or environmental sensitivity concerns (purple, hatched shading).
- Areas with potential for hydropower (blue diamond symbols).
- Areas where there is sufficient heat demand from existing buildings to justify establishing a district heating network with CHP that could be economically viable (red, orange shading).
- Possible heat anchor loads, including public sector assets, leisure centres, schools and hospitals (dark green dot symbols).

Scenarios for energy generation

6 Scenarios for energy generation

Given the uncertainties when considering the timeframe between now and 2025, a scenario approach has been used to illustrate potential outcomes for the renewable energy mix across the region.

The objective of the scenario modelling was to ascertain the contribution that Yorkshire and Humber could make towards achieving the UK's 2020 renewable energy target.

6.1 Targets for renewable energy generation

The UK Government is committed to achieving the UK's renewable energy target by 2020. This requires that 15% of energy consumption (i.e. electricity use plus energy used for heating and cooling plus energy used for transport) should be generated from renewable sources.[36] The UK Renewable Energy Strategy[37] anticipates that renewables will need to contribute around 30% of electricity supply and 12% of heating energy (section 4.2.1). Excluding transport energy, delivering the 15% target equates to 19% of the UK's non-transport energy demand being met by renewables by 2020.

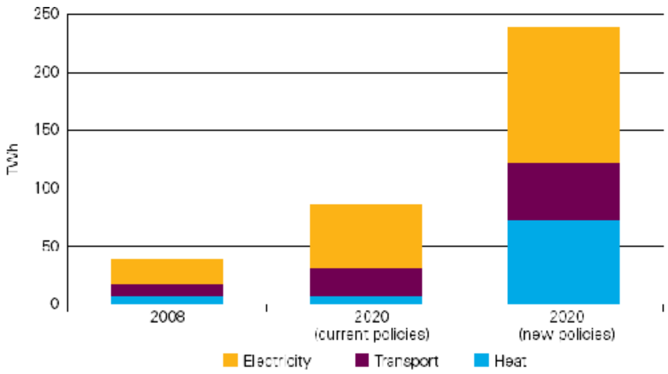


Figure 43 Potential scenario for the UK to reach 15% renewable energy by 2020 (Source: The UK Renewable Energy Strategy, DECC, July 2009)

6.2 Scenarios for energy demand

The first step was to build a picture of how energy demand might change in the region over the next 15-20 years. The DECC Pathways to 2050 study was used to examine the types of changes in energy demand that might be seen for three categories of end use, namely: lighting and appliances (domestic and commercial), industry and heating and cooling (domestic and commercial).[38] Trajectories were developed for the types of changes that might be seen in energy demand. These were designed to cover a broad range of possibilities but are illustrative and are not based on assumptions about future policy and its impacts.

Four energy demand scenarios were developed to represent baseline energy demand in the region in 2025. The modelling assumptions for each scenario are provided in Appendix A.6. The scenarios were as follows and are summarised Table 14.

1. Reference case. This represents the "Business as usual" situation. It assumes little or no attempt to decarbonise or change or only short run efforts; and that unproven low carbon technologies are not developed or deployed.
2. Ambitious but reasonable effort across all sectors to increase energy efficiency. This scenario describes what might be achieved by applying a level of effort that is likely to be viewed as ambitious but reasonable by most or all experts.
3. Very ambitious attempt to increase energy efficiency across all sectors. This describes what might be achieved by applying a very ambitious level of effort that is unlikely to happen without significant change from the current system. It assumes significant technological breakthroughs.
4. Large scale electrification of regulated energy use in the building sector.

Energy scenario	Heat demand (GWh/ yr)	Electricity demand (GWh/yr)	Total energy demand (GWh/yr)
1	84,088	36,727	122,514
2	47,490	34,403	107,311
3	48,858	30,234	103,576
4	32,344	37,371	107,481

Table 14 Projected energy demand (excluding transport) for Yorkshire and Humber in 2025 under each energy scenario.

[36] Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources, April 2009

[37] The UK Renewable Energy Strategy, DECC, July 2009

[38] 2050 Pathways Analysis, DECC, July 2010

The total energy demand is slightly higher than the sum of the heat and electricity demand, because it includes use of solid and liquid hydrocarbons for uses other than heating, such as for lighting and appliances, and for industry.

For each scenario, the mix of renewables that could meet in the region of 10-20% of non-transport energy demand was assessed based on the available resource for the region. Although the deadline for the target is 2020, we have modelled the potential renewable energy proportion of energy demand in 2025, to fit with the time frames of local authority local development frameworks.

Four illustrative pathways were then developed showing the mix of renewables that could be used to meet the UK renewables targets by 2025. These are described below and shown in detail in appendix A.6.7. 'Successful' pathways are those that achieve the target.

A. Pathway A illustrates a pathway with largely balanced effort across all types of resource, based on physical and technical ambition. In this pathway, there would be a concerted effort to maintain a moderate uptake of all renewables as well as district heating.

B. Pathway B looks at what would happen if the region achieved a deployment level of A plus a greater uptake of the potential for commercial scale wind energy generation.

C. Pathway C looks at what would happen if the region achieved a deployment level of A plus a greater uptake of the potential for biomass energy generation (covering wood waste, straw, energy crops, biomass co-firing, and dedicated biomass power stations fuelled by imported biomass).

D. Pathway D looks at what would happen if the region achieved a deployment level of C, plus a greater uptake of heat from renewable CHP (from biomass and energy from waste), as well as microgeneration.

6.3 Effect of co-firing

The following co-firing limits have been applied to the coal power stations in the region, based on information received from operators and in forward plans (Table 15). This would result in 5,058 GWh energy generated annually from biomass co-firing. This is taken to be the maximum potential for biomass co-firing in the region, although the proportion of this maximum which is realised various depending on the four pathways modelled.

Power station	Installed capacity by 2025 (MW)	Co-firing limit
Drax	3750	12.5%
Eggborough	1960	10%
Ferrybridge "C"	961.5	5%

Table 15 Co-firing limits applied to Yorkshire and Humber coal power stations for scenario modelling.

6.4 Effect of offshore technologies

6.4.1 Offshore wind

In December 2007, the UK government set out its ambition to expand offshore wind capacity, with up to 25GW of new offshore wind capacity to be installed by 2020 in addition to the 8GW already proposed.[39]

We have assumed an "ambitious but reasonable" effort occurs to increase the uptake offshore wind (as defined in the DECC Pathways to 2050 report), resulting in approximately 30 GW of capacity installed by 2025. This has been scaled down to fit the Yorkshire and Humber using population ratios, to estimate that around 2,600 MW of the total installed offshore wind capacity could be allocated to the Yorkshire and Humber region by 2025.

6.4.2 Wave and tidal stream technologies

In early 2010 the Government announced a vision for the marine energy sector in the future, and set out the key steps both industry and the Government will need to take to achieve mainstream deployment of wave and tidal stream energy around the UK's coasts by 2020/2030.

We have assumed an "ambitious but reasonable" effort occurs to increase the uptake of wave and tidal stream technologies.. This has been scaled down to fit the Yorkshire and Humber using population ratios, to estimate that 8 MW of the UK's installed wave capacity and 2 MW of the installed tidal stream capacity by 2025 could be allocated to the Yorkshire and Humber region.

6.4.3 Tidal range technologies

Most of the exploitable, tidal range resource in the UK is located down the west coast, though there are possible sites on the east coast in the Wash and at the Thames Estuary. The largest single site is the Severn Estuary, which could, if harnessed, generate 5% of UK electricity demand. Plans for a

[39] UK Offshore Energy SEA - Scoping for Environmental Report, BERR, December 2007

Severn estuary barrage tidal energy project were scrapped in response to the conclusions of the Severn Tidal Power Feasibility Study[40].

We have assumed that either the Mersey or Solway scheme comes to fruition by 2020, representing 400MW of installed capacity and consequently around 12 MW of the installed tidal range generation capacity could be allocated to the Yorkshire and Humber region by 2025.

6.4.4 Summary of effect of offshore technologies

If the potential contribution from offshore (and tidal barrage) renewables to the UK target is factored in, the proportion of UK non-transport energy demand that has to be met from onshore renewables to meet the 2020 target will be less than 19%.

As mentioned above, the potential offshore resource for the UK, when applied pro-rata to the Yorkshire and Humber region, amounts to a total potential annual energy generation of just over 8,000GWh. This would represent between 7-12% of the region's total non-transport energy demand by 2025, depending on which energy demand scenario is used.

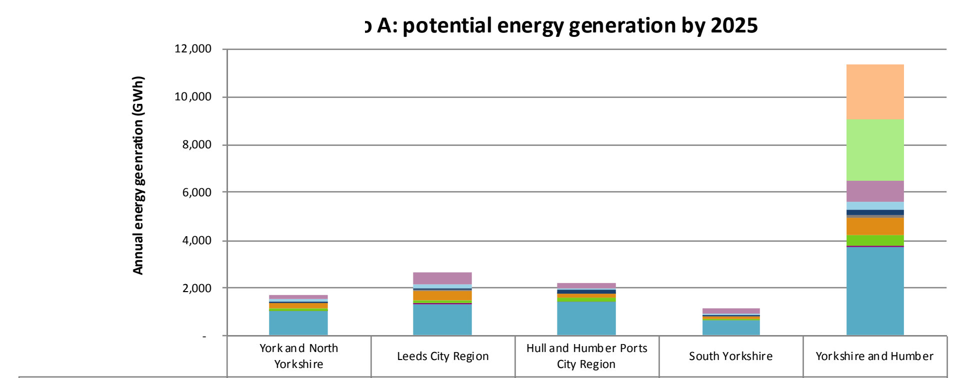
Therefore, to be in-line with UK targets, the region would need to meet up to 12% of its non-transport energy demand from on-shore renewables for energy demand scenario 1 (if offshore contributed 7%), and about 9% for energy demand scenarios 2 and 3.

[40] Severn Tidal Power Feasibility Study Conclusions and Summary Report, DECC, October 2010

Capabilities on project:
Building Engineering - Sustainability

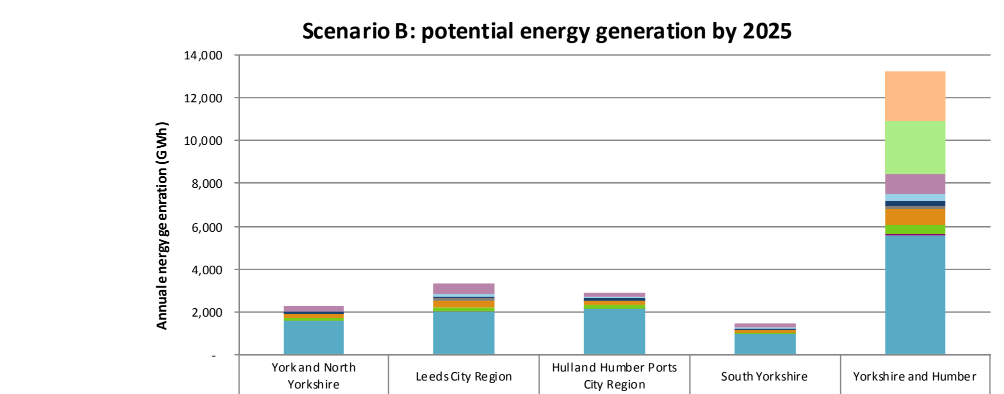
6.5 Results of scenario modelling

6.5.1 Results for all sub regions



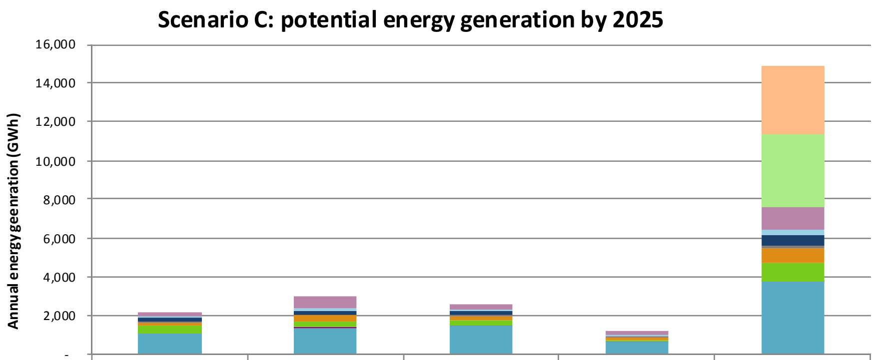
	York and North Yorkshire	Leeds City Region	Hull and Humber Ports City Region	South Yorkshire	Yorkshire and Humber
Imported dedicated biomass (elec)					2,293
Biomass co-firing (elec)					2,534
Microgen (heat)	195	488	207	183	926
Waste CHP (heat)	70	162	55	58	296
Biomass CHP (heat)	76	81	123	32	276
Microgen (elec)	16	63	16	25	106
Waste (elec)	178	359	160	122	706
Biomass (elec)	122	130	197	52	442
Hydro	17	34	0	5	44
Onshore wind	1,050	1,344	1,428	642	3,736
TOTALS	1,726	2,661	2,187	1,120	11,358

Figure 44 Effect on Yorkshire and Humber sub regions of scenario modelling of renewable energy Pathway A



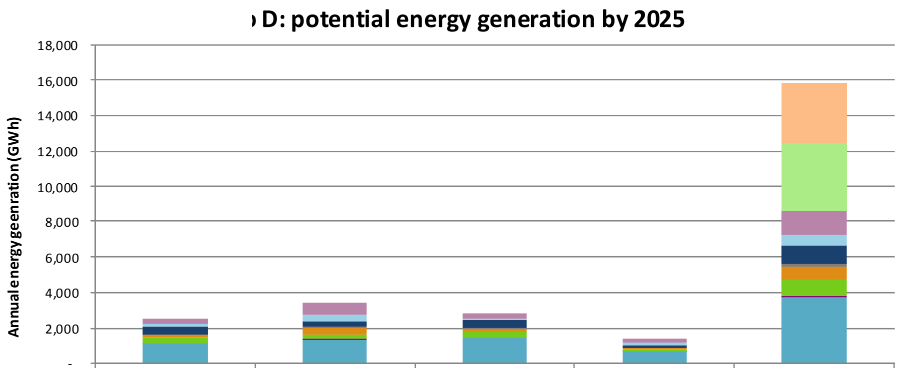
	York and North Yorkshire	Leeds City Region	Hull and Humber Ports City Region	South Yorkshire	Yorkshire and Humber
Imported dedicated biomass (elec)					2,293
Biomass co-firing (elec)					2,534
Microgen (heat)	195	488	207	183	926
Waste CHP (heat)	70	162	55	58	296
Biomass CHP (heat)	76	81	123	32	276
Microgen (elec)	20	73	20	28	123
Waste (elec)	178	359	160	122	706
Biomass (elec)	122	130	197	52	442
Hydro	17	34	0	5	44
Onshore wind	1,575	2,016	2,142	963	5,604
TOTALS	2,255	3,342	2,905	1,444	13,243

Figure 45 Effect on Yorkshire and Humber sub regions of scenario modelling of renewable energy Pathway B



	York and North Yorkshire	Leeds City Region	Hull and Humber Ports City Region	South Yorkshire	Yorkshire and Humber
Imported dedicated biomass (elec)					3,439
Biomass co-firing (elec)					3,801
Microgen (heat)	245	613	267	231	1,166
Waste CHP (heat)	70	162	55	58	296
Biomass CHP (heat)	221	160	218	56	561
Microgen (elec)	16	63	16	25	106
Waste (elec)	197	367	186	122	750
Biomass (elec)	371	266	355	93	927
Hydro	17	34	0	5	44
Onshore wind	1,050	1,344	1,428	642	3,736
TOTALS	2,186	3,009	2,524	1,233	14,826

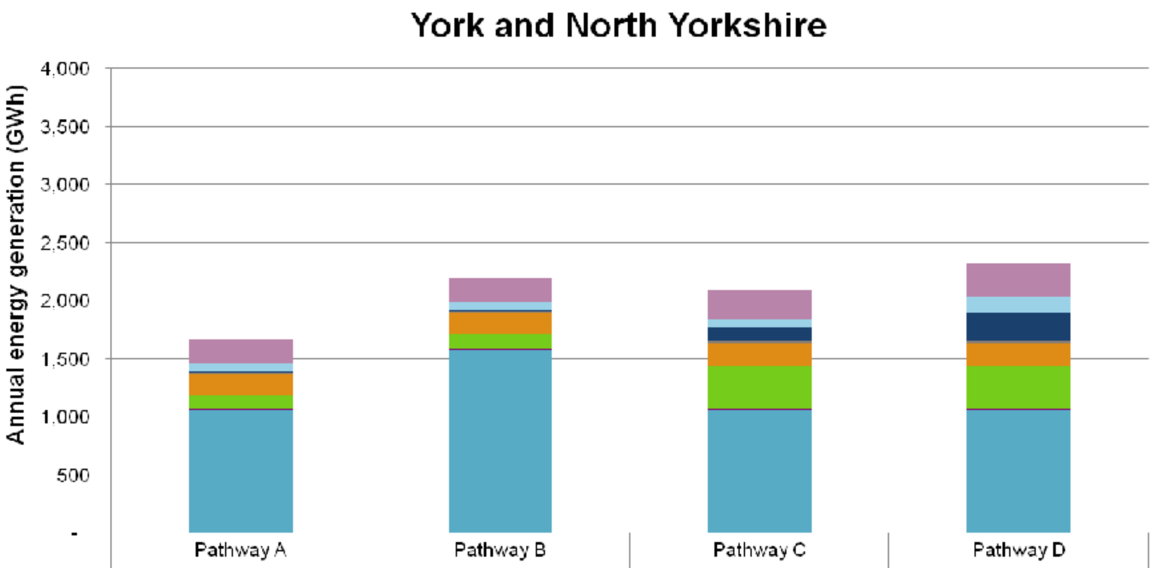
Figure 46 Effect on Yorkshire and Humber sub regions of scenario modelling of renewable energy Pathway C



	York and North Yorkshire	Leeds City Region	Hull and Humber Ports City Region	South Yorkshire	Yorkshire and Humber
Imported dedicated biomass (elec)					3,439
Biomass co-firing (elec)					3,801
Microgen (heat)	278	710	304	269	1,346
Waste CHP (heat)	140	323	109	117	593
Biomass CHP (heat)	442	321	436	113	1,122
Microgen (elec)	16	63	16	25	106
Waste (elec)	197	367	186	122	750
Biomass (elec)	371	266	355	93	927
Hydro	17	34	0	5	44
Onshore wind	1,050	1,344	1,428	642	3,736
TOTALS	2,510	3,428	2,835	1,385	15,864

Figure 47 Effect on Yorkshire and Humber sub regions of scenario modelling of renewable energy Pathway D

6.5.2 Results for the York and North Yorkshire sub-region



	Pathway A	Pathway B	Pathway C	Pathway D
Imported dedicated biomass (elec)	-	-	-	-
Biomass co-firing (elec)	-	-	-	-
Microgen (heat)	202	202	255	288
Waste CHP (heat)	70	70	70	140
Biomass CHP (heat)	10	10	122	243
Microgen (elec)	16	20	16	16
Waste (elec)	178	178	197	197
Biomass (elec)	122	122	371	371
Hydro	17	17	17	17
Onshore wind	1,050	1,575	1,050	1,050
TOTAL	1,666	2,195	2,097	2,322

Figure 48 Effect of scenario modelling of renewable energy pathways on York and North Yorkshire resource in 2025.

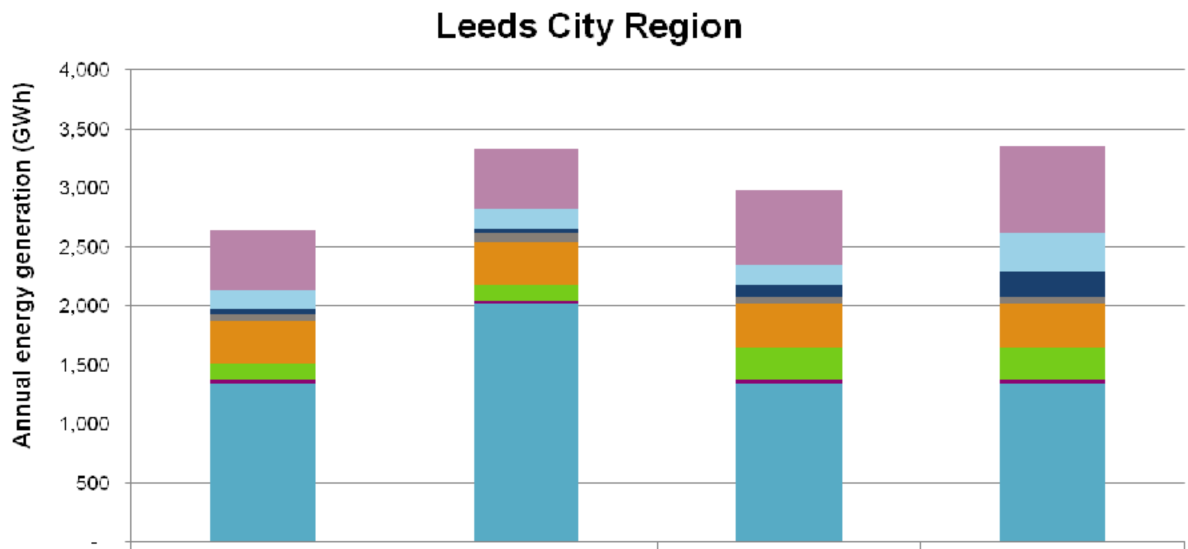
Energy scenario	Heat demand (GWh/ yr)	Electricity demand (GWh/yr)	Total energy demand (GWh/yr)
1	11,233	4,906	16,367
2	6,344	4,596	14,336
3	6,527	4,039	13,837
4	4,321	4,992	14,358

Table 16 Energy demand scenarios for York and North Yorkshire in 2025.

Figure 48 shows that the most successful pathways are D (effort to increase renewable heat uptake) followed by B (effort to increase commercial wind energy).

If it is assumed that offshore wind and marine technologies will contribute towards renewable energy targets, then all pathways are successful in achieving the resultant 12% generation target, except for the “equal effort” Pathway A under a “Business as usual” scenario. This implies that some level of energy efficiency is likely to be necessary to meet targets.

6.5.3 Results for Leeds city region



	Pathway A	Pathway B	Pathway C	Pathway D
Imported dedicated biomass (elec)	-	-	-	-
Biomass co-firing (elec)	-	-	-	-
Microgen (heat)	505	505	638	735
Waste CHP (heat)	162	162	162	323
Biomass CHP (heat)	46	46	107	214
Microgen (elec)	63	73	63	63
Waste (elec)	359	359	367	367
Biomass (elec)	130	130	266	266
Hydro	34	34	34	34
Onshore wind	1,344	2,016	1,344	1,344
TOTAL	2,642	3,323	2,981	3,346

Figure 49 Effect of scenario modelling of renewable energy pathways on Leeds City region resource in 2025.

Energy scenario	Heat demand (GWh/ yr)	Electricity demand (GWh/yr)	Total energy demand (GWh/yr)
1	38,311	16,733	55,818
2	21,637	15,674	48,892
3	22,260	13,775	47,190
4	14,736	17,026	48,969

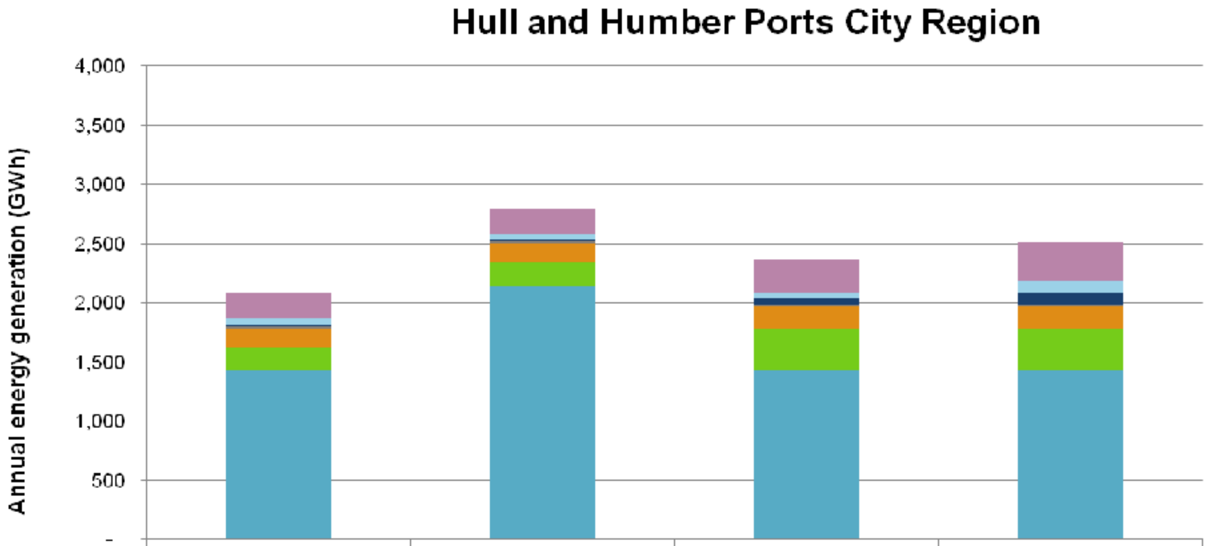
Table 17 Energy demand scenarios for the Leeds City region in 2025.

Due to the greater renewable energy resource in the Leeds City Region, all pathways are successful in achieving the 12% renewable energy target under all energy scenarios (including a contribution from offshore and marine technologies).

Heat generating microgeneration technologies are likely to be extremely important in achieving targets.

With a significant increase in energy efficiency (Energy Demand Scenario 3) and an effort to push onshore, commercial scale wind, the sub region could generate up to 24% of energy consumption from onshore renewable energy.

6.5.4 Results for the Hull and Humber Ports sub region



	Pathway A	Pathway B	Pathway C	Pathway D
Imported dedicated biomass (elec)	-	-	-	-
Biomass co-firing (elec)	-	-	-	-
Microgen (heat)	215	215	279	316
Waste CHP (heat)	55	55	55	109
Biomass CHP (heat)	11	11	49	98
Microgen (elec)	16	20	16	16
Waste (elec)	160	160	186	186
Biomass (elec)	197	197	355	355
Hydro	0	0	0	0
Onshore wind	1,428	2,142	1,428	1,428
TOTAL	2,083	2,800	2,367	2,509

Figure 50 Effect of scenario modelling of renewable energy pathways on Hull and Humber Ports resource in 2025.

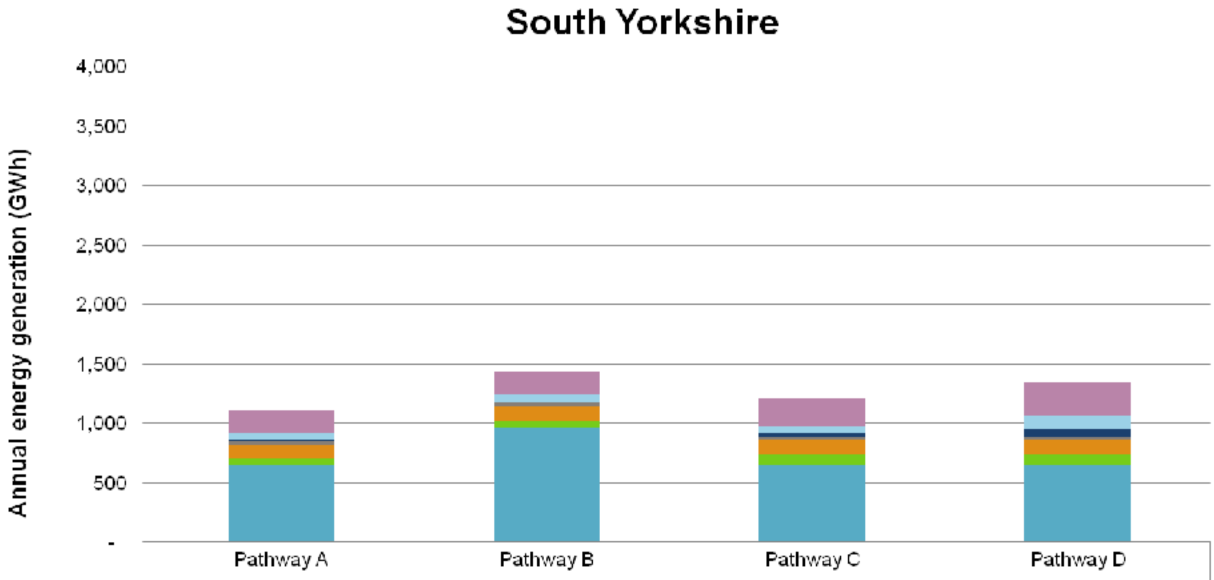
Energy scenario	Heat demand (GWh/ yr)	Electricity demand (GWh/yr)	Total energy demand (GWh/yr)
1	27,061	11,820	39,428
2	15,283	11,072	34,535
3	15,724	9,730	33,333
4	10,409	12,027	34,590

Table 18 Energy demand scenarios for the Hull and Humber Ports sub region in 2025.

Figure 50 shows that if it is assumed that offshore wind and marine technologies will contribute towards renewable energy targets, then all pathways are successful in achieving the resultant 12% generation target, although the “equal effort” Pathway A is only just successful under a “Business as usual” scenario. This implies that some level of energy efficiency is likely to be necessary to meet targets.

Commercial scale wind energy is likely to be extremely important in achieving targets.

6.5.5 Results for the South Yorkshire sub region



	Pathway A	Pathway B	Pathway C	Pathway D
Imported dedicated biomass (elec)	-	-	-	-
Biomass co-firing (elec)	-	-	-	-
Microgen (heat)	190	190	241	278
Waste CHP (heat)	58	58	58	117
Biomass CHP (heat)	16	16	32	63
Microgen (elec)	25	28	25	25
Waste (elec)	122	122	122	122
Biomass (elec)	52	52	93	93
Hydro	5	5	5	5
Onshore wind	642	963	642	642
TOTAL	1,110	1,434	1,218	1,345

Figure 51 Effect of scenario modelling of renewable energy pathways on South Yorkshire resource in 2025.

Energy scenario	Heat demand (GWh/ yr)	Electricity demand (GWh/yr)	Total energy demand (GWh/yr)
1	17,758	7,756	25,873
2	10,029	7,265	22,663
3	10,318	6,385	21,874
4	6,830	7,892	22,698

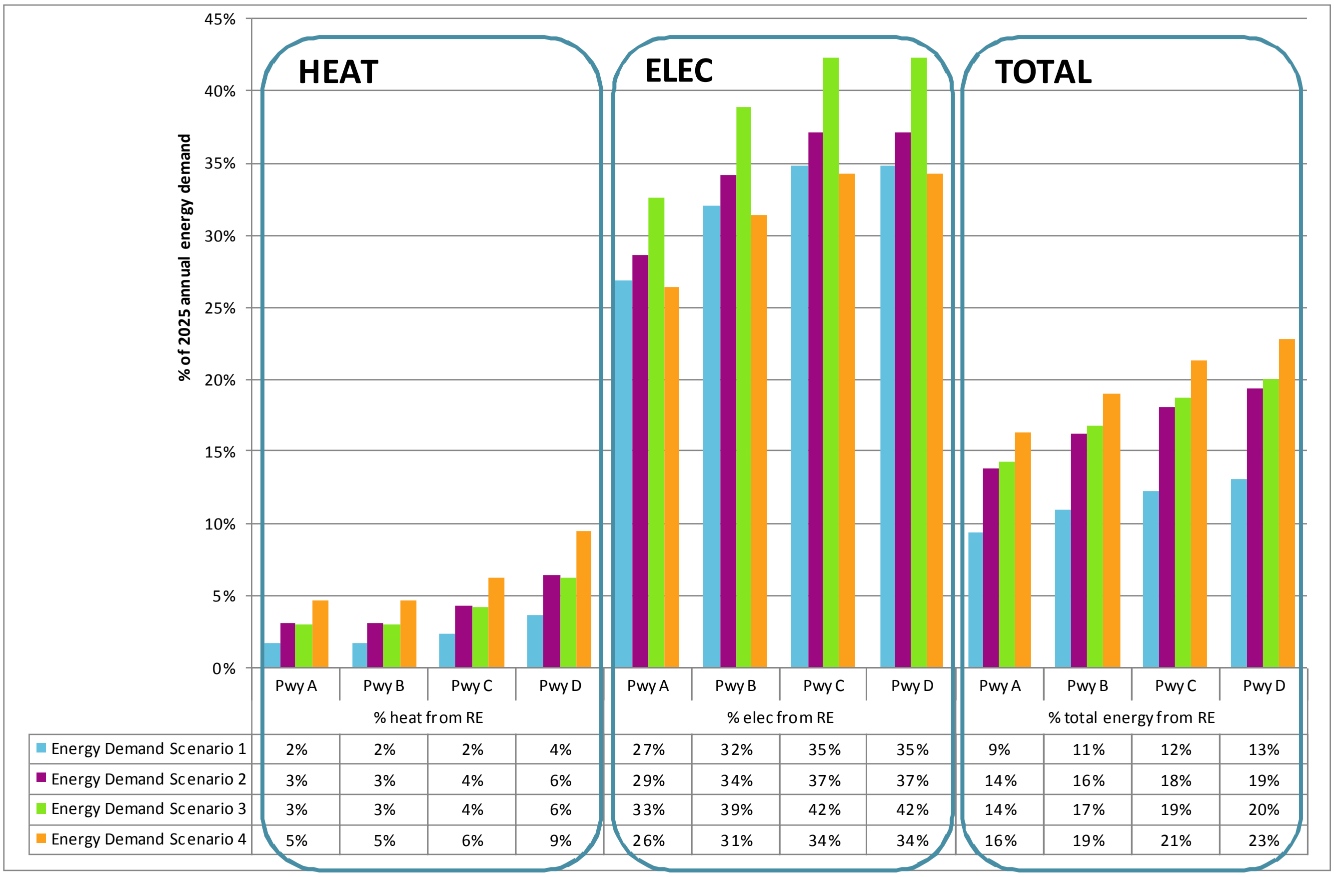
Table 19 Energy demand scenarios for the South Yorkshire sub region in 2025.

As the sub region with the lowest renewable energy resource, it will be extremely difficult for South Yorkshire to meet renewable energy targets.

Figure 51 suggests that none of the pathways will be successful in meeting targets, even with a dramatic increase in energy efficiency.

The results suggest that the sub region could achieve up to 10% of energy demand generated by onshore renewables. This could take place under Pathway B (high levels of onshore, commercial wind).

6.5.6 Overall results



	Pwy A	Pwy B	Pwy C	Pwy D	Pwy A	Pwy B	Pwy C	Pwy D	Pwy A	Pwy B	Pwy C	Pwy D
	% heat from RE				% elec from RE				% total energy from RE			
Energy Demand Scenario 1	2%	2%	2%	4%	27%	32%	35%	35%	9%	11%	12%	13%
Energy Demand Scenario 2	3%	3%	4%	6%	29%	34%	37%	37%	14%	16%	18%	19%
Energy Demand Scenario 3	3%	3%	4%	6%	33%	39%	42%	42%	14%	17%	19%	20%
Energy Demand Scenario 4	5%	5%	6%	9%	26%	31%	34%	34%	16%	19%	21%	23%

Figure 52 Options for achieving renewable energy targets in Yorkshire and Humber.

Figure 52 shows that in terms of renewable heat; all the pathways are unsuccessful. It is likely to be a major challenge for the region to generate 12% of its heat demand from renewable energy, as is thought to be necessary to meet UK renewable energy targets. The best performing pathway in terms of heat occurs under pathway D, which represents a major effort to deploy heating from microgeneration as well as securing heat from renewable CHP to meet domestic, commercial and industrial heat loads via heating networks.

In contrast, there are several pathways that could allow the region to meet 30% or more of electricity demand from renewable sources.

In terms of the overall UK renewable energy target, then, for energy demand scenario 1, only pathways C and D could meet the level of onshore deployment required (12%), after the offshore contribution is factored in. Under energy demand scenario 2, all of the pathways could deliver the required onshore deployment.

6.6 Conclusions from scenario modelling

The above analysis suggests that as part of a "no regrets" strategy, the region and sub regions should focus on the following approaches to help deliver their share of onshore renewable energy deployment:

- Actions to maximise energy reduction and efficiency, to move towards energy demand scenarios 2 or 3 rather than the "business as usual" scenario 1.
- Actions to facilitate greater deployment of renewable heat technologies, including from CHP, by maximising use of the biomass resource, as well as biomass co-firing.

Strategic barriers and opportunities

7 Strategic barriers and opportunities

Developing the knowledge and the understanding of the potential for renewable energy is only the first step in the process. Building from this understanding, a strategy needs to be developed to identify key partners and approaches to deliver the potential of the region.

This chapter describes the opportunities and barriers surrounding delivery of the renewable and low carbon energy opportunities identified in the Energy Opportunities Maps.

7.1 Delivering at the right scale

This study has considered the defined region of Yorkshire and Humber, and the four sub-regions within it. While the regional level no longer has a governmental role, there are a range of resources and a variety of collaboration that occurs at both a regional and sub-regional level.

The map shown in Figure 53 shows the four sub-regions within the Yorkshire and Humber regional boundary considered by this study. Sheffield City Region also includes local authority areas that are within the East Midlands regional area, and have not been considered specifically in this study. Sub-regions have unique environmental and economic characteristics as well as a level of coordination and partnership already in operation. Hence, sub-regions have the ability to both recognise their collective potential, but to share resources to deliver opportunities in priority areas.

Increasingly, local authorities and communities will take a central role in leading initiatives and installing renewable technologies. However, it is recommended that a number of actions are coordinated at a regional or sub-regional level, to ensure:

- Cross-boundary issues and opportunities for renewable energy are recognised, with a consistent approach being taken spatially where similarities exist across neighbouring authorities. For example, a consistent approach to cumulative effects of wind energy on landscape value would be valuable across the region.
- Policies and targets should be coordinated on a broad scale to ensure that the areas that show the greatest potential for renewable energy are supported through targeted local policy that builds from the evidence base.

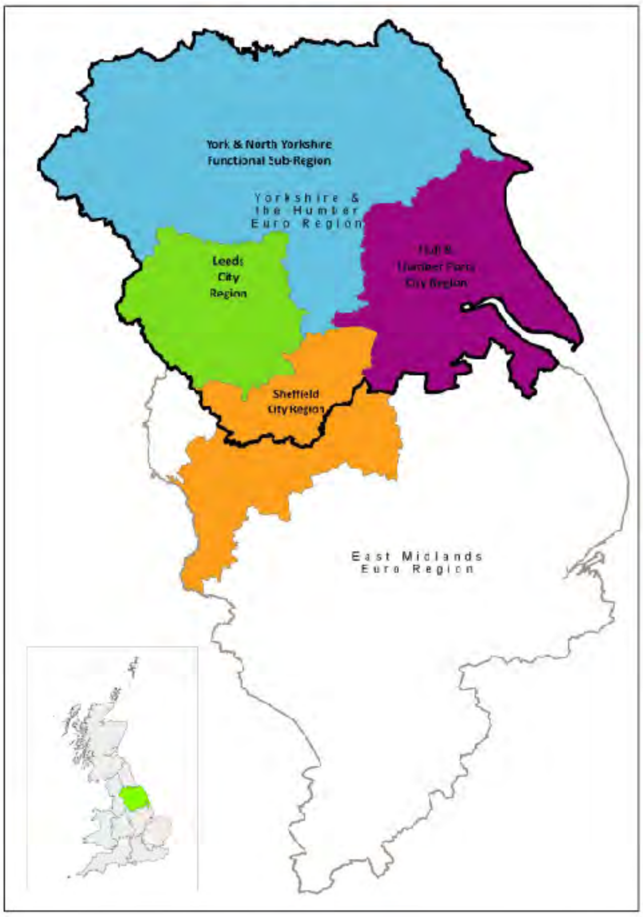


Figure 53 Location of the four functional sub-regions in Yorkshire and Humber

7.2 Delivery partners

It is clear that a collaborative and planned approach is necessary, with local targets complemented by spatial and infrastructure planning. Success will depend on coordination between planners, other local authority departments (including the corporate level), local strategic partners, local communities and various bodies who operate at a regional or national level.

There are a range of partners active in the Yorkshire and Humber region, and it will be important to harness these resources and partnerships to drive forward action and ensure activity is coordinated and cost-efficient. The table below includes a list of key partners and their current scale of operation.

Key Partner	Scale of Operation
21 Local Authorities in the region	Local
North York Moors, Yorkshire Dales and Peak District National Parks	Sub-Regional
Parish Councils and Neighbourhood Authorities	Local
Communities and Co-operatives	Local
Businesses	Local
Local Strategic Partnerships	Local
Private Sector Liaison Groups	Local
Local Enterprise Partnerships	Local / Sub-Regional
Housebuilders / Developers	Local / Sub-Regional / National
Energy Service Providers (ESCo) / Utility Providers	Local / Sub-Regional
Climate Change Skills Fund Facilitators	Regional
Yorkshire Forward	Regional
CO_2 Sense Yorkshire	Regional
Yorkshire & Humber Microgeneration Partnership	Regional
Energy Developers	National
Carbon Trust	National
Energy Saving Trust	National
Finance Institutions	National

Table 20 Key partners and their scale of operation

7.3 Strategic barriers

The following present strategic barriers to delivery of renewable energy in the region. These have been identified through consultation with local stakeholders.

1. *Limited resource* - The scenario modelling has shown that the onshore, economically viable renewable energy resource is limited in comparison to regional energy demand (section 6).

   Planning policy and delivery mechanisms can focus on driving uptake of on-site microgeneration as high as possible in new and existing buildings to supplement the region's limited off-site capacity, perhaps to standards beyond those required by the Building Regulations.

2. *Fatigue* – Some areas of the region have delivered relatively high levels of renewable energy in recent years, and there is a level of fatigue evident in both stakeholders and local communities in those areas feeling that they have contributed enough. It will be important to maintain local drive and enthusiasm but also to ensure delivery is in priority areas where the potential is the greatest.

3. *Political Opposition* – Related to the previous point, is the formation of significant levels of political opposition to some renewable energy technologies in areas of the region. Education and awareness activities will play an important role in changing views and creating a positive local reputation for renewable energy.

4. *Lack of Coordination* – While there has been a level of coordination from the regional level, with the abolishment of the RSS and the associated governance bodies, this coordination within and between sub-regions will need to be fostered through active local partnership.

5. *Protecting Natural Assets* – Yorkshire and Humber contains some very important landscape and biodiversity assets that will need to be protected from potential impacts associated with renewable energy infrastructure. A consistent approach is needed across the region to protecting key assets like the North York Moors and Yorkshire Dales National Parks, but also managing cumulative impacts on treasured rural landscapes.

6. *Technical Uncertainty* – Some renewable technologies are still in development, and hence there is a high level of risk and cost associated with their delivery. Partnerships in research and development in the region could aid trialling and confidence in emerging technologies.

7. *Biomass Fuel Supply* – While there are a number of biomass resources available in the region these need

to be coordinated, processed and supplied locally to ensure biomass can be substituted for fossil fuels as a low carbon fuel.

8. *Supporting Infrastructure* – Delivery of renewable energy also requires the distribution infrastructure to support it. There are constraints to grid capacity and connections in some areas of the region. The use of renewable heat technologies is also constrained through the lack of delivery of heat networks.

9. *Financial Barriers* – The high capital cost, low operational cost, nature of many renewable energy technologies means they require significant up-front capital investment. Securing sufficient finance can however be difficult, particularly for smaller sized schemes.

10. *Renewable energy targets* – Absence of targets in local, structure and unitary development plans mean there is no consequence for local authorities when renewable energy schemes are rejected.

11. *Viability Concerns* – While the RSS enforced a target of 10% renewable energy on new development sites, local authorities have expressed concern in raising local targets above that level due to possible impacts on viability in constrained housing markets. These viability concerns can be tested through analysis of suitable targets in a localised study, possibly at a housing market area scale. In the absence of local authority wide target for new development, specific targets can be set for strategic sites, where targets can be tested through a site-wide energy strategy.

12. *Mature LDF Development* – As shown in the diagram below (Figure 54), most authorities in the region have significantly progressed their Core Strategies towards adoption. Accordingly, the direct opportunity for the inclusion of progressive and consistent localised targets and policies for renewable energy may have passed in some cases. However, opportunities can be explored to include strong policies in LDFs still in Development Plan Documents and in Area Action Plans, Supplementary Planning Documents and development briefs.

13. *Housing targets* – Some of the opportunities for renewable energy generation will need be delivered in association with new development. The revocation of the RSS has introduced considerable uncertainty over the number of new homes that will come forward across the region. This will affect the opportunities for initiating community schemes through new development, or for increasing microgeneration capacity as a result of Building Regulations requirements.

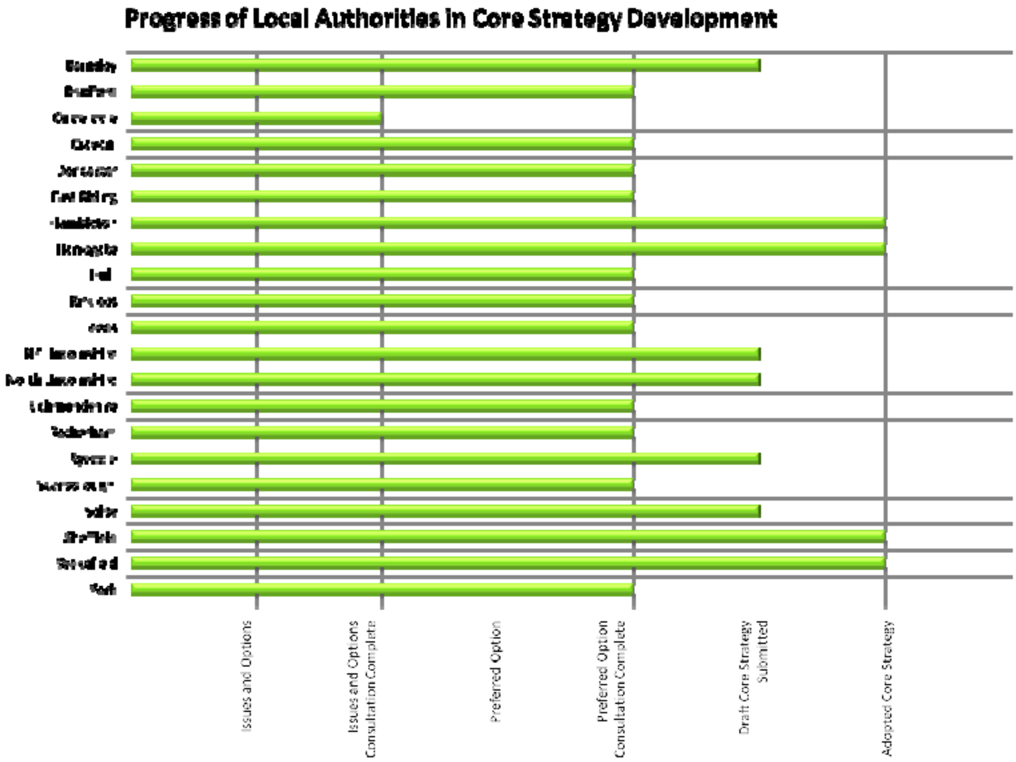


Figure 54 Relative progress in LDF development for local authorities in the Yorkshire and Humber region.

7.4 Strategic opportunities

The following present current opportunities for renewable and low carbon energy development in the Yorkshire and Humber region. These are overarching opportunities that should be coordinated and delivered across the region, with action being led at a sub-regional or local level.

1. *Experience with Technologies* – Across the region, there has been significant delivery of a variety of types of renewable energy on a large scale, including wind energy, hydro installations, district heating networks and biomass energy initiatives. The scale of delivery thus far gives the region a wealth of knowledge that will enable the region to keep delivering and to demonstrate that both technical and financial barriers can be overcome. There is a need utilise local experience and maintain region-wide networks that share knowledge and best practice.
2. *Variety and Security* – Compared to the installed capacity, Yorkshire and Humber as a region has a wealth of potential for renewable energy, and the options available are also varied in nature. With a mixture of both open rural land and dense urban centres, a range of technologies are deliverable in the area. This means that significant advances can be made in renewable energy delivery, with different partners concentrating on different priorities.
3. *Community Involvement* – Building on the localism agenda but also on the recent success of community cooperatives, local communities are becoming a key delivery partner for renewable energy. Community delivery guarantees that the economic benefits of renewable energy will be seen locally, and also helps to foster local support for renewable energy installations where the benefits are clear.
4. *Local Production* – Renewable energy delivery could also have significant local economic benefits, if production and supply chains can be created in the region. With guaranteed delivery, the region could

become a hub for production, simultaneously reducing the cost of renewables and providing local jobs and knowledge development.

5. *Redevelopment of Brownfield Land* – Integration of renewable energy as part of regeneration plans in existing areas should be encouraged and facilitated by planning authorities.
6. *Using Growth as a Driver* – Significant new development and housing growth is expected in parts of the region, with some of that growth being delivered as large urban extensions or new settlements which are of a scale that they can fund and drive significant installations of renewable energy. As carbon reduction requirements for new development become more challenging through proposed changes to Building Regulations, on-site renewable energy will become common-place. Larger developments may find it more cost-effective to invest in larger installations such as district heating or wind energy, and these initiatives can be used to drive wider decentralised schemes in the local area.
7. *Coordinating New Development Contributions* – New development will also begin to generate local funding for renewable energy schemes in the form of 'Allowable Solutions'. It will also be possible to utilise the Community Infrastructure Levy (CIL) to contribute towards local renewable energy schemes. It will be essential to develop a coordinated approach to allocating funding to priority projects. There may be opportunities to utilise sub-regional partnerships to identify and prioritise opportunities.
8. *Integrating Financial Support* – A number of new support mechanisms could have a decisive impact on commercial viability of many renewable energy projects. These include the Feed-In Tariff, Renewables Obligation, Renewable Heat Incentive, and a range of national capital grant programmes. Resources will be needed across the region to identify and coordinate funding bids.
9. *Revolving Renewable Energy Funds* – Kirklees Metropolitan Council already has a successful revolving renewable energy fund scheme in operation, which other local authorities in the area could use as a model. This provides seed-funding for renewable projects and then reinvests income into further schemes.
10. *ESCos and Local Delivery Vehicles* – Delivery can be greatly assisted through the establishment of a focussed delivery vehicle. These can be private delivery vehicles or Energy Service Companies (ESCOs) or there is an opportunities for Local Authorities or partners to set up a delivery vehicle. The skills needed to do this will likely need development, but this is not an insurmountable barrier. A growing number of local authorities are engaging in similar activities in energy as well as other areas. The key to success is likely to be leadership: from senior local authority management or, at least initially, from committed individuals in planning or other departments. Delivery vehicle models range from fully public, through partnerships between public, private and community sectors to fully private. In general, the greater the involvement of third parties, the lower the risk to the authority, but importantly, the less control the authority will have. Whichever model is chosen, putting the delivery vehicle in place as early as possible is important. This ensures that technical and financial requirements can be understood prior to negotiations with potential customers.
11. *Local Energy Planning* – A number of councils, including Harrogate, Kirklees, Calderdale, East Riding and Hull, have developed local energy planning studies where opportunities for renewable energy are strategically reviewed across a locality and potential projects have been identified. These planning exercises provide a locally focussed and more detailed examination of opportunities. This study forms a founding base with consistent information for more detailed local studies to build from.
12. *Local Targets and Policy* – Using this evidence base along with localised studies, local authorities should put in place core strategy policies that encourage deployment of suitable renewable energy installations. Targets and requirements can also be set for new development and strategic sites where delivery of levels of on-site renewable energy in excess of building regulations is deemed viable.

	Private Sector Led ESCo	Public Sector Led ESCo
Advantages	▪ Private sector capital ▪ Transfer of risk ▪ Commercial and technical expertise	▪ Lower interest rates on available capital can be secured through Prudential Borrowing ▪ Transfer of risk on a District heating network through construction contracts ▪ More control over strategic direction ▪ No profit needed ▪ Incremental expansion more likely ▪ Low set-up costs (internal accounting only)
Disadvantages	▪ Loss of control ▪ Most profit retained by private sector ▪ Incremental expansion more difficult ▪ High set-up costs	▪ Greater risk ▪ Less access to private capital and expertise, though expertise can be obtained through outsourcing and specific recruitment

Table 21 Advantages and disadvantages of ESCos and other delivery vehicle models

Action plans for delivery

8 Action plans for delivery

This chapter discusses the characteristics of each sub-region and provides an action plan for delivery of low carbon and renewable energy for each of the four functional sub regions in Yorkshire and Humber.

We have also reviewed the progress made on actions recommended in the SREATS study.

The action plans have been developed based on the results of the study and discussions with key stakeholders in a workshop environment.

8.1 Hull and Humber Ports sub-regional action plan

8.1.1 The potential of the sub-region

This sub-region comprises of the local authorities of East Riding, Hull, North Lincolnshire and North East Lincolnshire. The most significant opportunities with respect to renewable energy are: imported biomass, wind, straw, energy crops, poultry litter, district heating networks, and renewable energy research and skill development.

This sub-region has the highest wind potential in the region. East Riding has the highest potential for wind generation in the region, and there is also significant potential in North and North East Lincolnshire. East Riding already has four major wind projects in operation, with ten more that have planning consent and that are expected to become operational in the next few years. In the short to medium term there may be some issues around grid capacity in the Humber ports area. Issues in relation to visibility of wind farms to the Air Defence radar station at Staxton Wold may also constrain some of the potential wind resource in East Riding in the short to medium term, as may issues around cumulative visual and landscape impacts in certain parts of East Riding.

In terms of biomass, the sub-region has the largest straw resource in the region. The straw can either be used for co-firing in coal fired power stations or in dedicated biomass power or CHP stations. This resource is beginning to be tapped, with three straw burning CHP facilities that have planning consent and the Drax straw pelleting facility in Goole.

The major ports on the Humber provide an opportunity for large scale power plants fuelled by imported biomass. There are several proposals for schemes of this type and if they came to fruition they could make a significant contribution to the region's renewable energy capacity. There is also an opportunity for some of these facilities to potentially supply heat to the large industrial heat loads on the south bank of the Humber.

This area also has the largest poultry litter resource in the region, concentrated in North Lincolnshire. This led to the development of the Glanford poultry litter power station in the mid-1990's.

District heating is possible in the majority of the sub-region's more urban settlements. As Hull and Humber's largest urban settlement, Hull's significant heat densities justify making it a priority area for district heating. Other urban areas with heat densities that could support a heat network include: Bridlington, Grimsby, Immingham, Cleethorpes, and Scunthorpe. The potential for each of these settlements to support district heating networks should be investigated further, together with the potential for co-location with any energy generation from biomass or waste.

Hull and Humber is unique in that it has the potential to establish an industry which supports renewable energy development. Hull is home to a biofuels research centre and the University of Hull, which is researching marine renewable energies. These two might represent catalysts in the development of a renewable energy research hub in the unitary authority. Immingham and Grimsby have the two largest ports in the UK, with the capacity and services to support offshore wind farms. Should these ports develop offshore wind support, skills training for these ports could evolve as an industry.

As the UK's largest inland port, the port of Goole could play a part with regards to the potential for shipping and development of renewables energy technologies.

Siemens has recently confirmed that a wind turbine manufacturing factory will be located in Hull, which could attract other manufacturers and investors to the sub-region.

8.1.2 Key actions for the sub-region

The following actions were developed with stakeholders during the studies. They prioritise key immediate actions for the sub-region in particular, but also include a consistent set of actions which are important for the region as a whole. Reference should also be given to the strategic barriers and opportunities discussed in chapter 7 to identify ongoing and long-term actions for the region as a whole.

Action	Key Partners
Develop local policies and targets to support renewable energy in the LDF, including policies for new development and strategic sites (including viability testing)	Local Authorities Local Enterprise Partnership
Educate communities, authorities and members about appropriate technologies for the sub-region	Climate Change Skills Fund Coordinators Independent organisation lead Energy Savings Trust Members Local Enterprise Partnerships Local Authorities
Develop skills in local communities and support mechanisms help communities deliver renewable energy schemes	Climate Change Skills Fund Coordinators Local Authorities Community Representatives Parish Councils
Investigate and integrate local manufacture and management of renewable energy technologies within local economic strategies	Local Enterprise Partnerships Local Authorities
Identify delivery vehicles, and the role and capacity of local authorities to assist in delivery	Local Authorities ESCos Community Cooperatives
Share local knowledge and skills through a coordinated forum	Climate Change Skills Fund Coordinators Local Authorities Sub-Regional Leads
Stimulate the development of regional biomass supply markets	Farmers Foresters Local Authorities Renewable Energy Industry
Identify a lead coordinator for activity in the sub-region, who can act as a promotional lead and also coordinate funding to local priorities	Local Authorities
Develop greater understanding of the relationship between renewable energy development and the sub-region's landscape character and natural environment	East Riding Council North Lincolnshire Council Northeast Lincolnshire Council
Conduct a District Heating Viability Study to prioritise and test feasibility of district heating	Hull Council

systems across Hull	
Identify opportunities on brownfield land for renewable energy installations in tandem with regeneration and redevelopment initiatives	Hull Council
Create demonstration schemes and tours for the region to overcome political opposition and foster enthusiasm	Members Local Authorities
Upgrade the electricity grid in the area to allow further renewable installations	Utilities
Create a research and development network in the Humber area to coordinate and foster local research and skill development	Humber Ports University of Hull
Work with local communities and members to emphasise the potential of the sub-region in delivering renewable energy in the region, particularly regarding wind energy	Climate Change Skills Fund Coordinators East Riding of Yorkshire Council North Lincolnshire Council

Capabilities on project:
Building Engineering - Sustainability

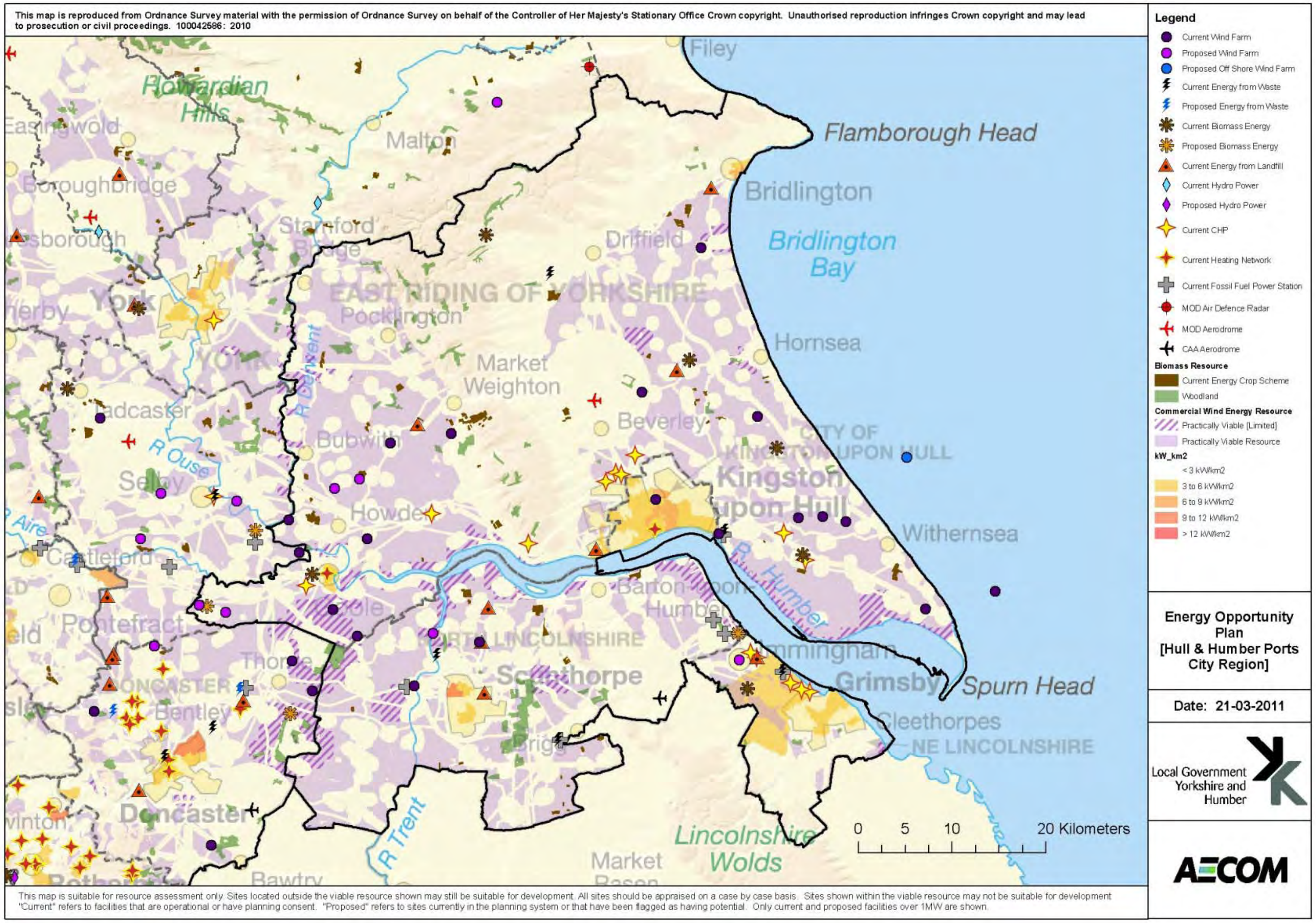


Figure 55 Energy Opportunities Plan for the Hull and Humber Ports sub region. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed facilities over 1MW are shown. The areas with purple hatched shading described as “Practically viable [Limited]” represent areas where commercial scale wind energy development should be viable but the number of turbines may be restricted due to environmental constraints. Please refer to appendix A.7 for more details.

8.2 York and North Yorkshire sub-regional action plan

8.2.1 The potential of the sub-region

York and North Yorkshire is geographically the largest sub-region, but it also has some very significant landscape constraints, including the North York Moors and the Yorkshire Dales National Park.

Having said this, the study finds that there may be significant wind power potential in those areas of lower landscape sensitivity, particularly in Selby and Hambleton, although the presence of three RAF airbases in the latter may cause some local radar constraints.

The rural hinterland of the area has significant potential to produce biomass fuel, and significant biomass investment has already been seen in areas like Ryedale and Selby.

In terms of biomass, Selby hosts the Drax and Eggborough coal fired power stations, and therefore has significant renewable energy capacity and potential from biomass co-firing.

The area has the largest potential for growing energy crops in the region, and the second largest for straw. There are three operational biomass CHP facilities in the sub-region, (in Ryedale and Selby) but to date the energy crops resource remains largely untapped. There are currently just under 900ha of energy crops being grown, but the potential for almost 39,000 ha, without any conflict with food production. This crop could be used either for biomass co-firing, or for dedicated biomass energy plants.

The sub region has a significant potential resource for energy generation from the anaerobic digestion of animal wastes from the large numbers of livestock kept in the rural areas. However, the economics for using this resource are not currently favourable.

The sub region also has significant potential for energy recovery from MSW, if the proposals for the Allerton Waste Recovery Centre in Harrogate District go ahead.

Some urban areas in the sub-region have load densities suitable for the installation of district heating networks. Some centres including York, Harrogate and Scarborough have small district heating networks in place, and there is the potential to expand these and connect existing properties in the area.

8.2.2 Key actions for the sub-region

The following actions were developed with stakeholders during the studies. They prioritise key immediate actions for the sub-region in particular, but also include a consistent set of actions which are important for the region as a whole. Reference should also be given to the strategic barriers and opportunities discussed in chapter 7 to identify ongoing and long-term actions for the region as a whole.

Action	Key Partners
Develop local policies and targets to support renewable energy in the LDF, including policies for new development and strategic sites (including viability testing)	Local Authorities Local Enterprise Partnership Yorkshire Dales National Park Authority
Educate communities, authorities and members about appropriate technologies for the sub-region	Climate Change Skills Fund Coordinators Independent organisation lead Energy Saving Trust Members Local Enterprise Partnerships Local Authorities Yorkshire Dales National Park Authority
Develop skills in local communities and support mechanisms help communities deliver renewable energy schemes	Climate Change Skills Fund Coordinators Local Authorities

	Community Representatives Parish Councils Yorkshire Dales National Park Authority
Investigate and integrate local manufacture and management of renewable energy technologies within local economic strategies	Local Enterprise Partnerships Local Authorities
Identify delivery vehicles, and the role and capacity of local authorities to assist in delivery	Local Authorities ESCos Community Cooperatives
Share local knowledge and skills through a coordinated forum	Local Authorities Sub-Regional Leads
Stimulate the development of regional biomass supply markets	Farmers Foresters Local Authorities Renewable Energy Industry
Identify a lead coordinator for activity in the sub-region, who can act as a promotional lead and also coordinate funding to local priorities	Local Authorities
Develop greater understanding of the relationship between renewable energy development and the sub-region's landscape character and natural environment	North Moors National Park Yorkshire Dales National Park Local Authorities, particularly rural authorities
Conduct a District Heating Viability Study to prioritise and test feasibility of district heating systems in York, Selby, Harrogate and Scarborough	York Council Selby Council Harrogate Council Scarborough Council
Identify opportunities on brownfield land for renewable energy installations in tandem with regeneration and redevelopment initiatives	York Council Selby Council Harrogate Council Scarborough Council
Training for officers, members and statutory consultees on technologies	Climate Change Skills Fund Coordinators Statutory consultees Local Authorities
Establish a sub-regional mechanism to share knowledge across Local Authorities	Local Authorities

	County Council Climate Change Skills Fund Coordinator
Engage with private woodland owners in the area to facilitate biomass management	Woodland Trust County Council Local Authorities Forestry Commission Yorkshire Dales National Park Authority
Establish a 'go-to' body for the sub-region that provides renewable energy advice and expertise	Climate Change Skills Fund Coordinators Yorkshire Micro-generation Partnership Energy Savings Trust Local Authorities

Capabilities on project:
Building Engineering - Sustainability

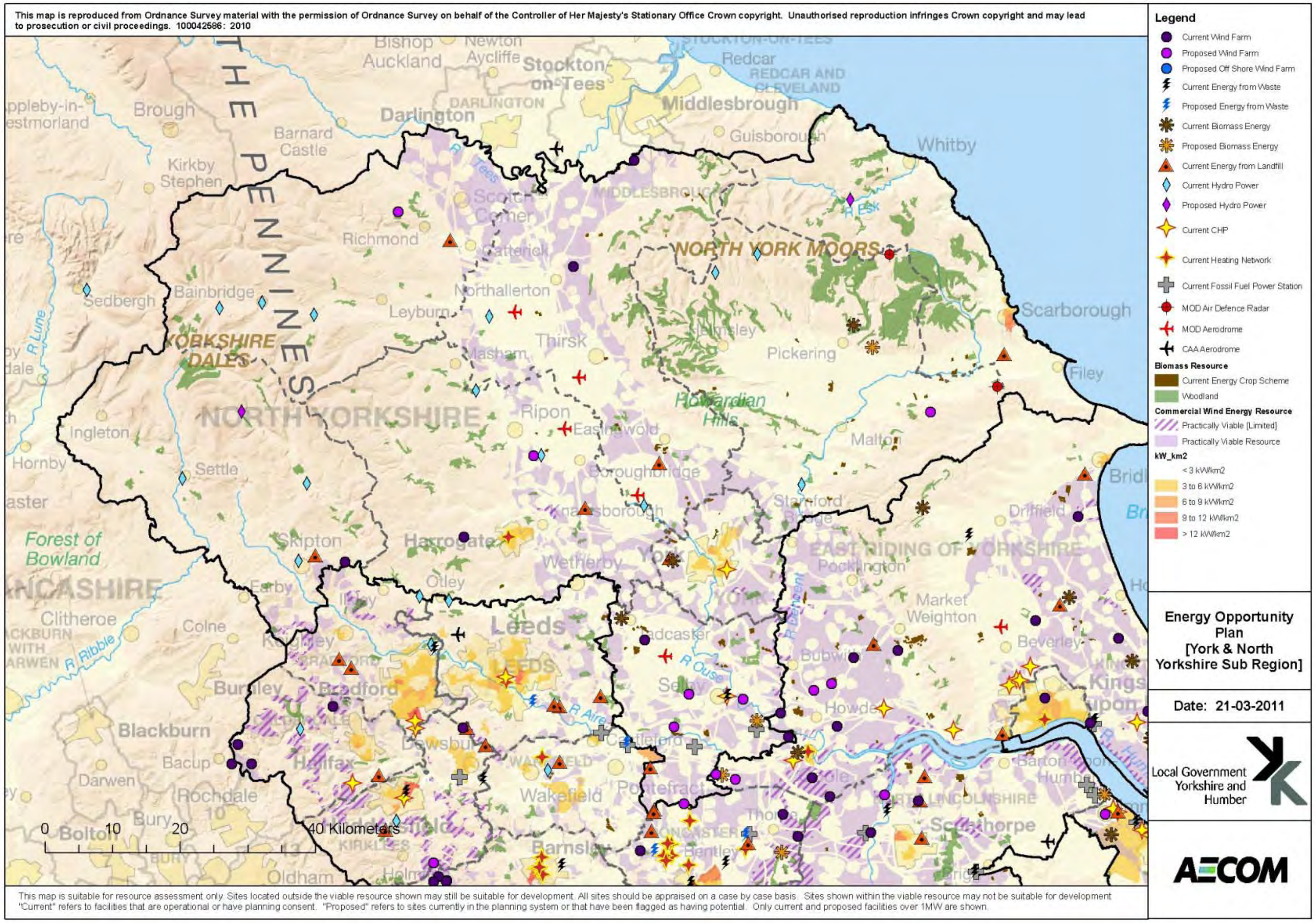


Figure 56 Energy Opportunities Plan for the York and North Yorkshire sub region. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed facilities over 1MW are shown. The areas with purple hatched shading described as “Practically viable [Limited]” represent areas where commercial scale wind energy development should be viable but the number of turbines may be restricted due to environmental constraints. Please refer to appendix A.7 for more details.

8.3 Leeds City sub-regional action plan

8.3.1 The potential of the sub-region

Leeds City Region is a sub-region with diverse opportunities for renewable energy. It is made up of Bradford, Leeds, Calderdale, Kirklees, and Wakefield, but in addition includes Selby, York, Harrogate and Craven, which also form part of the York and North Yorkshire sub region, and Barnsley, which forms part of the South Yorkshire sub region.

The sub-region has many urban settlements, and the majority of them have heat densities that meet the required threshold to support a district heating network. The towns of York, Selby, Huddersfield, Halifax, and Bradford each show a significant potential to support one. Barnsley Council has taken the initiative to connect their buildings to a biomass heating scheme, and to source their biomass locally. District heating networks already operating in the sub-region include one in each of Harrogate, Leeds, and Wakefield. These towns represent the urban settlements with the greatest potential; however, there are a number of other opportunities in the sub-region.

Leeds City Region also has a number of biomass energy schemes. There is existing and future potential for biomass co-firing in the coal fired power stations of Drax and Eggborough in Selby, and Ferrybridge in Wakefield. At the time of writing there is also a proposal for a 290MW_e dedicated biomass facility at Drax, to be fuelled by imported biomass.

The other key opportunity in the Leeds City Region is wind power. Although the largest resource is in Selby, wind opportunities are scattered throughout the sub-region, with eight wind projects in operation, and another three that have planning consent.

The sub region also has significant potential for energy recovery from MSW, if the proposals for the Allerton Waste Recovery Centre in Harrogate District go ahead. Leeds also has plans for an energy recovery facility to deal with residual MSW. The latter may present an opportunity for supplying heat from such a facility into a district heating network, as is the case in Sheffield. There are also proposals for facilities to take residual C&I waste, at the Ferrybridge site in Wakefield and at Skelton Grange in Leeds. Again, if these schemes were to reach fruition, they may also present an opportunity for low carbon district heating.

8.3.2 Key actions for the sub-region

The following actions were developed with stakeholders during the studies. They prioritise key immediate actions for the sub-region in particular, but also include a consistent set of actions which are important for the region as a whole. Reference should also be given to the strategic barriers and opportunities discussed in chapter 7 to identify ongoing and long-term actions for the region as a whole.

Action	Key Partners
Develop local policies and targets to support renewable energy in the LDF, including policies for new development and strategic sites (including viability testing)	Local Authorities Local Enterprise Partnership
Educate communities, authorities and members about appropriate technologies for the sub-region	Independent organisation lead Energy Savings Trust Members Local Enterprise Partnerships Local Authorities
Develop skills in local communities and support mechanisms help communities deliver renewable energy schemes	Climate Change Skills Fund Coordinators Local Authorities Community Representatives Parish Councils

Capabilities on project:
Building Engineering - Sustainability

Investigate and integrate local manufacture and management of renewable energy technologies within local economic strategies	Local Enterprise Partnerships Local Authorities
Identify delivery vehicles, and the role and capacity of local authorities to assist in delivery	Local Authorities ESCOs Community Cooperatives
Share local knowledge and skills through a coordinated forum	Local Authorities Sub-Regional Leads
Stimulate the development of regional biomass supply markets	Farmers Foresters Local Authorities Renewable Energy Industry
Identify a lead coordinator for activity in the sub-region, who can act as a promotional lead and also coordinate funding to local priorities	Local Authorities
Adopt renewables targets for Leeds City Region to give consistency across the area	Local Authorities
Conduct a District Heating Viability Study for the Sub-region	Local Authorities
Identify opportunities on brownfield land for renewable energy installations in tandem with regeneration and redevelopment initiatives	Local Authorities
Develop the Capital and Asset Pathfinder to have a low carbon focus	Public Sector
Use eco-developments as exemplars	Developers Local Authorities
Develop some publically visible projects in an urban context, e.g. renewable street lighting. Engage and promote with members	Members Local Authorities
Coordinate and promote energy efficiency measures across the sub-region	Energy Savings Trust
Integrate renewable energy initiatives with carbon initiatives within the transport strategy	Leeds Institute for Transport Studies Yorkshire Forward

Capabilities on project:
Building Engineering - Sustainability

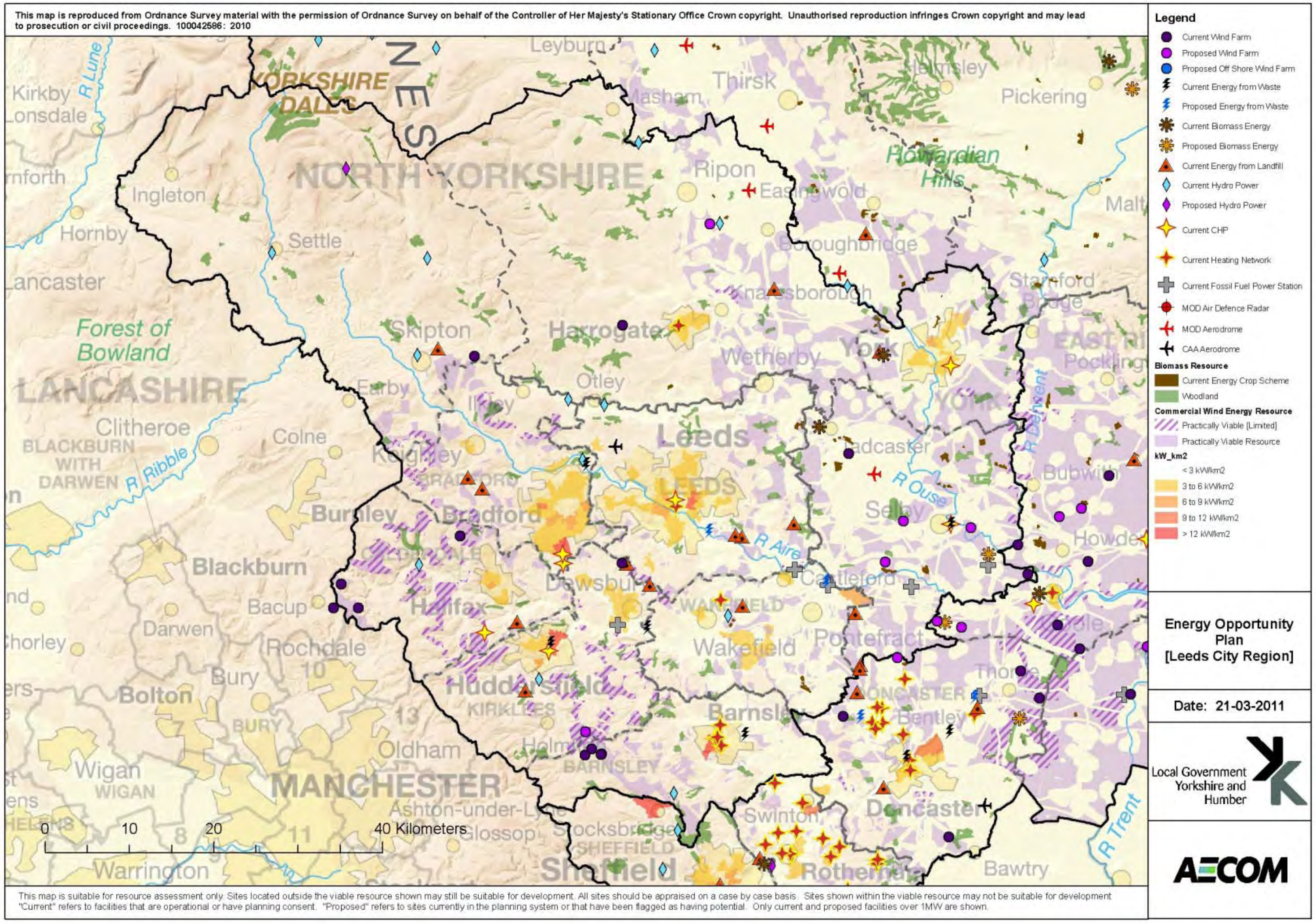


Figure 57 Energy Opportunities Plan for the Leeds City sub region. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed facilities over 1MW are shown. The areas with purple hatched shading described as “Practically viable [Limited]” represent areas where commercial scale wind energy development should be viable but the number of turbines may be restricted due to environmental constraints. Please refer to appendix A.7 for more details.

8.4 South Yorkshire sub-regional action plan

8.4.1 The potential of the sub-region

South Yorkshire is the smallest sub-region, in terms of geographical area, in Yorkshire and Humber. It consists of the four local authorities areas of Sheffield, Doncaster, Barnsley and Rotherham. The greatest constraint for the South Yorkshire sub-region, in terms of renewable energy, is the Peak District National Park, which covers much of Sheffield Borough's land area.

The local authorities in South Yorkshire also form part of the Sheffield City Region, along with Chesterfield, Derbyshire Dales, North East Derbyshire, Bolsover and Bassetlaw in the East Midlands region. This suggests that cross-boundary collaboration will be particularly important for the Sheffield City Region. Identification of possible heat networks and prioritisation of funding across the City Region will be crucial to pool resources and ensure delivery opportunities are taken. The hinterland around Sheffield will also play a key supporting role to district heating networks and biomass energy use. The areas south of Sheffield, located in the East Midlands Region, have a high coverage of woodland which may be a possible source of local biomass fuel. Local authorities and industry groups in the region should work together to develop local supply chains of biomass from forestry management. The areas bordering the Peak District should also take a coordinated approach to wind development policy, seeking consistency in assessment processes surrounding landscape value considerations.

Despite the limited geographical area, it has considerable potential for renewable energy from wind power, and from energy from waste, including food waste and municipal and industrial general waste.

In terms of wind power, Doncaster has the second largest potential in the region, and there is also a significant resource in Rotherham and Barnsley. The sub region already has six operational wind schemes with a further five schemes that have planning consent, including the 65MW_e Tween Bridge wind farm in Doncaster.

The area also has the most district heating networks in the greater region. In Sheffield, there is the city heat network fed from the energy from waste facility. Rotherham has sixteen community heating schemes in operation, where residential blocks are served from central boilers. Doncaster has one district heating network and other communal schemes, another opportunity exists on the border with Rotherham. This represents an opportunity for Doncaster and Rotherham to work together in expanding the sub-regional heat network. In Barnsley, the Council has taken the initiative to connect their buildings to a biomass heating scheme, and to source their biomass locally.

There is also the potential for energy generation from waste wood. There is a planning consent for a 25MW_e facility at Blackburn Meadows, in Sheffield, and if built, there is the potential for that to also supply heat to neighbouring commercial and industrial businesses.

In terms of energy from waste, the area already has the Sheffield energy recovery facility, which takes MSW as its feedstock. There is also considerable potential for energy from C&I waste in the area, with a planning consent in place for an energy recovery facility at Kirk Sandhall in Doncaster, as well as proposals for a large scale facility adjacent to Hatfield colliery. There is a potential opportunity for these new energy recovery facilities to also supply low carbon heat for heating networks, or for industrial uses.

There is a 2MW_e AD facility under construction in Doncaster which will take retail food waste.

Finally, the South Yorkshire councils of Doncaster, Barnsley and Rotherham are proposing to transform the area through an "Eco-Vision" with the aim of making it the lowest carbon community of its type in the UK within a decade. The plans involve building energy-efficient homes, encouraging new green businesses into the area, enhancement of the natural environment and improving public transport. The Energy Opportunities Plan should prove a resource for delivering this vision.

8.4.2 Key actions for the sub-region

The following actions were developed with stakeholders during the studies. They prioritise key immediate actions for the sub-region in particular, but also include a consistent set of actions which are important for the region as a whole. Reference should also be given to the strategic barriers and opportunities discussed in chapter 7 to identify ongoing and long-term actions for the region as a whole.

Action	Key Partners
Develop local policies and targets to support renewable energy in the LDF, including policies for new development and strategic sites (including viability testing)	Local Authorities Local Enterprise Partnership
Develop greater understanding of the relationship between renewable energy development and the sub-region's landscape character and natural environment. This is mainly in relationship to Doncaster and Sheffield, with respect to the Peak District National Park, Thorne and Hadfield Moor, European Site designations and other SSSI in the sub area.	Local Authorities Sub-Regional Leads
Educate communities, authorities and members about appropriate technologies for the sub-region	Independent organisation lead Energy Savings Trust Members Local Enterprise Partnerships Local Authorities
Develop skills in local communities and support mechanisms help communities deliver renewable energy schemes	Climate Change Skills Fund Coordinators Local Authorities Community Representatives Parish Councils
Investigate and integrate local manufacture and management of renewable energy technologies within local economic strategies	Local Enterprise Partnerships Local Authorities
Identify delivery vehicles, and the role and capacity of local authorities to assist in delivery	Local Authorities ESCos Community Cooperatives
Share local knowledge and skills through a coordinated forum	Local Authorities Sub-Regional Leads
Stimulate the development of regional biomass supply markets	Farmers, foresters Local Authorities Renewable Energy Industry
Identify a lead coordinator for activity in the sub-region, who can act as a promotional lead and also coordinate funding to local priorities	Local Authorities
Coordinate with the emerging East Midlands Renewable Potential Study to develop priorities for the sub-region	Local Authorities
Conduct a District Heating Viability Study for the Sub-region to prioritise action and link existing systems	Local Authorities

Identify opportunities on brownfield land for renewable energy installations in tandem with regeneration and redevelopment initiatives	Local Authorities
Undertake feasibility study for power station and district heating in Doncaster	Doncaster Council
Viability study of Barnsley biomass district heating proposal (which includes Town Hall, Library, Westgate Plaza 1 and 2)	Barnsley Council
Determine if there is potential for co-firing at proposed Algreave/Waverline power station in Rotherham	Rotherham Council
Educate communities and authorities about appropriate technologies and set up skills development programs	Local Authorities

Capabilities on project:
Building Engineering - Sustainability

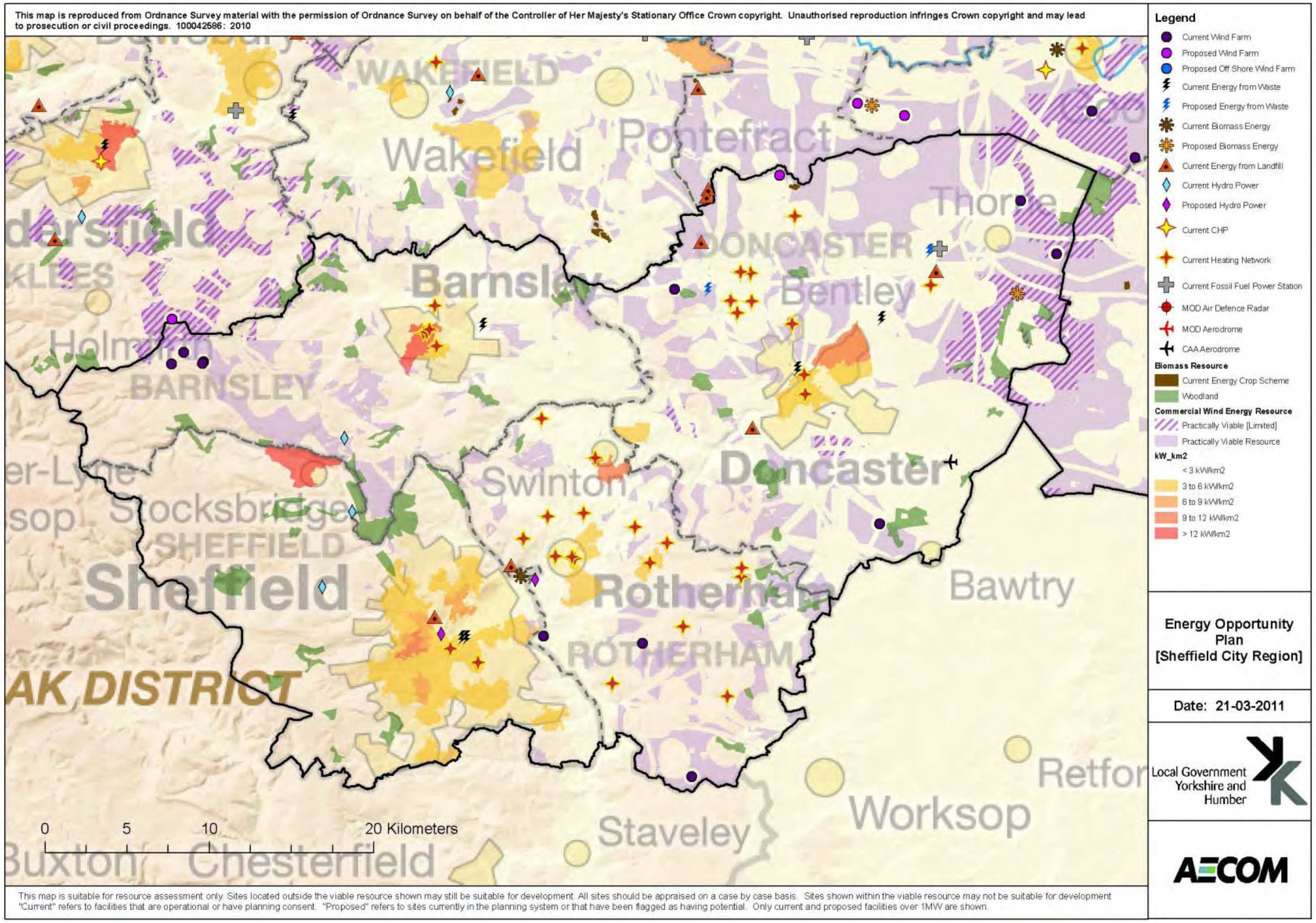


Figure 58 Energy Opportunities Plan for the South Yorkshire sub region. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed facilities over 1MW are shown. The areas with purple hatched shading described as “Practically viable [Limited]” represent areas where commercial scale wind energy development should be viable but the number of turbines may be restricted due to environmental constraints. Please refer to appendix A.7 for more details.

8.5 Review of previous actions

The most recent assessment of the renewable energy resource, SREATS, described a set of actions proposed by stakeholders.

	Action	Description	Who responsible	Timescale	Outcome	Indicators of success	Status of actions
A	Publish summary of current report for wide distribution	The current study has taken the target-setting agenda further forward but has not completed it. A brief summary of the work, coupled with statements of the wider policy context and future regional intentions, would help to tackle one of the key requirements set out above. One aspect of this summary could be to set out what LPAs would be expected to do next.	Government Office and Yorkshire and Humber Assembly	2 months	Relevant reference information in the public domain	Summary published and distributed widely	Completed.
B	Undertake more detailed technical assessments to confirm and refine LPA targets	The current study has used a consistent strategic approach region-wide to promote equity of target-setting. This approach has been unable to fully reflect more detailed local issues (e.g. existing local landscape assessments). Further work – ideally undertaken by sub-regional LPA groupings – would help to further refine the assessments, promoting both equity and technical veracity.	LPAs (individually & collectively)	12-18 months	Increased technical basis for acceptance of targets	Refined local targets accepted and adopted by individual LPAs and sub-regional groupings	Partially complete. Some local authorities have undertaken studies that reflect more detailed issues. These include Hull, Sheffield, South Pennines Landscape Sensitivity study, Kirklees hydro study.
C	Provide a structured framework for support to renewable energy and planning Across the region	A crucial element of local RE target acceptance is the ability to communicate much more information on a wider basis to key stakeholder groups, and to support LPAs to develop and enhance their approach to RE. One model for this could be the approach adopted within the South East. LPAs stressed the significance of outside impartial support, which in some	Yorkshire and Humber Assembly, Government Office, LPAs (individually & collectively)	12-18 months	An informed context for policy- and decision-making for RE at all levels	Greater support for RE within policies and in planning decisions	Partially complete. Some local authorities have incorporated policies requiring a minimum level of renewable energy generation on new development

	Action	Description	Who responsible	Timescale	Outcome	Indicators of success	Status of actions
		circumstances is perceived by elected Members to provide more persuasive evidence than from Officers.					into DPDs or UDP documents.
D	Encourage Local RE Forums	Practical opportunities for RE developers, LPAs and others to develop broad agreement before schemes are submitted and to identify suitable "areas of search"	Local Authorities (with Yorkshire and Humber Assembly, developers, community groups)	Ongoing	Forums to carry forward the prospective targets at LPA level through devising "areas of mutual interest" for RE implementation, input to Local Development Frameworks	Forums initiated, feedback obtained on "success stories" from this approach	Completed (ongoing). In February 2007, the Renewable Energy Forum developed a regional energy infrastructure to 2010.
E	Collation and dissemination of "Good Practice" information	"Good Practice" information was requested by a number of LPA stakeholders to assist them with both forward planning and development control.	Government Office (with Yorkshire and Humber Assembly)	12-18 months	Guidance used to aid consideration of RE within the planning framework	Guidance available and being used	Completed. Renewable Energy Toolkit launched by Local Government Yorkshire and Humber in 2008 to enable Local Authorities to deal with the issue of microgeneration, decentralised and low carbon energy.

Table 22 Actions for delivery of renewable energy as suggested in SREATs report, 2004.

Recommendations for further work

9 Recommendations for further work

The aim of this chapter is to set out how individual local authorities, and other key stakeholders, can use and build on the outputs from this study.

9.1 Introduction

The outputs provided by this study, for each local authority, consist of:

1. An estimate of the maximum economic potential for each type of renewable energy technology or resource type,
2. A set of Energy Opportunities Plans (EOPs) consisting of GIS data layers and maps showing the location of schemes, resource and constraints, where appropriate.

A key aim of this study was to try to collate and carry out as much analysis as possible using national and regional datasets to minimise the additional amount of evidence base work that would be required at a local authority level. We believe we have done that, and that the EOPs produced by this study provide sufficient evidence for a local authority to develop general policies in support of renewable energy as part of a core strategy. However, there is more value that can be added to this data at a local authority. We see these areas of further work to be as follows:

1. Developing local authority area wide targets for renewable energy;
2. Developing a more detailed EOP to inform planning policy, development management and wider corporate and strategic action.

The further local work that would be required for each is set out in more detail below.

9.2 Local authority targets for renewable energy

Individual local authorities, or sub-regional groups of authorities, may wish to set area wide targets for renewable energy generation. These targets may take the form of installed capacity in MW, or annual energy generation in MWh or a proportion of energy demand in %. There could be separate targets for renewable electricity and heat, or an overall target.

Such targets can provide a useful benchmark for an area of the scale of deployment that will be required to make a meaningful contribution to the UK renewable energy targets by 2020. It also can act as a stimulus for corporate and wider stakeholder action to assist in increasing the deployment of renewable energy.

In order to develop the renewable energy potential figures that have been supplied as part of this study into a target, the further work that would be required at a local authority level is likely to consist of the following:

- Engage with relevant local stakeholders to explore how much of the potential for each resource set out in this study is likely to be realised, given more detailed local information on constraints, proposals and plans. This study sets out some examples of scenarios that could be used.
- Consider issues of resource allocation between local authorities. One issue with trying to develop targets at a local authority level is that resources such as biomass and energy from waste do not respect boundaries. Therefore, one local authority may contain an energy recovery facility that takes waste from a neighbouring local authority. The first local authority would see a contribution to its renewable energy generation target whilst the second wouldn't. Therefore, if you know that there are plans or proposals for these sort of facilities in neighbouring authorities, you should discount any contribution from this resource towards your own target. Conversely, if your area is to host such a facility, then this could enable a higher target.
- Once suitable possible targets or target ranges have been agreed, these would then need to be taken through the local authority political approval process

9.3 Developing the EOP for policy and corporate use

By its nature, this study has been restricted to using regional and national datasets. However, there is additional data available at local authority level that can be superimposed (in GIS format) to the EOPs to add more value, particularly in relation to potential heat loads, and we recommend that local authorities should do this. This could then be used to inform planning policy, development management and wider corporate and strategic action. The additional data could include:

- Candidate sites for new developments
- Strategic new development sites
- Preferred sites for locating energy recovery facilities
- Public sector buildings

- Local authority or public land ownership
- Fuel poverty data
- Social housing
- Local knowledge of potential renewable heat customers
- Local environmental or landscape constraints, such as Local Nature Reserves, or greenbelt

The local authority will have many of these datasets available in house, or could engage with local public sector or other stakeholders to obtain them.

Specifically in relation to wind power, this regional study has used the OS Strategi dataset to identify the location of existing dwellings. A disadvantage of this dataset is that it assumes that there are no (commercial scale) wind power opportunities in urban areas. If a local authority wanted to have a picture of the potential for brownfield wind development in their urban areas, then they may wish to commission a more detailed wind assessment that would make use of Address Point data or OS MasterMap data.

9.4 Using the more detailed EOP

This enhanced EOP can then be used to facilitate the deployment of renewable and low carbon energy. These include:

- Informing the setting of renewable energy or carbon reduction targets for new development sites or areas;
- Assist in identifying strategic areas for renewable energy deployment, as part of Area Action Plans or Core Strategy development. This may require more detailed viability assessment;
- Assisting development management in terms of developing site briefs, or discussion with developers around incorporating renewable energy into new developments;
- Assist in identifying locations for energy from waste facilities to deal with residual MSW, and identify potential heat loads;
- Identifying areas of potential for district heating networks, as a starting point for more detailed viability assessment;
- Informing corporate action to facilitate the deployment of low carbon and renewable energy. This could involve action in any number of the following roles:
    - Land owner,
    - Procurement of energy services,
    - Financing and delivery vehicles,
    - Property developer,
    - Transport infrastructure,
    - Waste management,
    - Leadership.