Building Engineering - Sustainability

Local Government Yorkshire and Humber

11 April 2011

Low carbon and renewable energy capacity in Yorkshire and Humber

Final report

Prepared by: APA... Abena Poku-Awuah Senior Consultant, AECOM

Approved by: SW .... Stephen Ward Regional Director, AECOM

Client: ME.. Martin Elliot Planning Manager, Local Government Yorkshire and Humber

Low carbon and renewable energy capacity in Yorkshire and Humber
Final report

Rev No	Comments	Prepared by	Date	Approved by	Date
0	Draft for comment	APA	10.01.11	SW	10.01.11
1	Draft issued to DECC	APA	15.02.11	SW	15.02.11
2	Draft issued to heads of planning for comment	APA	16.02.11	SW	16.02.11
3	Final report issued	APA	21.03.11	SW	22.03.11
4	EOPs corrected to state that all hydro (incl <1MW) has been shown	APA	11.04.11	SW	11.04.11

The Johnson Building, 77 Hatton Garden, London, EC1N 8JS
Telephone: 020 7645 2000 Website: http://www.aecom.com

Job No 60147118 Reference Date Created April 2011

f:\sdg\jobs\sdg - yorkshire and humber renewable energy capacity study\06 reports\part c report\110411_lgyh_part_c_final report (issued).docx

Table of Contents

List of figures

List of tables

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).

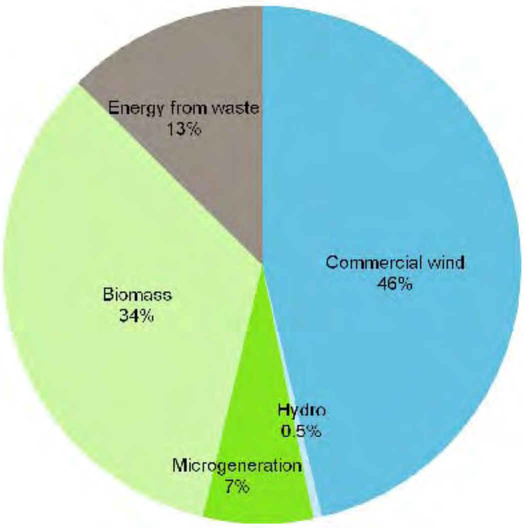


Figure 1 Distribution of potential renewable energy resource (annual energy output) in Yorkshire and Humber by technology

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

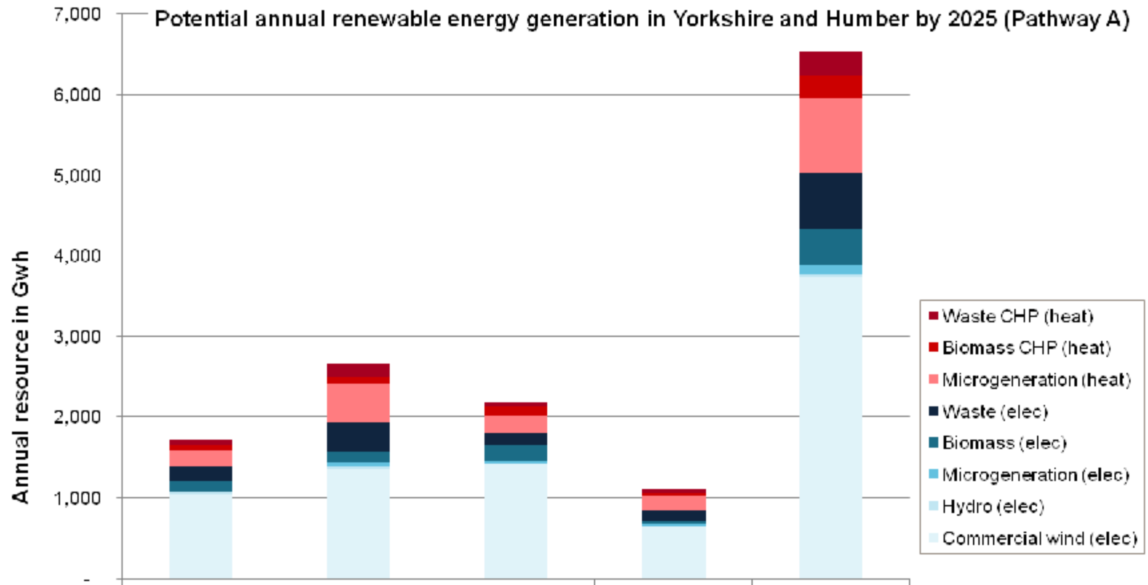
Biogas can be produced from anaerobic digestion of crops, segregated food waste, and mixed municipal, commercial and industrial waste streams. Landfill gas and sewage gas production currently represents around 20% of regional renewable energy generation, and it is all used to generate electricity.

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:
Building Engineering - Sustainability



	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.

Capabilities on project:
Building Engineering - Sustainability

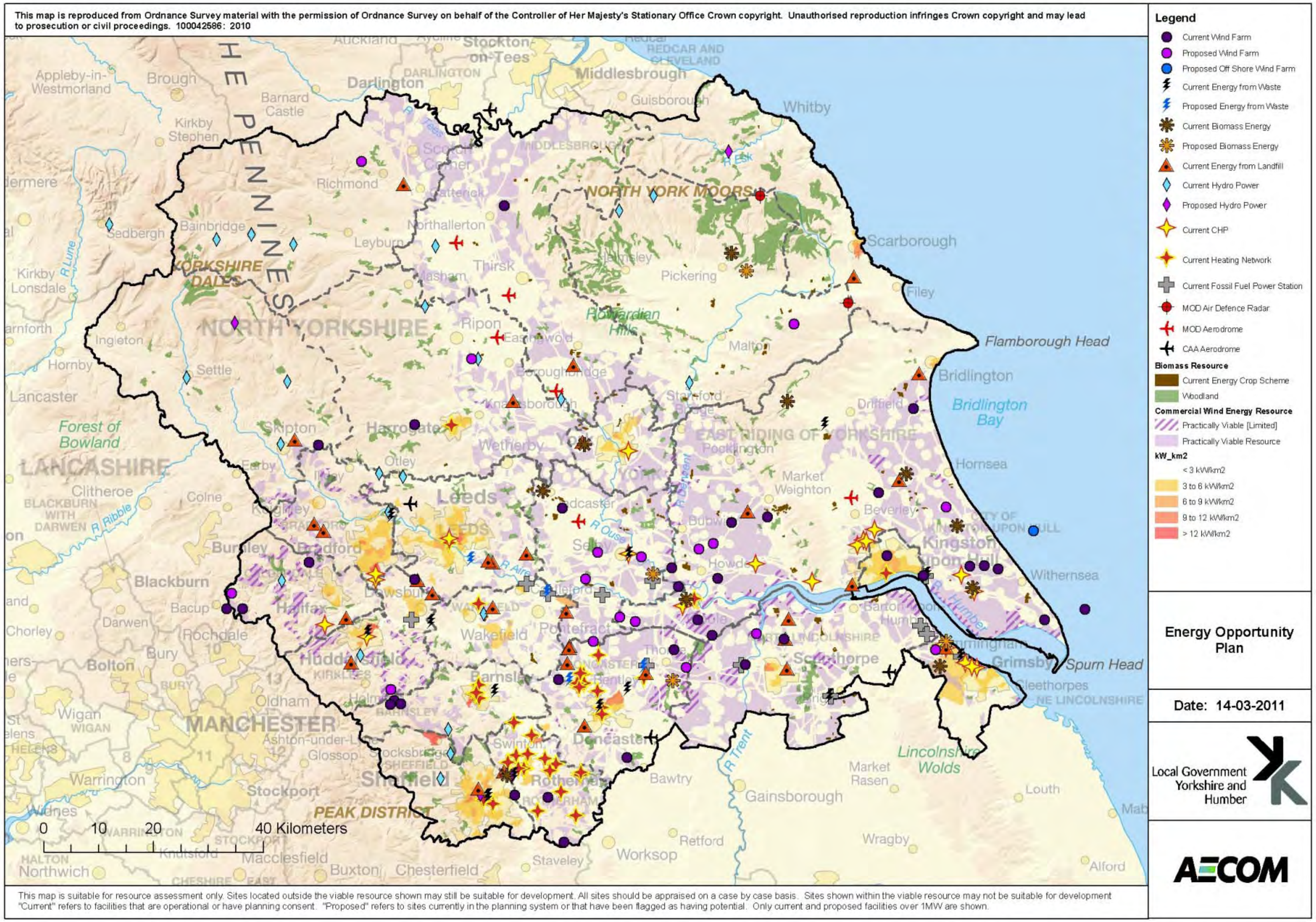


Figure 3 Energy Opportunities Plan for the Yorkshire and Humber region. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, 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

Capabilities on project:
Building Engineering - Sustainability

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.

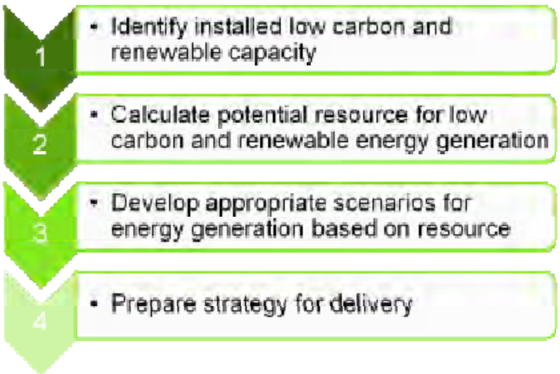


Figure 5 Methodology for study

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.

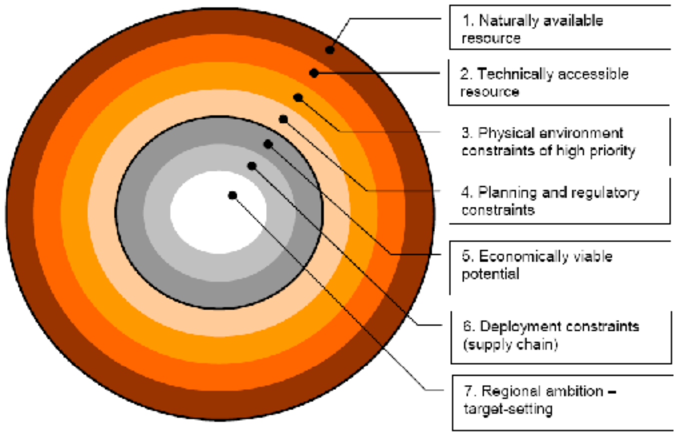


Figure 6 Stages for developing a comprehensive evidence base for renewable energy potential (Source: Renewable and Low-carbon Energy Capacity Methodology for the English Regions, SQW Energy, January 2010)

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.

---

[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.

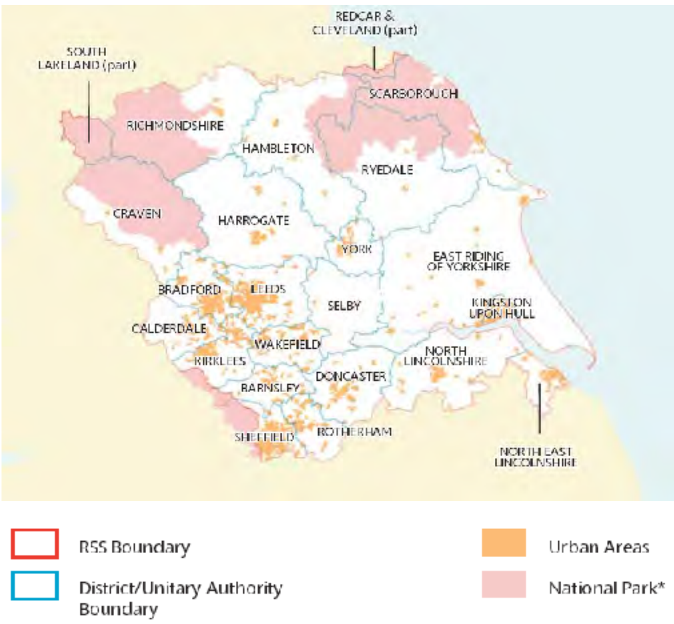


Figure 9 Planning authorities covered within the Yorkshire and Humber region (Source: Yorkshire and Humber Plan, Government office for Yorkshire and Humber, May 2008)

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

Capabilities on project:
Building Engineering - Sustainability

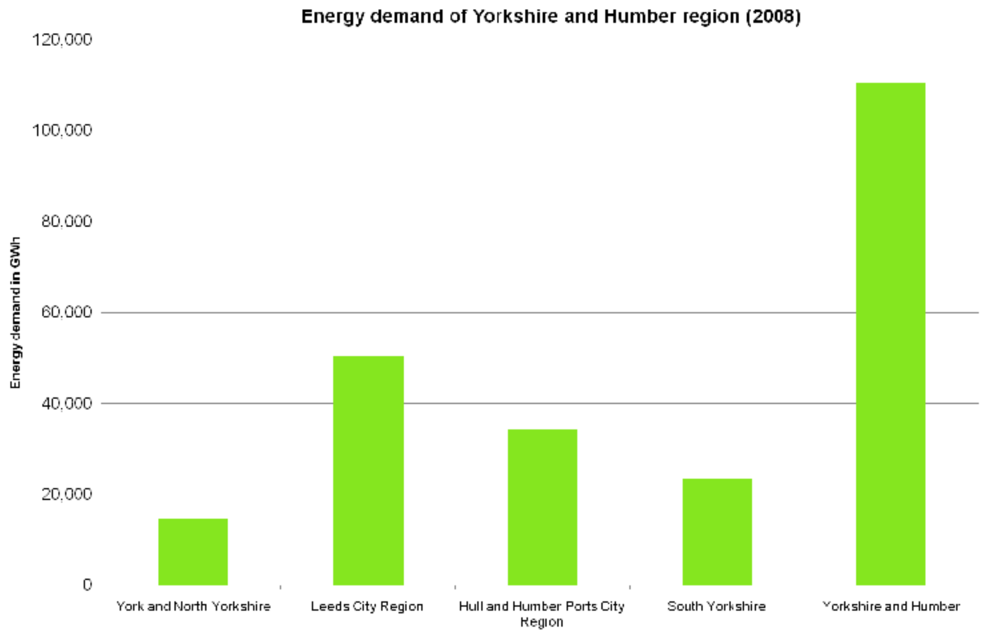


Figure 10 Annual energy demand of Yorkshire and Humber region in 2008 (domestic, industrial and commercial), in GWh

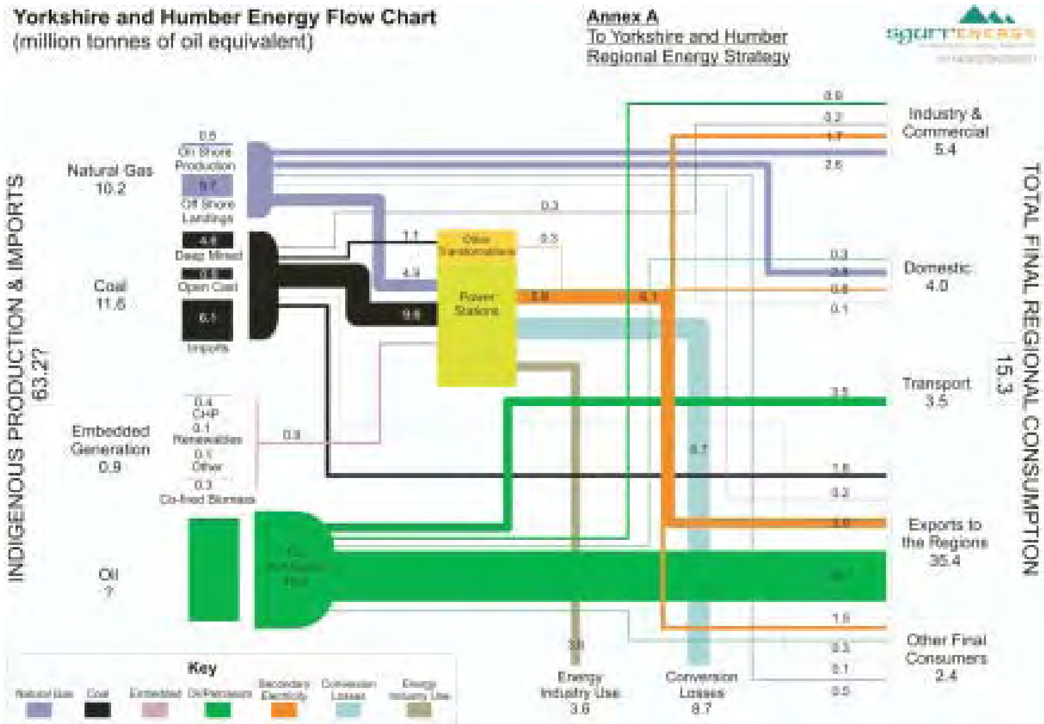


Figure 11 Current flows of energy in the region (million tonnes of oil equivalent) (Source: The Regional Energy Infrastructure Strategy, Regional Energy Forum, February 2007)

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.

Capabilities on project:
Building Engineering - Sustainability

Figure 12 Electricity network in Yorkshire and Humber

Capabilities on project:
Building Engineering - Sustainability

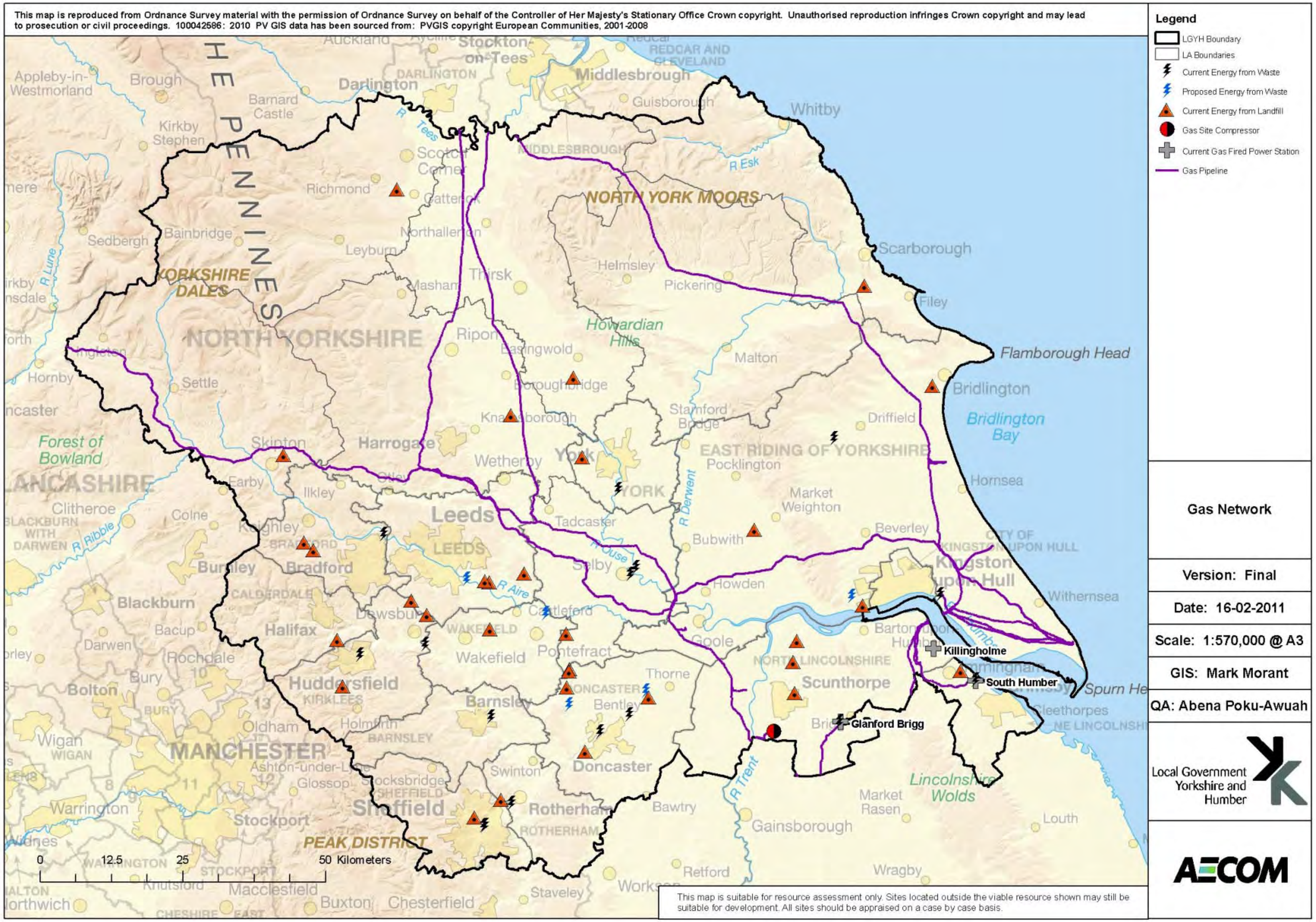


Figure 13 Gas network in Yorkshire and Humber

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.

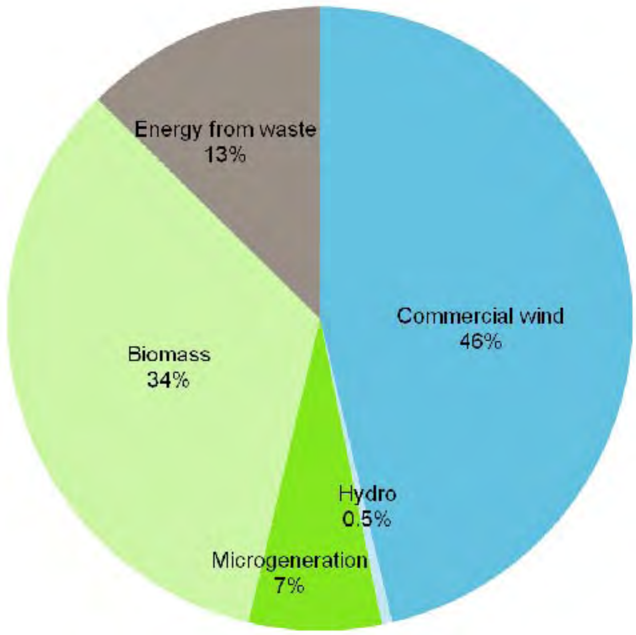


Figure 14 Distribution of renewable energy capacity in Yorkshire and Humber by technology

[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.

Capabilities on project:
Building Engineering - Sustainability

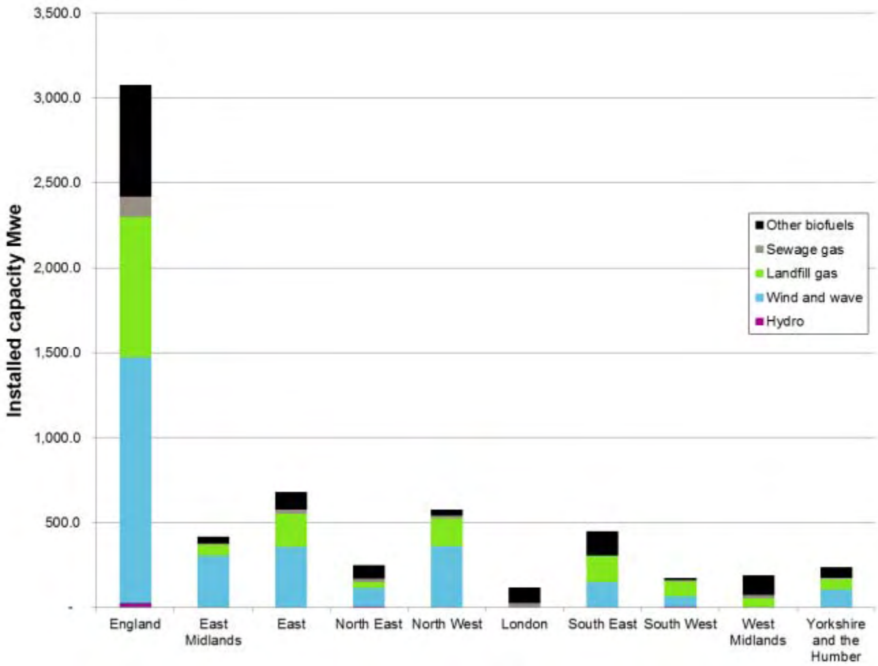


Figure 15 Installed renewable energy capacity in the Yorkshire and Humber region in 2009, relative to the other English regions (Source: DUKES 2009, DECC website, accessed November 2010)

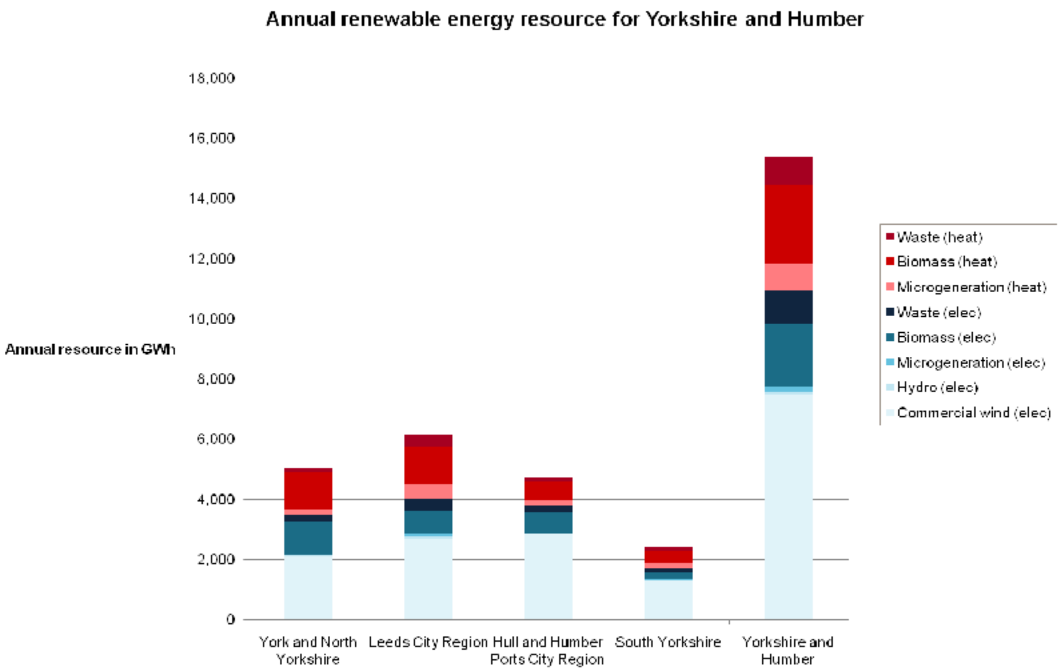


Figure 16 Renewable energy resource in Yorkshire and Humber, in terms of annual GWh of heat and electricity generation (excludes district heating resource).

Capabilities on project:
Building Engineering - Sustainability

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:
Building Engineering - Sustainability

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:
Building Engineering - Sustainability

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.

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

Capabilities on project:
Building Engineering - Sustainability

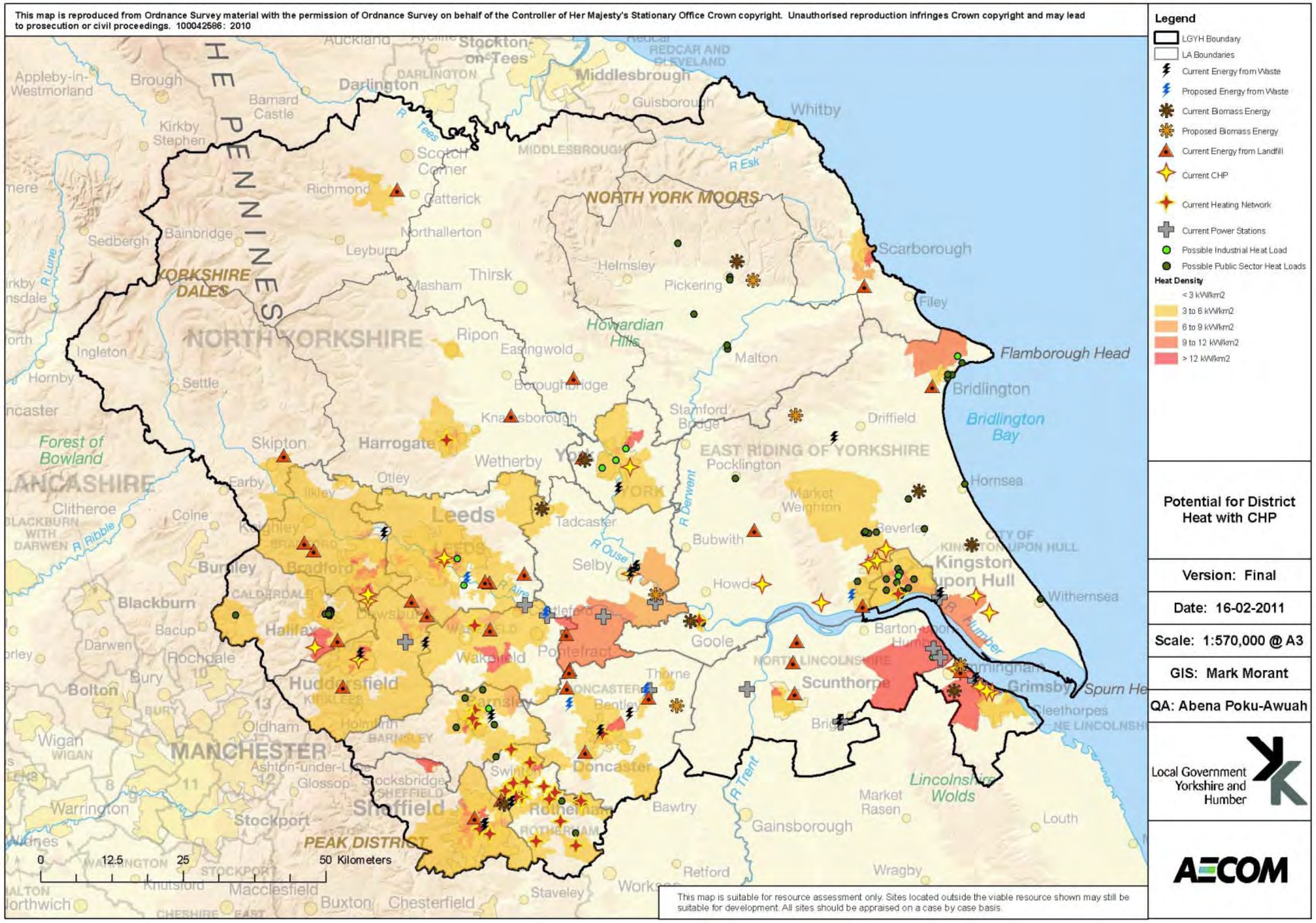


Figure 17 Potential for district heating with CHP, based on heat density. The areas with most potential are shown in red, areas with least potential are shown in yellow.

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.

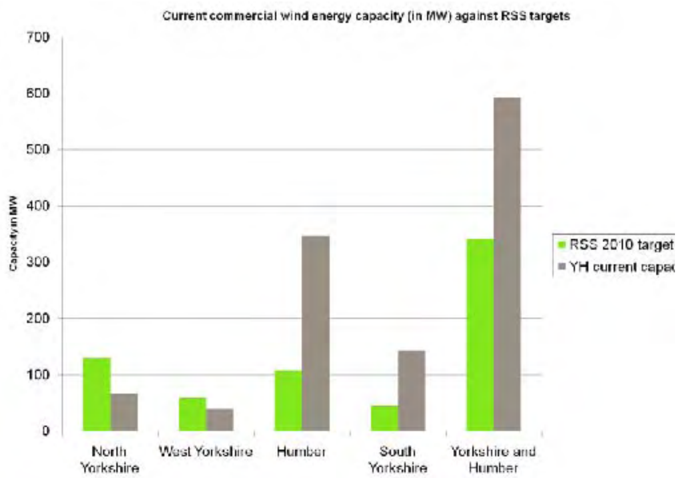


Figure 18 Progress of current commercial wind energy capacity against 2010 RSS targets. "Current" refers to facilities that are operational or have planning consent.

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.

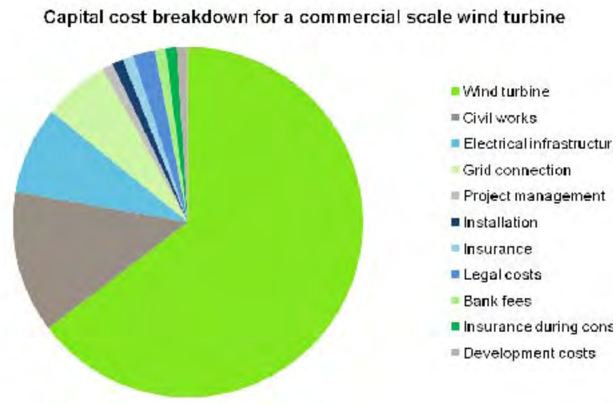


Figure 20 Capital cost breakdown for a large scale wind turbine. (Source: The economics of onshore wind energy; wind energy fact sheet 3, DTI)[17]

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

Capabilities on project:
Building Engineering - Sustainability

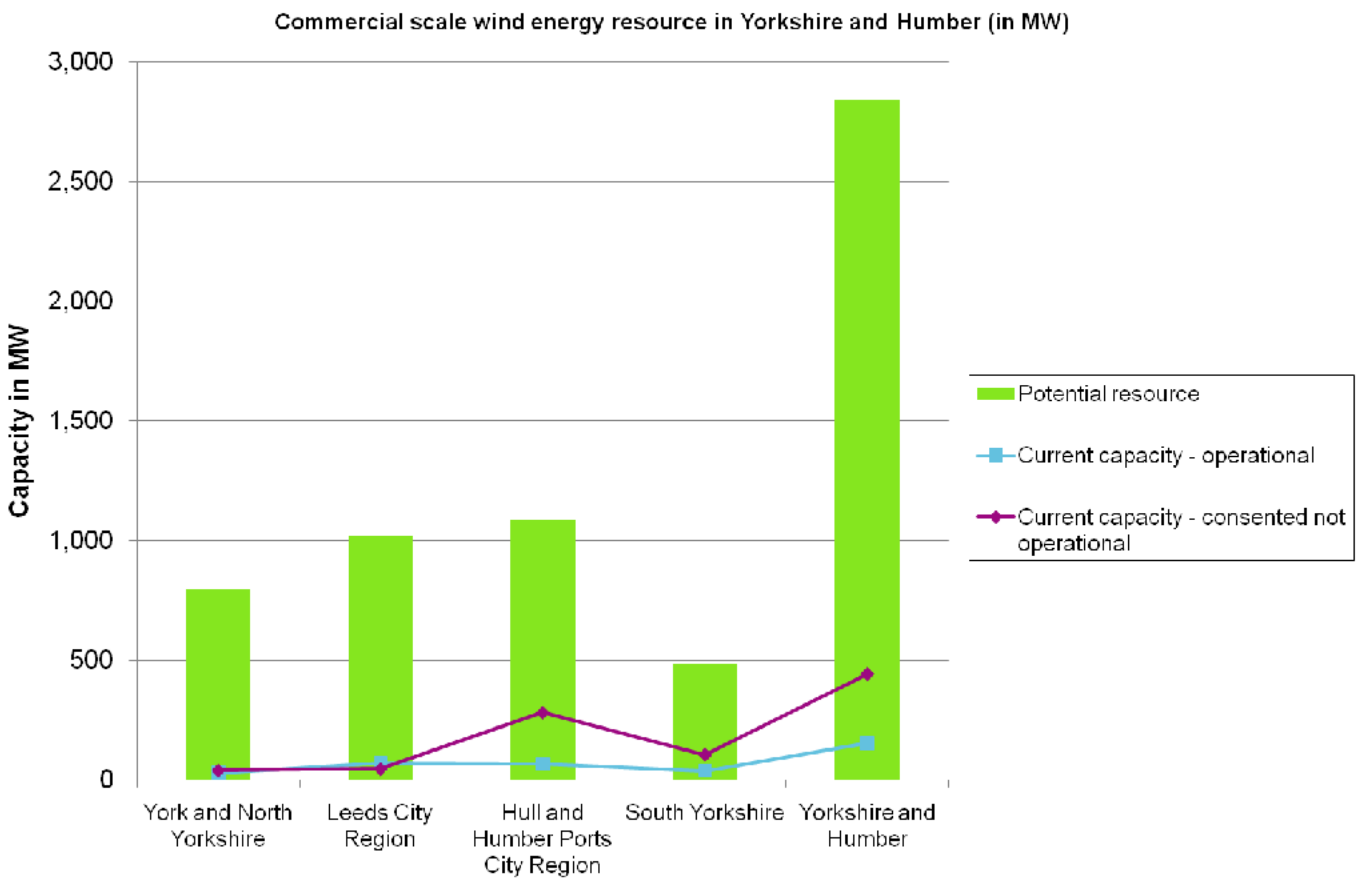


Figure 21 Commercial scale wind energy resource in Yorkshire and Humber, by sub region, in terms of potential MW.

Capabilities on project:
Building Engineering - Sustainability

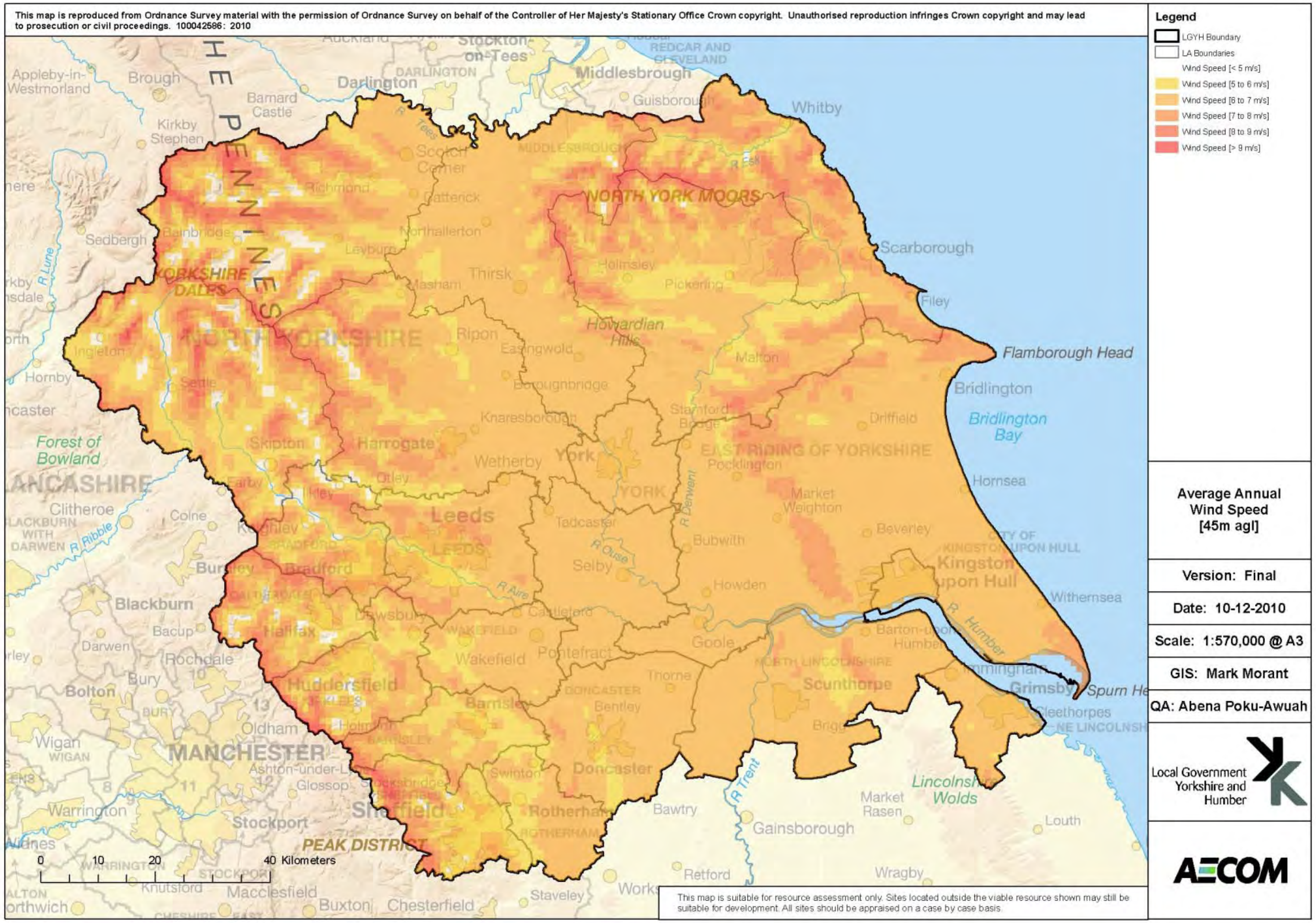


Figure 22 Annual average wind speed in Yorkshire and Humber in m/s, at 45 m height above ground level (Source: UK Wind Speed Database, accessed November 2010).

Capabilities on project:
Building Engineering - Sustainability

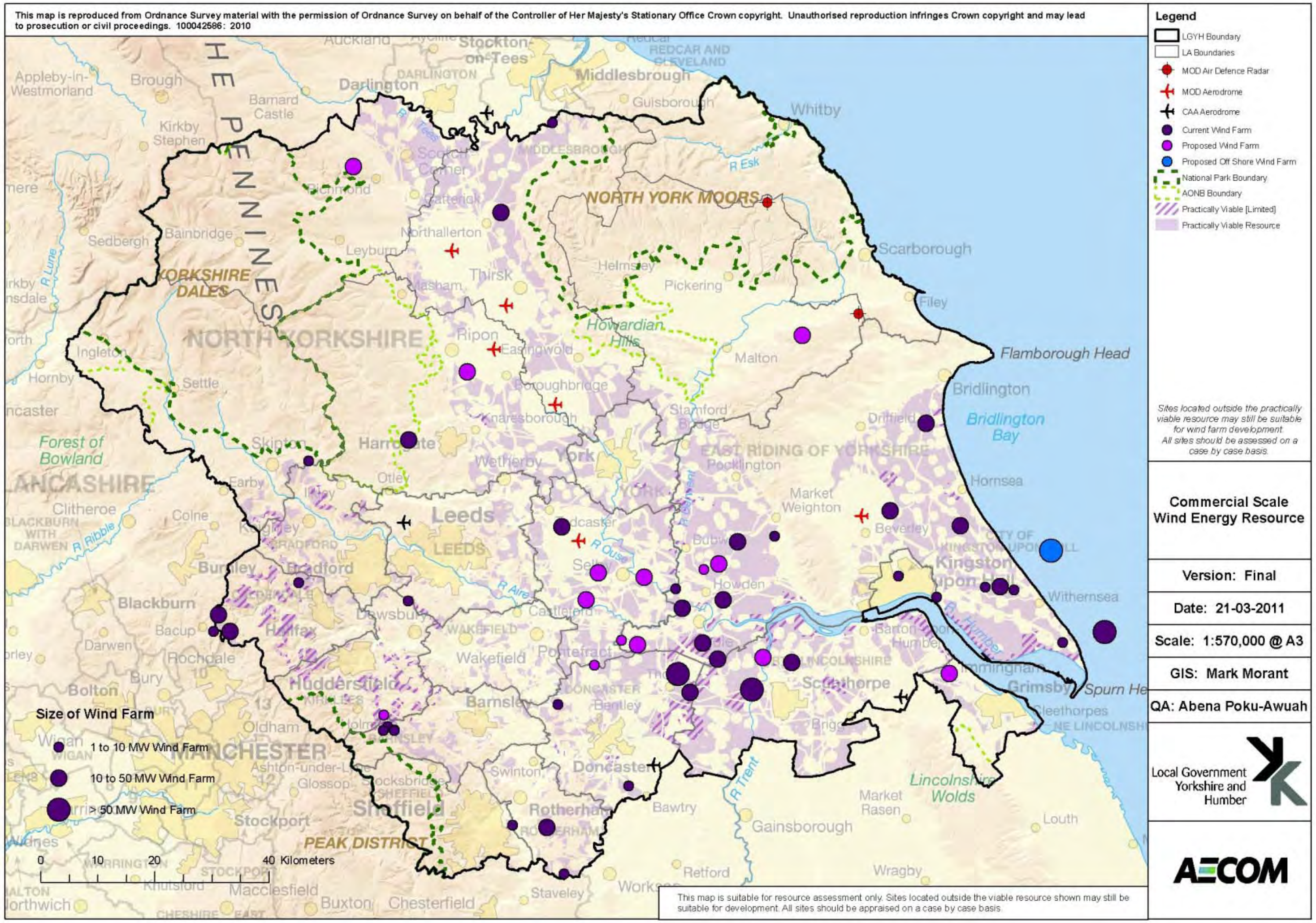


Figure 23 Commercial scale wind energy resource in Yorkshire and Humber. There are two further offshore wind farms in planning off the east coast (beyond boundary of map), Dogger Bank and Hornsea. “Current Wind Farm” refers to facilities that are operational or have planning consent. “Proposed Wind Farm” 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.

Capabilities on project:
Building Engineering - Sustainability

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.

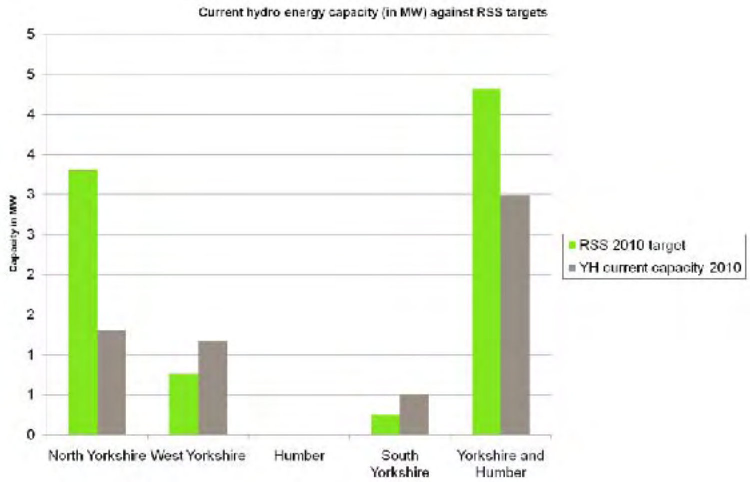


Figure 26 Progress of current hydro power schemes against 2010 RSS target. "Current" refers to facilities that are operational or have planning consent.

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.

Capabilities on project:
Building Engineering - Sustainability

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.

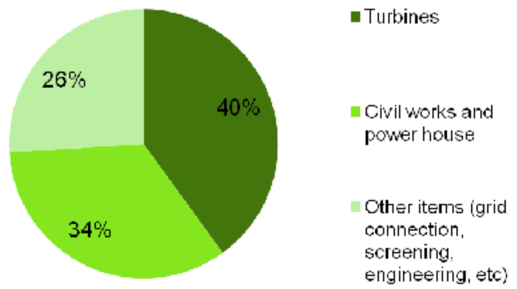


Figure 27 Typical cost breakdown for a hydro energy scheme (Source: Sustainability at the Cutting Edge, Smith, F, 2007)

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

Capabilities on project:
Building Engineering - Sustainability

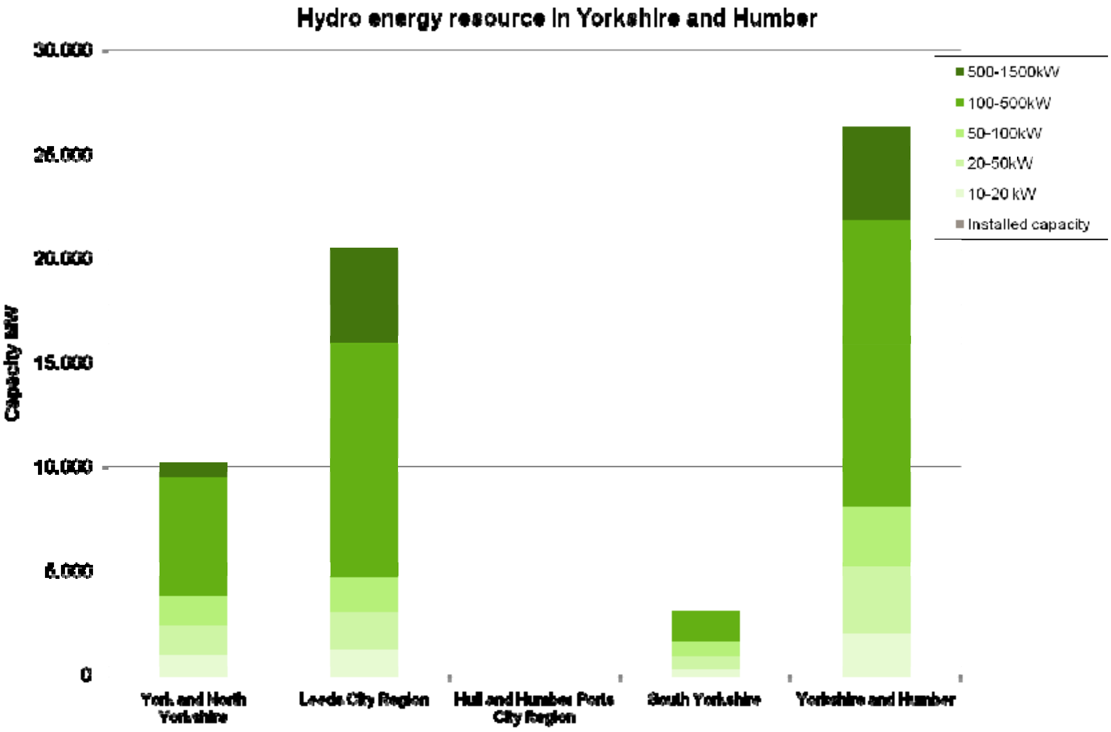


Figure 28 Hydro energy resource in Yorkshire and Humber by sub-region, in terms of potential MW. "Current" refers to facilities that are operational or have planning consent.

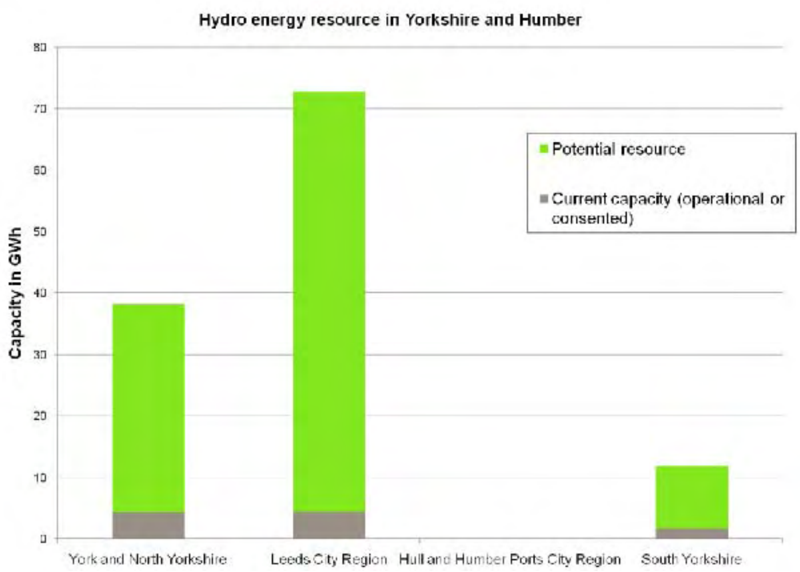


Figure 29 Hydro energy resource in Yorkshire and Humber, in terms of potential annual energy generation in GWh. "Current" refers to facilities that are operational or have planning consent.

Capabilities on project:
Building Engineering - Sustainability

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.

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

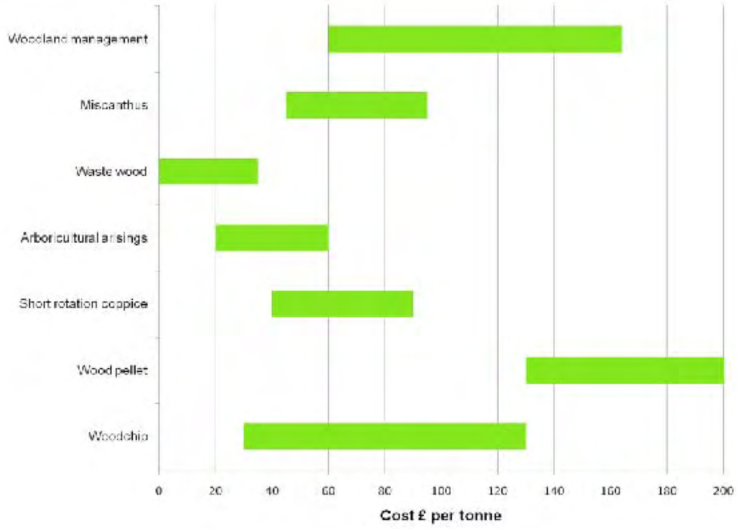


Figure 33 Guideline costs for different biomass fuels. (Source: Biomass heating, A practical guide for potential users CTG012, Carbon Trust, January 2009)

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

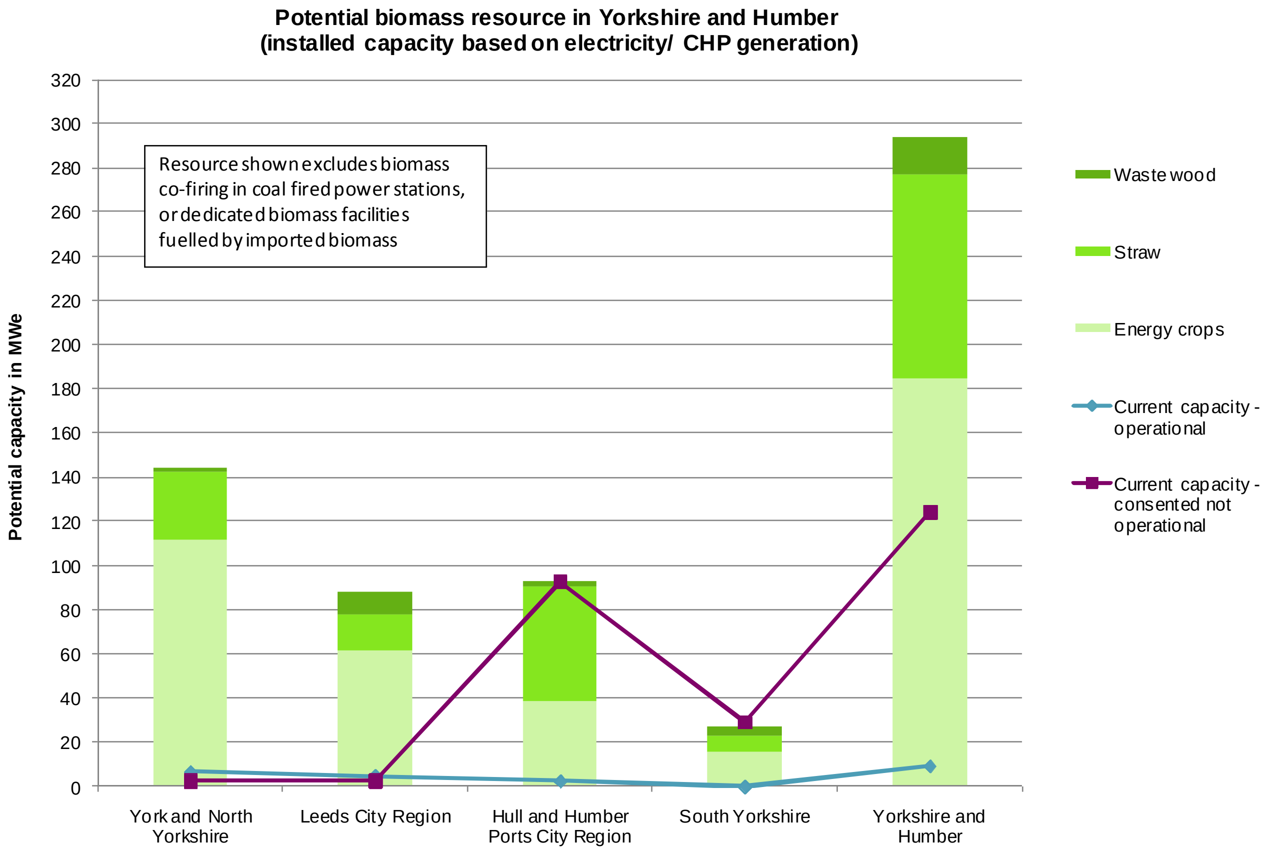


Figure 34 Biomass resource in Yorkshire and Humber, by sub region, in terms of potential MW. “Current” refers to facilities that are operational or have planning consent. The 129MWe of consented schemes for the region includes the 65MWe Stallingborough scheme, on the Humber which would run off imported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

Capabilities on project:
Building Engineering - Sustainability

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.

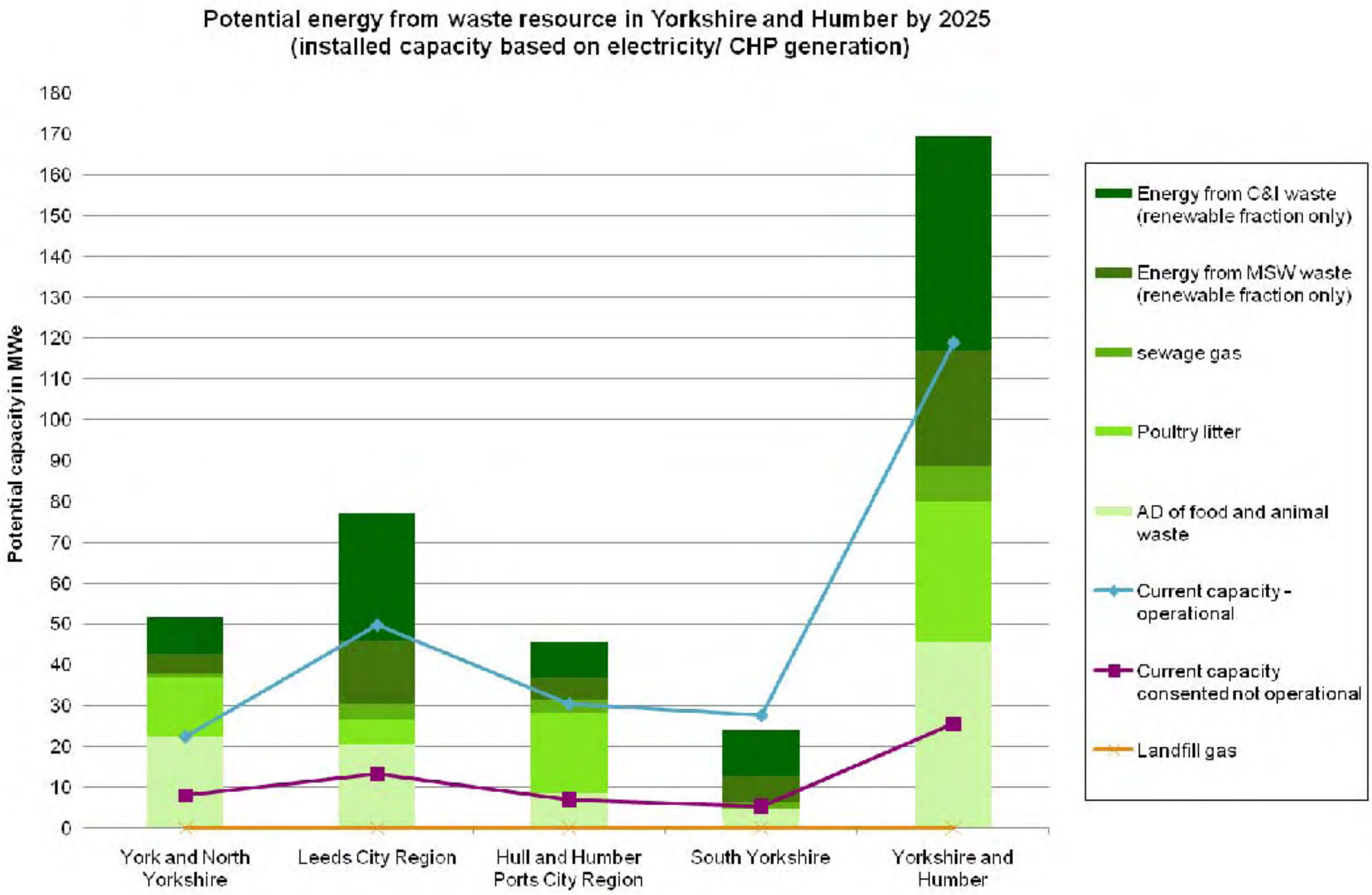


Figure 37 Energy from waste resource in Yorkshire and Humber, by sub region, in terms of potential installed electricity generation capacity in MW. The stacked columns illustrate the potential resource by 2025, whilst the lines show the current operational and consented capacity.

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.

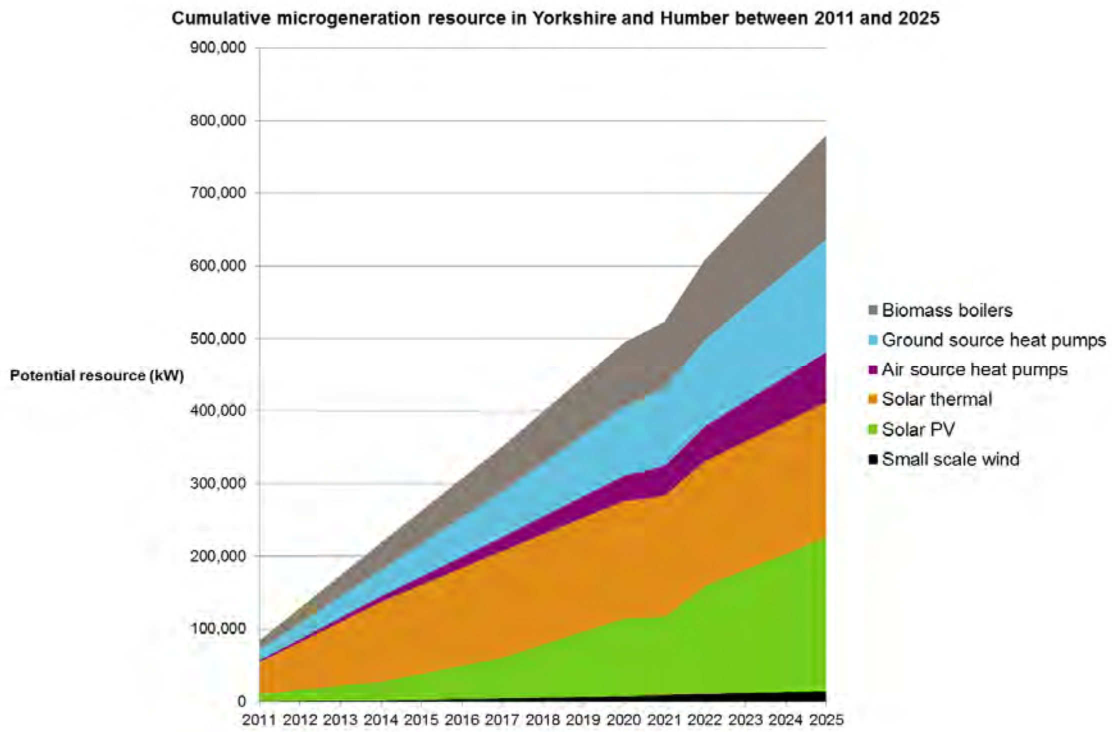


Figure 40 Cumulative microgeneration resource in Yorkshire and Humber between 2011 and 2025, in kW.

Capabilities on project:
Building Engineering - Sustainability

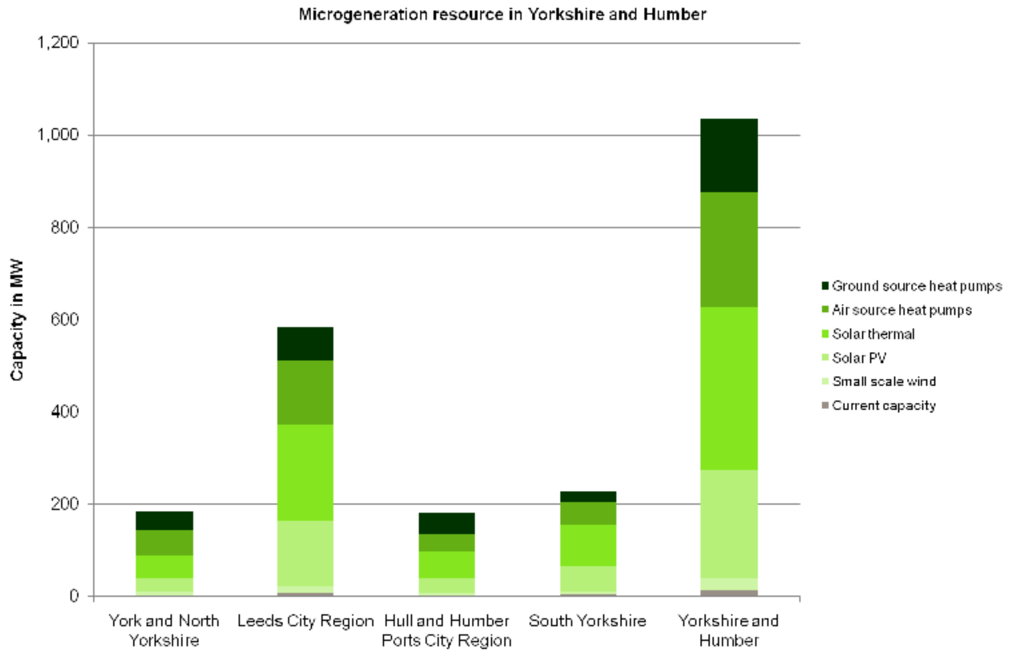


Figure 41 Microgeneration resource in Yorkshire and Humber, by sub region, in terms of potential MW. "Current" refers to facilities that are operational or have planning consent.

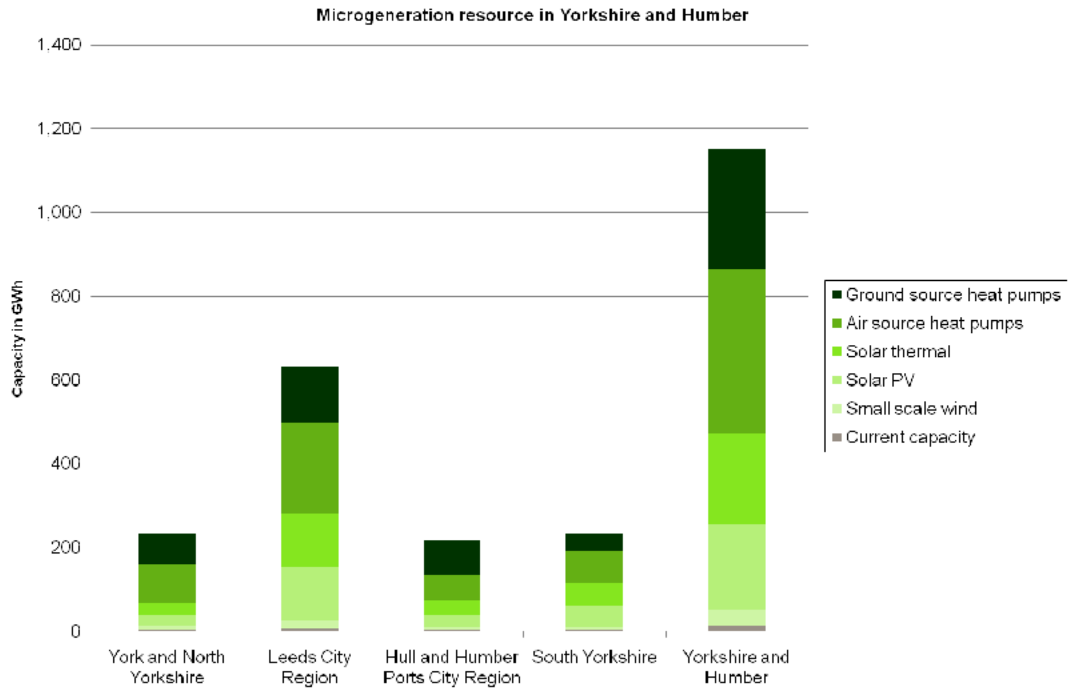


Figure 42 Microgeneration resource in Yorkshire and Humber, by sub region, in terms of annual energy generation in GWh. "Current" refers to facilities that are operational or have planning consent.

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.

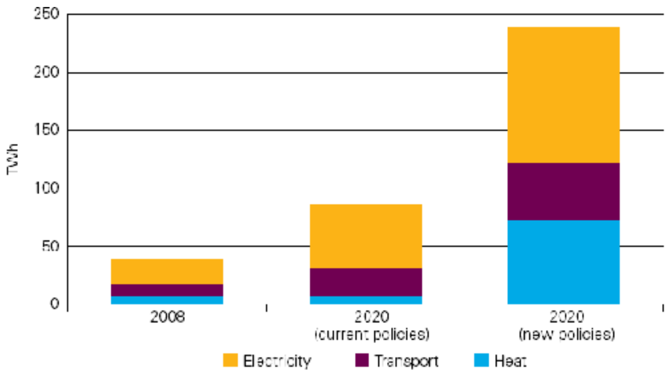


Figure 43 Potential scenario for the UK to reach 15% renewable energy by 2020 (Source: The UK Renewable Energy Strategy, DECC, July 2009)

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%.

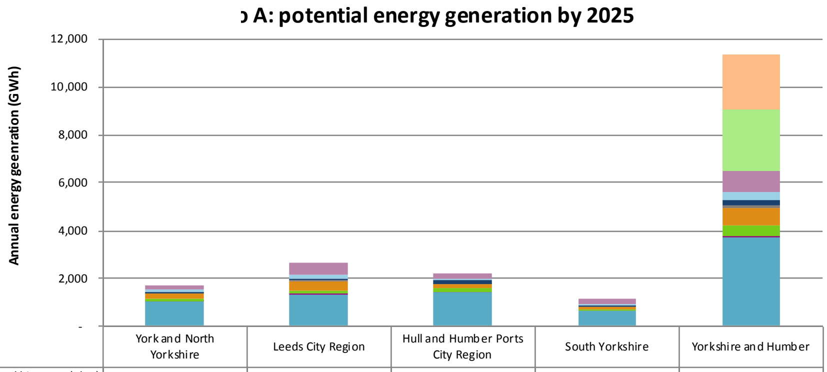
As mentioned above, the potential offshore resource for the UK, when applied pro-rata to the Yorkshire and Humber region, amounts to a total potential annual energy generation of just over 8,000GWh. This would represent between 7-12% of the region's total non-transport energy demand by 2025, depending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

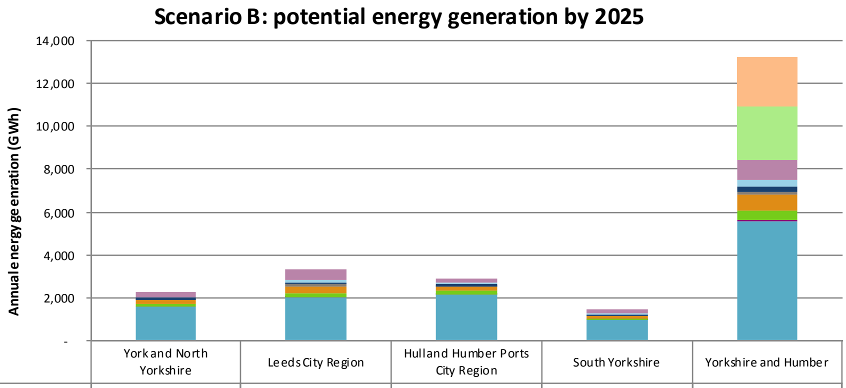
6.5 Results of scenario modelling

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

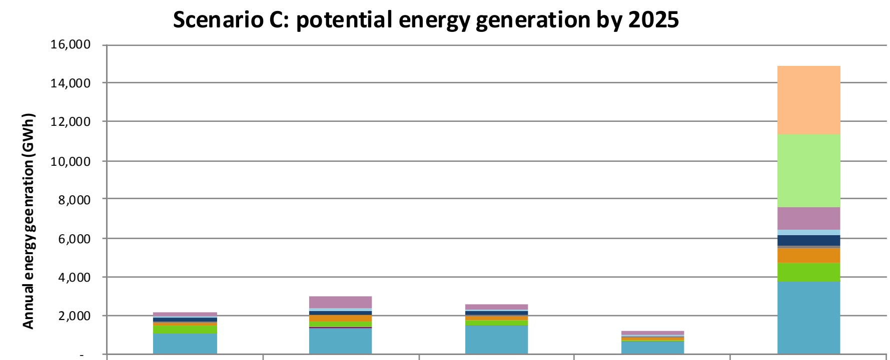
Figure 44 Effect on Yorkshire and Humber sub regions of scenario modelling of renewable energy Pathway A



	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

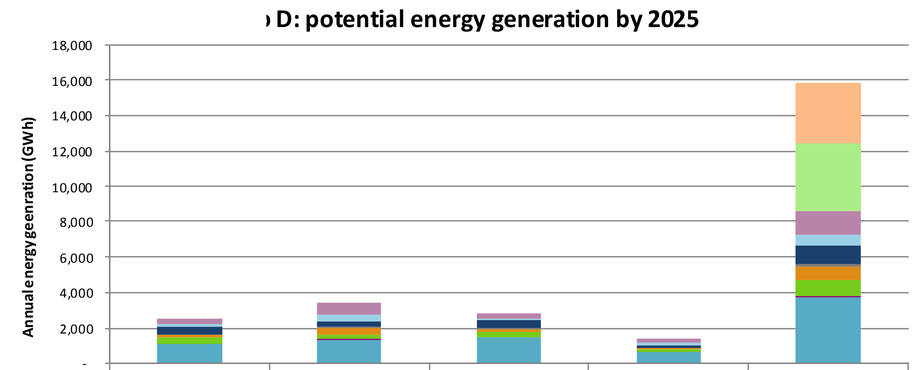
Figure 45 Effect on Yorkshire and Humber sub regions of scenario modelling of renewable energy Pathway B

Capabilities on project:
Building Engineering - Sustainability



	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

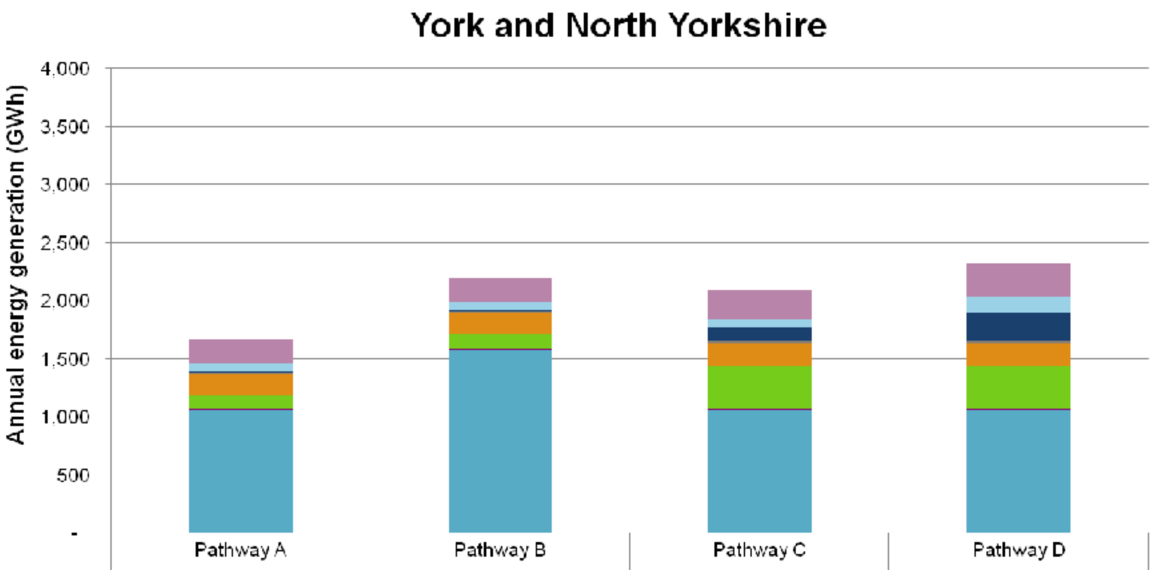
Figure 46 Effect on Yorkshire and Humber sub regions of scenario modelling of renewable energy Pathway C



	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.

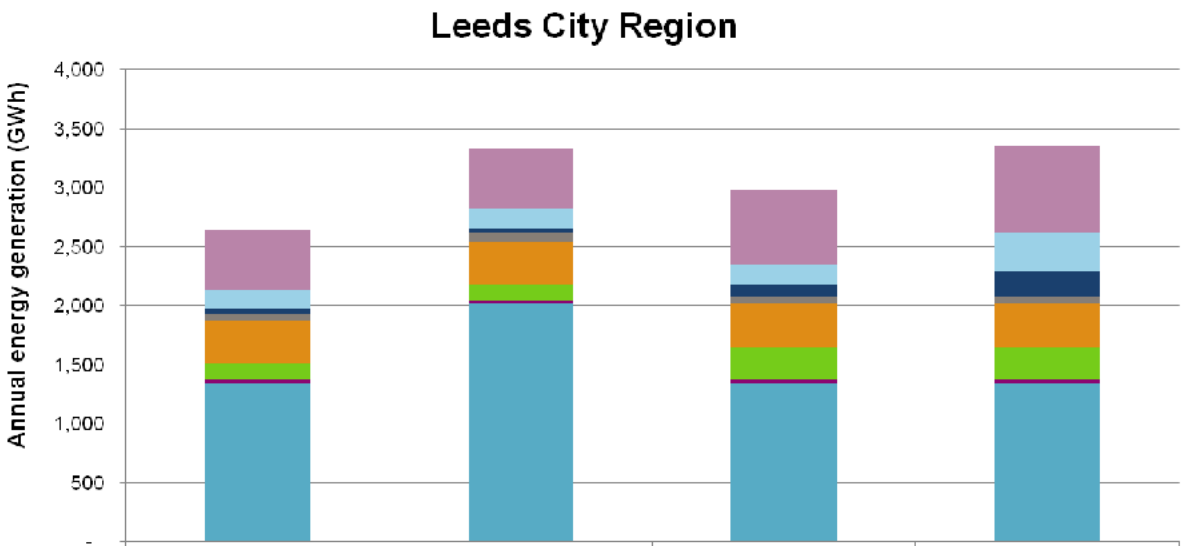
Energy scenario	Heat demand (GWh/ yr)	Electricity demand (GWh/yr)	Total energy demand (GWh/yr)
1	11,233	4,906	16,367
2	6,344	4,596	14,336
3	6,527	4,039	13,837
4	4,321	4,992	14,358

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

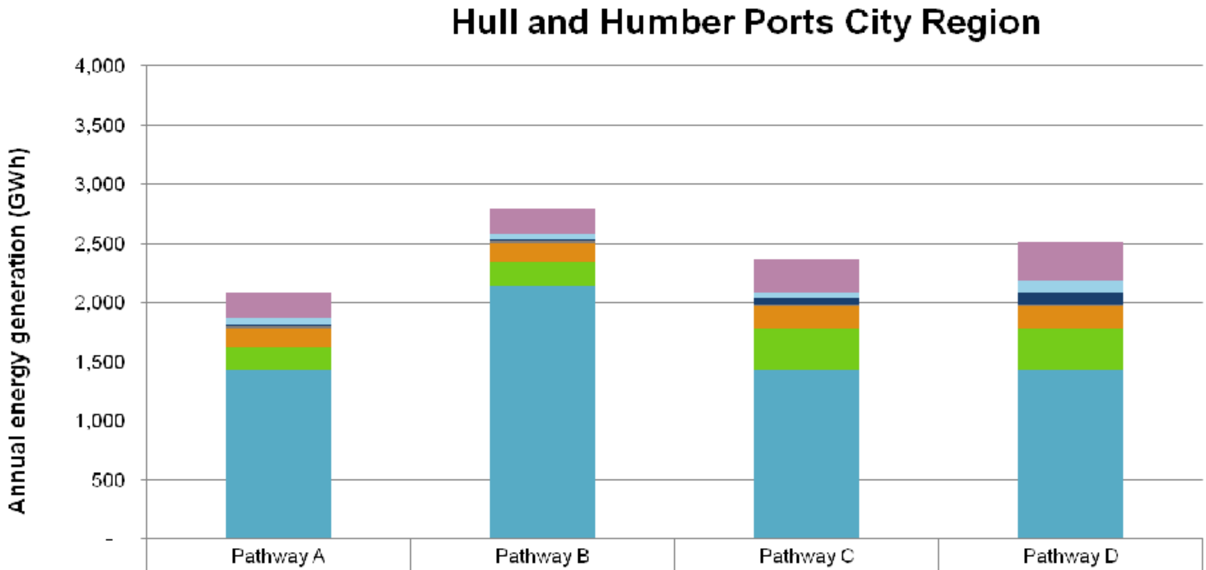
Table 17 Energy demand scenarios for the Leeds City region in 2025.

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.

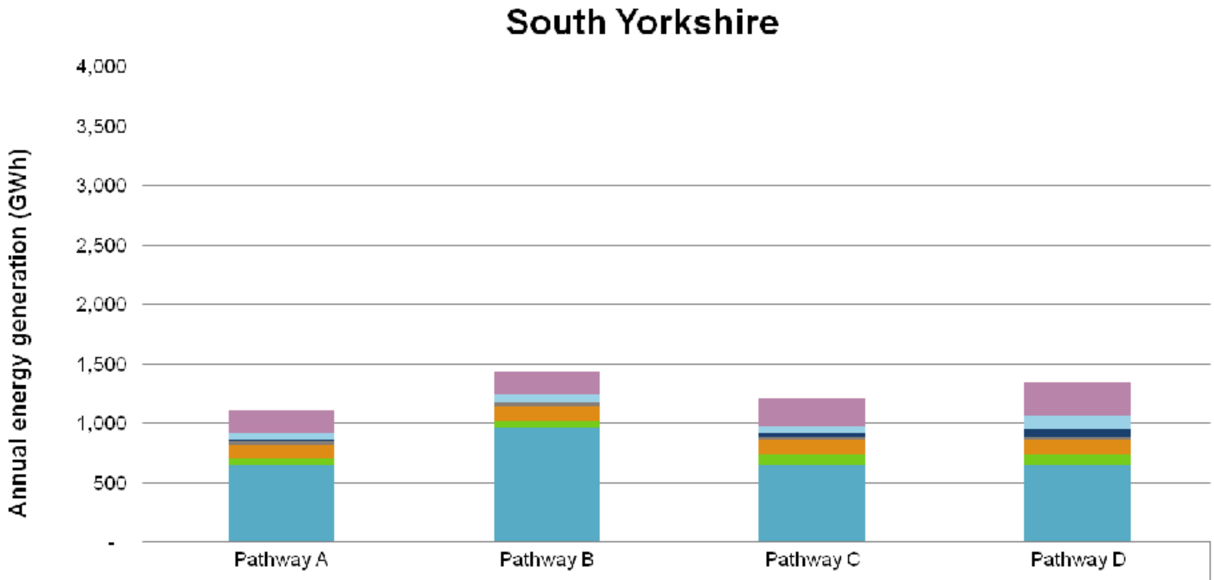
Energy scenario	Heat demand (GWh/ yr)	Electricity demand (GWh/yr)	Total energy demand (GWh/yr)
1	27,061	11,820	39,428
2	15,283	11,072	34,535
3	15,724	9,730	33,333
4	10,409	12,027	34,590

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

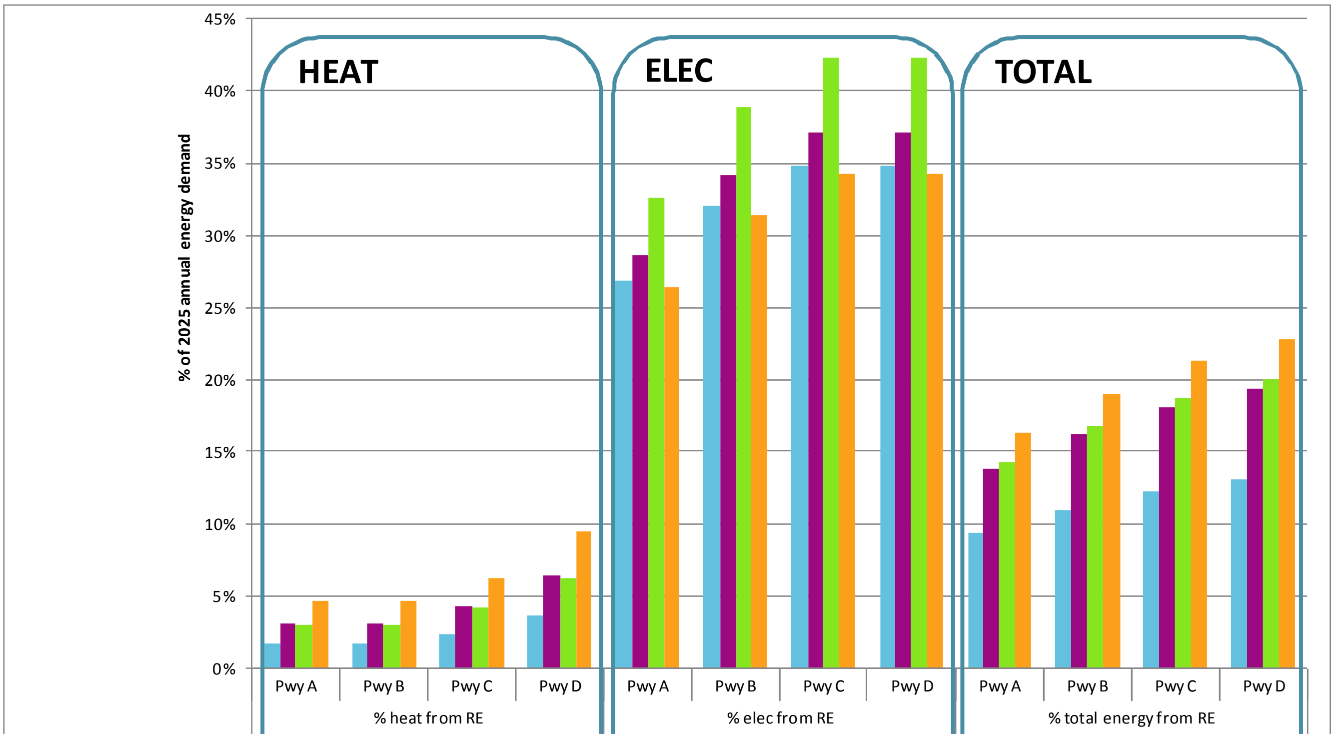
Table 19 Energy demand scenarios for the South Yorkshire sub region in 2025.

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.

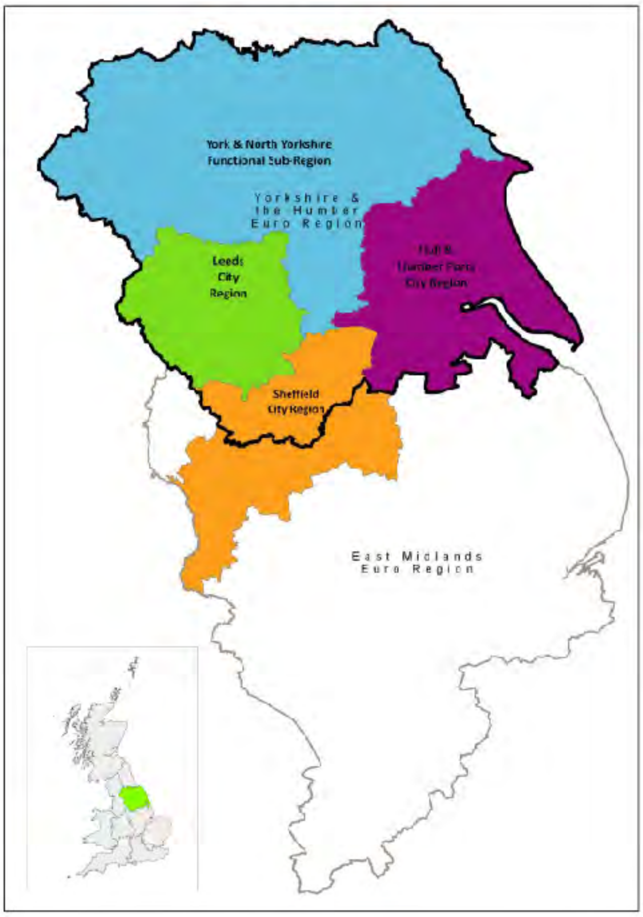


Figure 53 Location of the four functional sub-regions in Yorkshire and Humber

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.

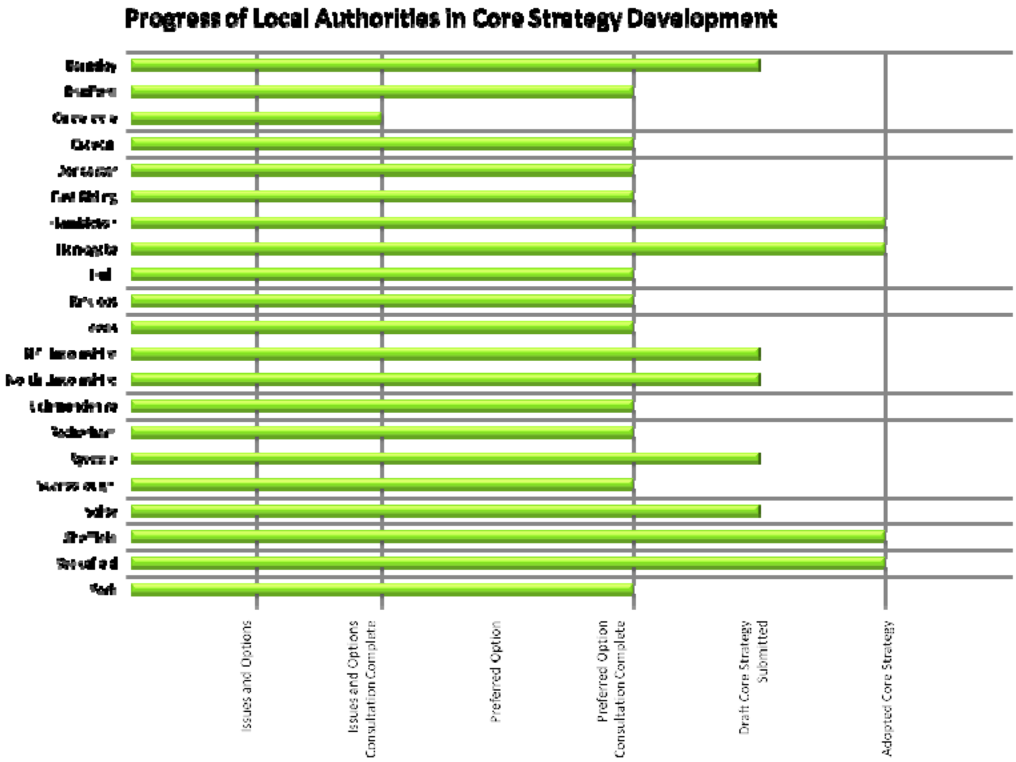


Figure 54 Relative progress in LDF development for local authorities in the Yorkshire and Humber region.

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

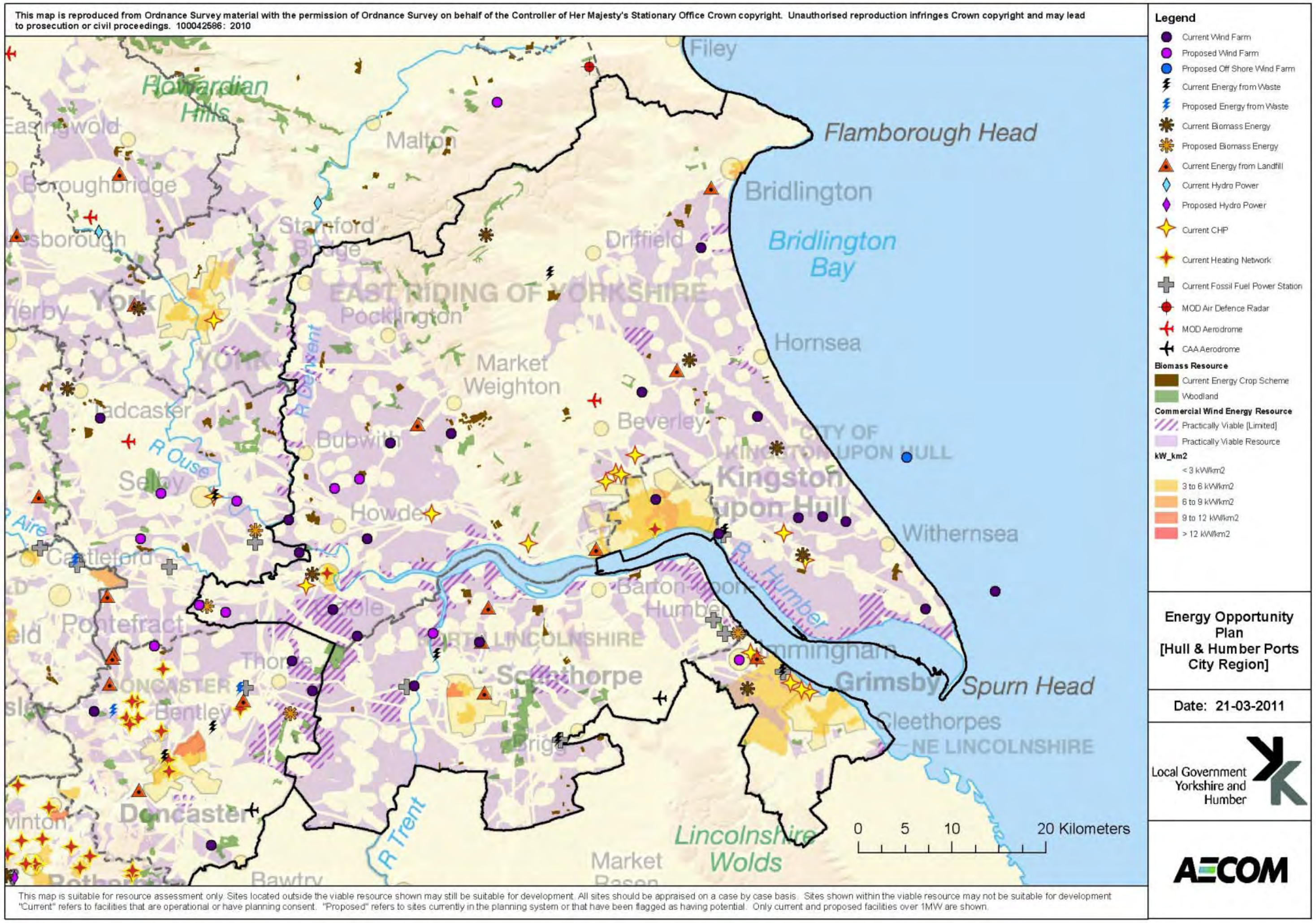


Figure 55 Energy Opportunities Plan for the Hull and Humber Ports sub region. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except 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

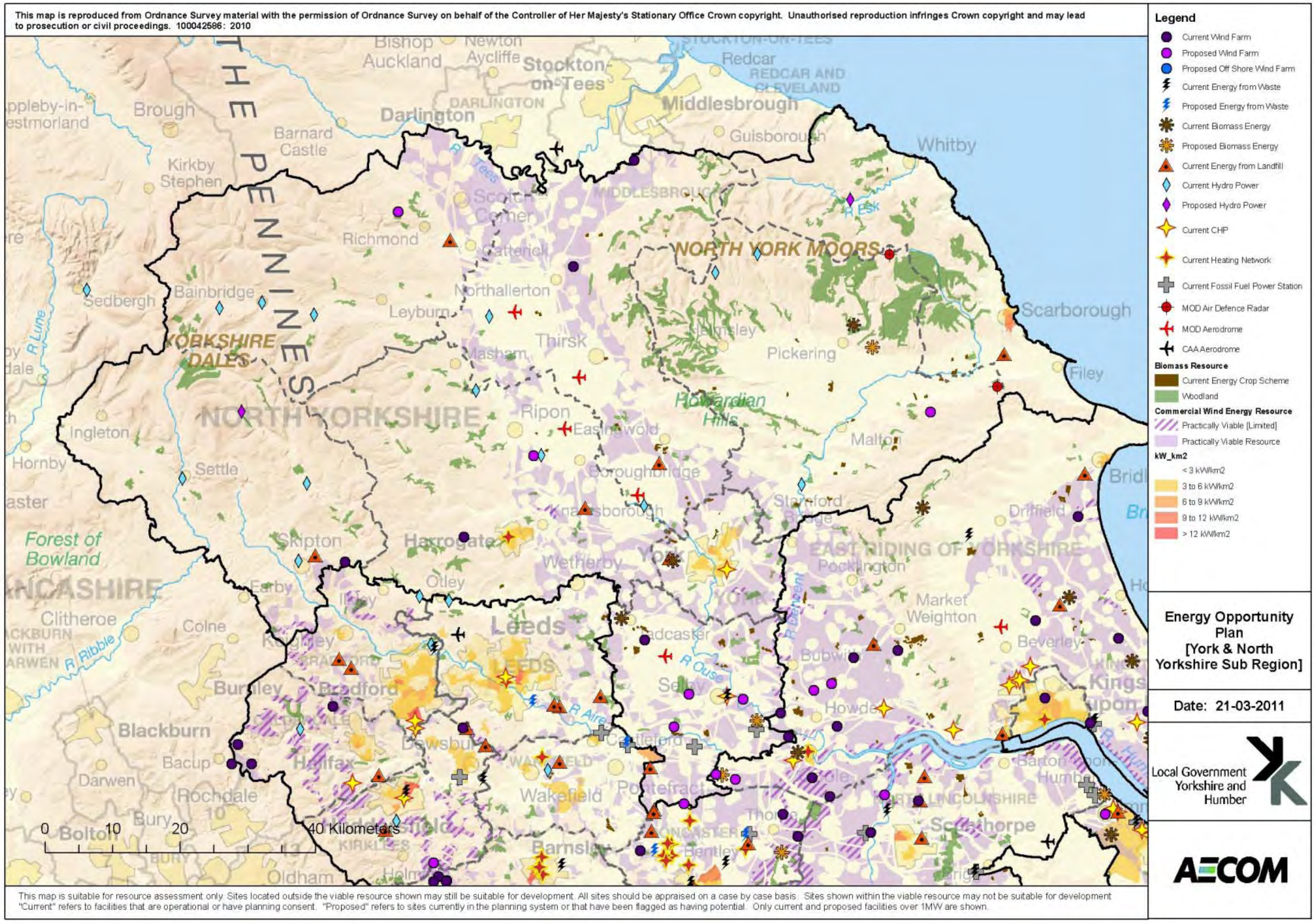


Figure 56 Energy Opportunities Plan for the York and North Yorkshire sub region. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except 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

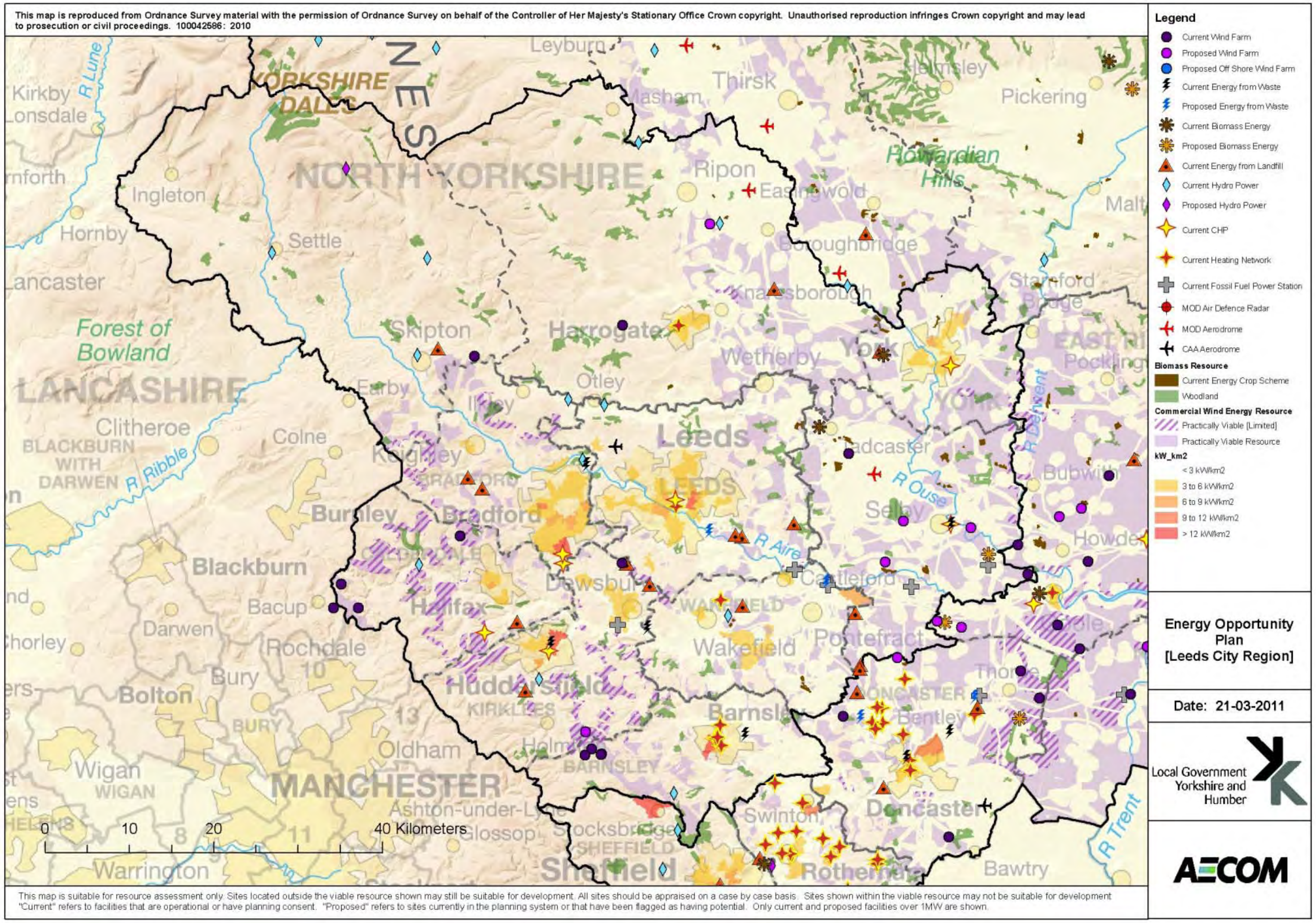


Figure 57 Energy Opportunities Plan for the Leeds City sub region. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only 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.

Capabilities on project:
Building Engineering - Sustainability

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

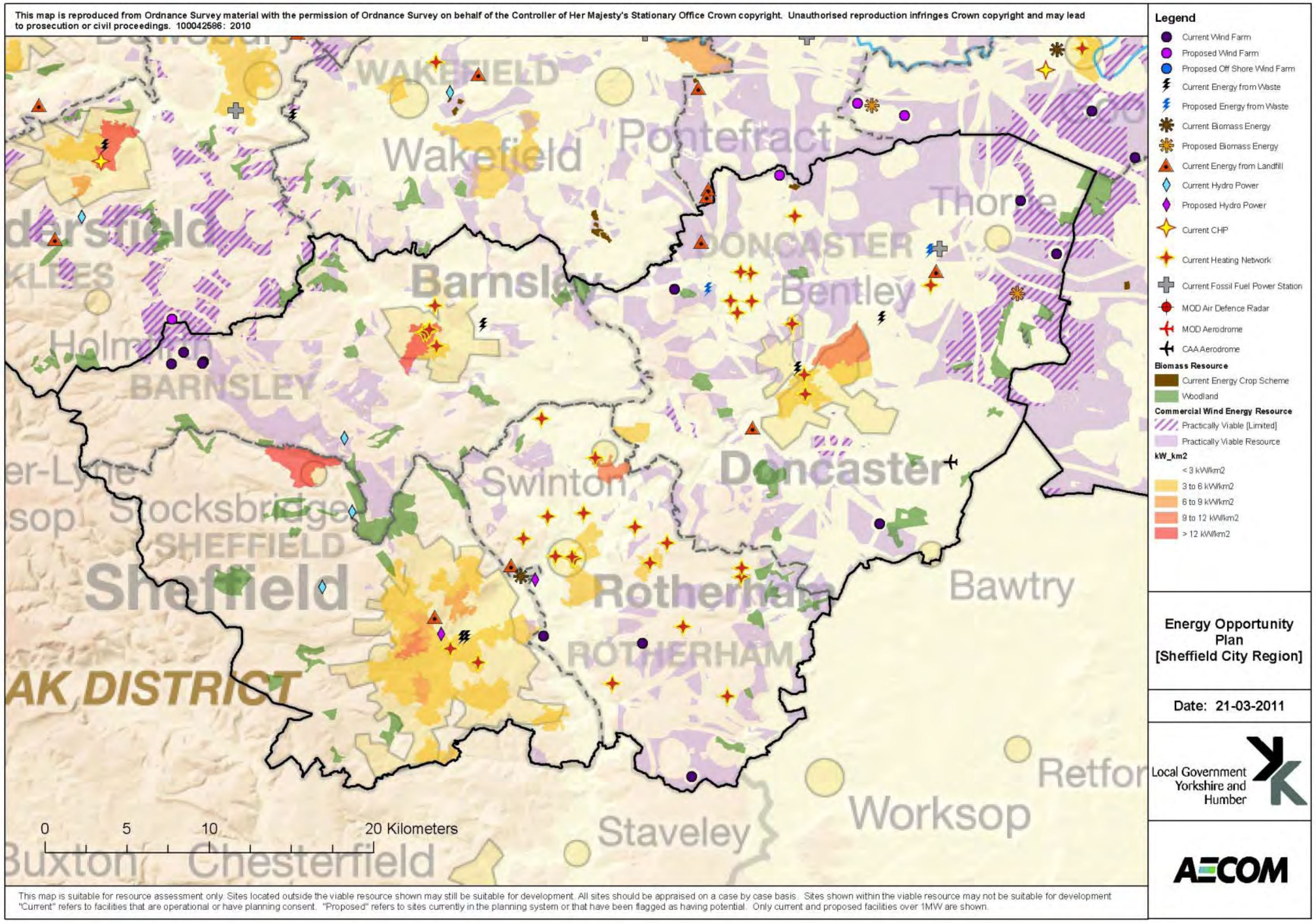


Figure 58 Energy Opportunities Plan for the South Yorkshire sub region. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, 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.

Capabilities on project:
Building Engineering - Sustainability

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.

Building Engineering - Sustainability

Local Government Yorkshire and Humber

11 April 2011

Low carbon and renewable energy capacity in Yorkshire and Humber

Final report

Prepared by: APA.. Abena Poku-Awuah Senior Consultant, AECOM

Approved by: SW .... Stephen Ward Regional Director, AECOM

Client: ME... Martin Elliot Planning Manager, Local Government Yorkshire and Humber

Low carbon and renewable energy capacity in Yorkshire and Humber
Final report

Rev No	Comments	Prepared by	Date	Approved by	Date
0	Draft for comment	APA	10.01.11	SW	10.01.11
1	Draft issued to DECC	APA	15.02.11	SW	15.02.11
2	Draft issued to heads of planning for comment	APA	16.02.11	SW	16.02.11
3	Final report issued	APA	21.03.11	SW	22.03.11
4	EOPs corrected to state that all hydro (incl <1MW) has been shown	APA	11.04.11	SW	11.04.11

The Johnson Building, 77 Hatton Garden, London, EC1N 8JS
Telephone: 020 7645 2000 Website: http://www.aecom.com

Job No 60147118 Reference Date Created April 2011

f:\sdg\jobs\sdg - yorkshire and humber renewable energy capacity study\06 reports\part c report\110411_lgyh_part_c_final report (issued).docx

Appendices

Appendix A Detailed description of methodology

A.1 Identification of installed capacity

Since the installation of renewables is not recorded consistently and in one place, details of installed capacity had to be aggregated from a number of sources, including:

- DECC CHP database[41]
- DUKES capacity of, and electricity generated from renewable sources[42];
- RESTATS database;[43]
- UK Heat Map[44];
- Natural England dataset;[45]
- CO2 sense dataset;
- Ofgem Renewables and CHP Register, data retrieved from April 2010 to December 2010;
- Low carbon buildings programme dataset, valid to February 2010;
- Ofgem FIT Installations Statistical Report;[46]
- Microgeneration Partnership.

A.2 Heat mapping of existing stock

In order to make inferences about the viability of district heating, the concept of "heat density" has been used. This is defined by the equation below.

$$Heat\ density = \frac{Annual\ heat\ demand\ [H]}{Number\ of\ hours\ in\ a\ year\ [N] x\ Area[A]}$$

Annual heat demand [H] has been estimated using DECC data for gas consumption at the MLSOA level. The gas consumption from residential and commercial uses has been combined for each MLSOA. An 80% efficiency factor has been assumed for conversion of gas supplied to heat demand. It has been assumed that 2.6% of gas supplied to the residential sector is used for cooking, based on statistics from DECC[47] (and has consequently been removed from the figure for annual heat demand).

The number of hours [N] in a year is 8760.

The area [A] in km^2 of each MLSOA has been taken from the Generalised Land Use Database.[48]

Potential issues with this method are:

- This approach misses heat supplied by other heating fuels. These are unlikely to be viable for district heating networks anyway. A small amount of electricity will be used for heating, especially in city centre flats and commercial buildings. However it is not possible to extract this split from the data.
- The highest resolution that we can carry out heat mapping for is at MLSOA scale. A large heat load will influence the average heat density for that entire MLSOA and could be misleading.

The DECC methodology states that "if heat density exceeds 3,000 kW/km^2, the heat density is considered to be high." Consequently this has been used as the threshold above which district heating with CHP can be considered viable.

The heat map shows additional information that could be used to inform the identification of future potential district heating schemes. These include:

- The location and size of large public sector buildings;
- Significant commercial and industrial loads;
- Potential sources of waste heat including power generation stations;
- Existing CHP and district heating infrastructure.

A.3 Microgeneration uptake in existing stock

The potential uptake of renewable microgeneration technologies in the existing housing stock and in the bulk of the existing non-residential building stock in each local authority was projected using a spreadsheet model developed by

[41] CHP database, DECC website accessed November 2010 http://chp.decc.gov.uk/app/reporting/index/viewtable/token/2
[42] Digest of United Kingdom energy statistics, DUKES database
[43] RESTATs, DECC website accessed November 2010, https://restats.decc.gov.uk/cms/welcome-to-the-restats-web-site
[44] UK heat map, DECC website accessed November 2010 http://chp.decc.gov.uk/heatmap/
[45] Wind turbine developments potentially relevant to the North, South and West Yorkshire, East Yorks & Humber, Natural England dataset, provided November 2010
[46] FIT Installations Statistical Report, Ofgem website accessed December 2010 https://www.renewablesandchp.ofgem.gov.uk/Public/ReportViewer.aspx?ReportPath=%2fFit%2fFIT+Installations+Statistical+Report_ExtPriv&ReportVisibility=1&ReportCategory=9
[47] The UK Low Carbon Transition Plan, DECC, July 2009
[48] Topics, Neighbourhood Statistics website, Office for National Statistics, accessed October 2010

AECOM. This forecasts the uptake of microgeneration technologies based on information about:

- The rates at which 'Primary' systems come up for necessary replacement and at which 'Discretionary' purchases are considered;
- The current housing stock and non-residential building stock;
- The identity and attributes of 'Primary' heating system options (including some renewables) and of 'Discretionary' renewables systems; and
- The relationship between system attributes (including cost and 'nuisance' factors) and purchasing decision-making – the Choice Model.

Installations in new homes and new non-residential buildings are subject to different drivers and were considered separately (section A.4).

The system attributes assumed to influence purchasing decisions are:

- Capital cost;
- Net annual energy costs: electricity & heating fuel costs (after any renewables savings) minus any incomes from feed in tariffs, renewable heat incentive and exports of electricity to the grid;
- Annual maintenance costs;
- Whether fuel storage is required (e.g. for biomass pellets or woodchip);
- Whether the garden needs to be dug up (for ground source heat pumps installation in homes); and
- Whether additional indoor 'cupboard' space is needed (for micro-CHP units in homes, as the technology is typically larger than the generator being replaced).

The model accounts for projected real (i.e. excluding inflation) changes in costs and prices over time.

A.3.1 Rate of consideration for Primary and Discretionary systems

It is assumed in the model that householders or landlords may purchase microgeneration technologies in one of two situations:

1. As the 'Primary' heating system for a home, as a necessary replacement for a previous heat generator that has reached the end of its life. Once homes reach an age equal to the typical service life of a boiler, it is assumed that a fixed percentage of homes need a new primary heat generator each year. The replacement rate is assumed to be 6% per year. As the replacement is 'of necessity', it is assumed that one of the list of suitable heating options must be selected;
   - Condensing gas boiler,
   - Condensing oil boiler,
   - Condensing LPG boiler,
   - Direct electric heating,
   - Ground source heat pump,
   - Air source heat pump,
   - Stirling engine CHP,
   - Fuel cell CHP (non-residential only),
   - Biomass pellet boiler, or
   - Biomass woodchip boiler.
2. As a 'Discretionary' purchase where the status quo is not to have a micro generator, and therefore one of the 'system' options is not to install one. By definition, Discretionary systems may be purchased at any time. The assumption made in the model is that 10% of households and businesses consider purchasing a microgeneration system each year.

   The following Discretionary generator options are included in the model:
   - Micro-wind turbines
   - Small wind turbines
   - Solar water heating
   - Solar PV

A.3.2 Existing building stock

The rates of consideration are combined with data on the building stock to determine the number of primary heat generator replacements being selected and the number of discretionary purchases of micro generators being considered each year.

System suitability for non-residential buildings is assumed to depend only on building type. For homes, the suitability of technology options depends on:

- Home type (house or flat),
- Age (pre-1980, 1981 – 2005 or 2006 – 2016),
- Tenure (owner occupied, private rented, or social rented),
- Rurality (urban, suburban, or rural), and
- Gas connectivity (connected to mains gas or off-gas).

As such, the model requires data on:

- The current total number of homes, and the breakdown by type, age, tenure, rurality and gas connection; and
- The number (and where possible the floor area) of non-residential buildings by type.

A.3.3 Housing stock data

The modelling uses the most up to date and comprehensive data on house numbers and typology that were identified. Data on the numbers of homes in each local authority area were obtained from Communities and Local Government 'Dwelling Stock Estimates' (CLG, 2010). The breakdown of the housing stock was arrived at as follows:

- The percentage split by home type (house or flat) was based on Strategic Housing Market Assessment reports. (No SHMA was found for Doncaster, so the split was assumed to be the average for Yorkshire & Humber.)
- The percentage split by age was based on a sample of Private Housing Stock Condition Surveys published by local authorities in or around 2004.
- Percentage by tenure was taken from the last English House Condition Survey Regional Report Supplementary Tables (CLG, 2006).
- The percentage split by rurality was based on rural-urban designation of Middle Super Output Areas obtained through a custom query on the Neighbourhood Statistics portal of the Office of National Statistics website. The ONS RUURB designations are different from the 'urban – suburban – rural' split used in the model. The breakdown in the model was derived by: grouping source data for all MLSOAs designated 'Urban' and assuming 75% are 'suburban' (for the purposes of the model); grouping source data for all other MSOAs as 'rural'.
- The percentage split by gas network connectivity was based on data published on ruralfuelpoverty.org.uk (resulting from research on Hard to Treat Homes).

The housing stock classification adopted in the model results in 144 housing sub-types. The number of homes of each sub-type in each local authority is assumed to be the total number of homes multiplied by the respective percentages for type, age, tenure, rurality and gas connectivity.

The total number of homes in the stock is assumed to decline at 0.07% per year, reflecting historical rates of demolition.

A.3.4 Non-residential building stock data

The modelling uses available data on non-residential buildings, accepting that with the possible exception of Valuation Office Agency data on Bulk classes, the data are not comprehensive. The numbers of non-residential buildings by type were obtained as follows:

Bulk class types (Valuation Office Agency)

- Retail
- Offices
- Warehouses
- Factories

Other types (Local Authority data, as available)

- Hospitality
- Health
- Schools
- Leisure centres

The total number of non-residential buildings is assumed to be constant for the purposes of the model.

A.3.5 The Choice Model for projecting purchasing decisions

At the heart of the AECOM take-up model is a choice model for forecasting purchasing decisions given the attributes of alternative, competing system options. In outline, the choice model is based on the theory that consumers make decisions to maximise 'utility' – the net benefits as perceived by the consumer, and that consumers' utility calculations are based on differences in specific attributes of the available options.

Day-to-day utility calculations are largely implicit and evaluation varies from consumer to consumer. A particular type of market survey called a 'conjoint survey' was used to collect data in a way that can reveal the implicit utility calculations, given a set of what are assumed to be the key attributes. A statistical technique called 'conditional logit', a form of regression analysis, was then used to calculate the coefficients of the formulas that each group of consumers is implicitly using to make choices. The survey distinguished owner-occupiers from landlords and non-domestic building owners and, as expected, found they valued attributes differently. The survey and analysis also distinguished between 'Primary' and 'Discretionary' choices and hence developed independent uptake models. The coefficients derived were highly statistically significant, showing that within the groups identified, consumer survey responses suggested strong similarity in the implicit calculation of utility.

The benefit of the use of conditional logit analysis is that the results can be used to forecast purchasing decisions given the attributes of alternative system options. For Primary decisions, the model calculates the proportion of consumers that will select each of the suitable system options, given their attributes. (Costs, fuel prices, etc. vary over time, while non-cost attributes stay constant.) The modelling principles are identical for Discretionary decisions with the notable inclusion of "do nothing" among the system options.

A detailed mathematical explanation of the choice model is outside the scope of this report but further information on the conjoint survey and conditional logit analysis underpinning the modelling is available in the original Element Energy research report used as the basis for the model. [49]

A.4 Microgeneration uptake in new development

Our analysis was based on standard assumptions about the renewable energy output that a range of technologies could deliver for different types of building. The microgeneration technologies considered for new development were:

- Solar PV
- Solar water heating
- Air source heat pumps
- Ground source heat pumps
- Biomass boilers
- Small scale wind

We have assumed that 21,145 homes will be built annually across the region, in the locations shown in Table 23 below.

Typical development scenarios were derived from CLG research analysing the cost of Code for Sustainable Homes compliance.[50] These were used to break down homes in to different development types and estimate the mix of homes compared to flats.

Expected employment/job numbers were taken from the RSS. These were converted into potential area (in m^2) of new commercial development per building type using the "Planning for Employment Land" report produced for Yorkshire Forward in 2010[51] and an Arup report produced for the Homes and Communities Agency and Regional Development Agencies, analysing typical employment densities.[52]

[49] The growth potential for Microgeneration in England, Wales and Scotland, Element Energy, TNS, Willis, K., Scarpa, R., Munro, A., 200

[50] Code for Sustainable Homes: A Cost Review, CLG, March 2010

[51] Planning for employment land, translating jobs into land, Roger Tyms and Partners, April 2010

[52] Employment Densities: A Full Guide, Arup Economics and Planning, July 2001

Capabilities on project:
Building Engineering - Sustainability

Local authority	Annual number of homes
Barnsley	1015
Bradford	2700
Calderdale	670
Craven	250
Doncaster	1230
East Riding of Yorkshire	1150
Hambleton	280
Harrogate	390
Kingston Upon Hull, City of	880
Kirklees	1700
Leeds	4300
North East Lincolnshire	512.5
North Lincolnshire	747.5
Richmondshire	200
Rotherham	1160
Ryedale	200
Scarborough	560
Selby	440
Sheffield	1425
Wakefield	1600
York	850

Table 23 Expected residential development in Yorkshire and Humber (Source: correspondence with Local Government Yorkshire and Humber).

Size	Type	Number of dwellings	Density per hectare	% flats	% terraced	% semi	% detached	Num. flats	Num. terraced	Num. semi	Num. detached
small	brownfield	20	80	40%	35%	20%	5%	8	7	4	1
Small	greenfield	50	40	40%	30%	20%	10%	20	15	10	5
small	edge of town	10	40	0%	40%	20%	40%	0	4	2	4
medium	edge of town	650	40	30%	30%	20%	20%	195	195	130	130
medium	Urban (mixed)	350	80	50%	25%	20%	5%	175	87.5	70	17.5
Large	edge of town	3300	40	30%	30%	20%	20%	990	990	660	660

Table 24 Housing development types used in projecting renewable energy uptake for Yorkshire & Humber (Source: Code for Sustainable Homes: A Cost Review, CLG, March 2010)

Type of building	m^2
Offices B1	255
Retail & Leisure	187
Industry	1050
Storage	818
Health & Education	5000
Other	426

Table 25 Assumed gross internal area per workspace (Source: Planning for employment land, translating jobs into land, Roger Tyms and Partners, April 2010 and Employment Densities: A Full Guide, Arup Economics and Planning, July 2001)

Local authority	Offices B1	Retail & Leisure	Industry	Storage	Health & Education	Public Services Other	Other
Barnsley	3230	5000	17000	6500	5500	-920	9200
Bradford	23370	15800	26180	17500	19000	-1840	39100
Calderdale	4180	2200	-3400	3000	3500	0	8280
Craven	760	1000	-1020	500	250	0	1840
Doncaster	1140	1800	26520	3500	5250	-1380	16560
East Riding of Yorkshire	2660	3800	-3400	2000	9250	-1380	7360
Hambleton	190	800	680	1000	750	-1840	4600
Harrogate	1520	2000	340	1500	2250	-920	5980
Kingston Upon Hull, City of	6460	7000	0	-3500	7000	-1380	1840
Kirklees	1900	4000	21080	8000	6000	-1380	11960
Leeds	22800	7000	74120	22000	16250	3680	51520
North East Lincolnshire	1900	800	-680	2000	10500	1380	5060
North Lincolnshire	3040	1200	0	5000	2750	-460	5980
Richmondshire	0	1000	0	500	1000	-920	2760
Rotherham	2280	4000	13600	5000	8500	460	19320
Ryedale	380	400	680	500	500	-460	3220
Scarborough	380	400	680	0	1000	-460	3220
Selby	0	600	-680	0	250	0	-4140
Sheffield	22230	13600	8500	8000	25500	3220	47840
Wakefield	6080	7400	-5440	4500	6500	-1840	13800
York	9120	9000	7140	9000	12000	2300	10580

Table 26 Additional commercial/employment floorspace expected by new, non-domestic development in Yorkshire and Humber, in m2 (Source: Planning for employment land, translating jobs into land, Roger Tyms and Partners, April 2010 and Employment Densities: A Full Guide, Arup Economics and Planning, July 2001)

A.5 Calculating energy output from renewable schemes
The installed generating capacity is expressed in terms of megawatts MW throughout the report. This is a measure of the maximum power that can be delivered by the technology.

The installed generating capacity is not the same as actual generation. The installed capacity must be multiplied by a capacity factor which represents the proportion that is likely to be generated in practice.

All energy generation technologies have a capacity factor less than 100% and this occurs for a variety of reasons. There may be reductions in generation due to maintenance, faults or variations in demand. The capacity factor for some technologies also reflects the fact that energy generation may be inherently intermittent, as for wind, or diurnal, as for solar.

The capacity factors used within the study are shown below in Table 27. The annual generation for each technology has been expressed throughout the report in Gigawatt Hours (GWh).

Energy generation method	Load factor	Availability	Overall Capacity factor	Source of information
Commercial scale, onshore wind	n/a	n/a	30%	DECC 2050 calculator[53]
Commercial scale, offshore wind	n/a	n/a	35%	DECC 2050 calculator[53]
Hydro	n/a	n/a	38%	DECC 2050 calculator[53]
Wave	25%	90%	23%	DECC 2050 calculator[53]
Tidal stream	40%	90%	36%	DECC 2050 calculator[53]
Tidal range	24%	95%	23%	DECC 2050 calculator[53]
Biomass heat (managed woodland)	n/a	n/a	340%	AECOM experience
Biomass CHP (heat)	n/a	n/a	50%	AECOM experience
Biomass CHP (electricity)	n/a	n/a	90%	AECOM experience
Biomass co-firing (electricity)	n/a	n/a	81%	DUKES 2009[54]
Energy from dry organic waste (heat)	n/a	n/a	59%	DUKES 2009[54]
Energy from wet organic waste (heat)	n/a	n/a	80%	DUKES 2009[54]
Energy from MSW, C&I waste CHP (heat)	n/a	n/a	50%	AECOM experience
Energy from MSW, C&I waste CHP (electricity)	n/a	n/a	80%	AECOM experience
Energy from waste, landfill gas	n/a	n/a	60%	DUKES 2009[54]
Energy from waste, sewage gas	n/a	n/a	42%	DUKES 2009[54]
Small scale wind	n/a	n/a	15%	AECOM experience
Solar PV	n/a	n/a	10%	AECOM experience
Solar water heating	n/a	n/a	7%	AECOM experience
Air source heat pumps	n/a	n/a	30%	AECOM experience
Ground source heat pumps	n/a	n/a	30%	AECOM experience

Table 27 Capacity factors used to estimate annual energy generation

[53] The 2050 calculator tool, DECC, http://2050-calculator-tool.decc.gov.uk/ , website accessed January 2011
[54] Digest of United Kingdom energy statistics, DUKES database

A.6 Scenario modelling

The DECC Pathways to 2050 study was used to estimate changes in energy demand, based on scaling population rations for the UK to the Yorkshire and Humber region.

Population	2008	2010	2015	2020	2025
Yorkshire and Humber	5,231, 400	5,327, 500	5,572, 000	5,818, 000	6,055, 400
UK	61,411 ,692	62,309 ,130	64,531 ,754	66,754 ,043	68,863 ,174

Table 28 Population estimates for the UK and Yorkshire Humber region between 2008 and 2025 (Source: 2050 Pathways Analysis, DECC, July 2010)

Four energy scenarios were modelled using different configurations of the 2050 calculator; these are described in Table 29.

A.6.1 Heating and cooling

The heat sector comprises space heating, hot water and cooling for domestic and non-domestic buildings. Non-domestic buildings include buildings within the service sector but exclude buildings in the industrial sector

A.6.2 Industry

Industrial emissions – both direct process and combustion emissions and indirect emissions from the use of non-decarbonised electricity – will be determined by the combination of future output levels and the emissions produced per unit of output.

A.6.3 Lighting and appliances

Domestic and non-domestic lighting and appliances were considered separately. Domestic products include consumer electronics, home computing, cold appliances, wet appliances and lighting. Non-domestic products include lighting, catering and computing, with other appliances grouped in a separate category.

Energy Scenario	1	2	3	4
Description	Reference case	Ambitious but reasonable effort across all sectors to improve energy efficiency	Very ambitious attempt to improve energy efficiency	Large scale electrification of regulated energy use
Average temperature of homes	Average room temperature increases to 20 degrees (a 2.5 degree increase on 2007)	Average room temperature increases to 18 degrees (a 0.5 degree increase on 2007)	Average room temperature decreases to 17 degrees (a 0.5 degree increase on 2007)	Average room temperature increases to 20 degrees (a 2.5 degree increase on 2007)
Home insulation	Average thermal leakiness of dwellings decreases by 25%	Average thermal leakiness of dwellings decreases by 33%	Average thermal leakiness of dwellings decreases by 40%	Average thermal leakiness of dwellings decreases by 25%
Home heating electrification	Proportion of domestic heat supplied using electricity is 0-10%, as today	Proportion of domestic heat supplied using electricity is 20%	Proportion of domestic heat supplied using electricity is 20%	Proportion of domestic heat supplied using electricity is 80-100%
Home heating that isn't electric	Dominant domestic heat source is gas (biogas if available)	Dominant domestic heat source is gas (biogas if available)	Dominant domestic heat source is mixture of gas/biogas, coal/biomass and heat from power stations.	Dominant domestic heat source is gas (biogas if available).
Commercial heat / cooling demand	Space heating demand increases by 50%, hot	Space heating demand increases by 30%, hot	Space heating demand stable, hot water demand	Space heating demand increases by 50%, hot

	water demand by 60%, cooling demand by 250%	water demand by 50%, cooling demand by 60%	increases by 25%, cooling demand is stable	water demand by 60%, cooling demand by 250%
Commercial heating electrification	Proportion of non domestic heat supplied using electricity is 0-10%, as today	Proportion of non domestic heat supplied using electricity is 0-10%, as today	Proportion of non domestic heat supplied using electricity is 0-10%, as today	Proportion of non domestic heat supplied using electricity is 80-100%
Commercial heating that isn't electric	Dominant non domestic heat source is gas (biogas if available)	Dominant non domestic heat source is gas (biogas if available)	Dominant domestic heat source is mixture of gas/biogas, coal/biomass and heat from power stations.	Dominant non domestic heat source is gas (biogas if available)
Home light and appliance demand	Energy demand for domestic lights and appliances increases by 20% (compared to 2007)	Energy demand for domestic lights and appliances is stable	Energy demand for domestic lights and appliances decreases by 40% (compared to 2007)	Energy demand for domestic lights and appliances increases by 20% (compared to 2007)
Home light and appliance technology	Energy used for domestic cooking remains at 63% electricity and 37% gas	Energy used for domestic cooking remains at 63% electricity and 37% gas	Energy used for domestic cooking remains at 63% electricity and 37% gas	100% electric
Commercial light and appliance demand	Energy demand for lights and appliances increases by 33%. Energy for cooking is stable	Energy demand for lights and appliances increases by 15%. Decreases by 5% for cooking	Energy demand for lights and appliances decreases by 5%. Decreases by 20% for cooking.	Energy demand for lights and appliances increases by 33%. Energy for cooking is stable
Commercial light and appliance technology	60% electricity and 40% gas (no change from 2007)	60% electricity and 40% gas (no change from 2007)	60% electricity and 40% gas (no change from 2007)	100% electric
Industrial processes	Industrial sector is same size and intensity in 2025 (no change from 2007)	Industrial sector is same size and intensity in 2025 (no change from 2007)	Industrial sector is same size and intensity in 2025 (no change from 2007)	Industrial sector is same size and intensity in 2025 (no change from 2007)

Table 29 Description of energy demand scenarios

A.6.4 Offshore technologies

It is assumed that offshore renewable energy development develops according to projections modelled in the DECC 2050 study, as shown in Table 30. The proportion serving Yorkshire and Humber region has been estimated using population rations.

Technology	UK	Yorkshire and Humber
Offshore wind (MW)	30,834	2,605
Wave (MW)	201	17
Tidal stream (MW)	40	3
Tidal range (MW)	300	25

Table 30 Estimated offshore renewable energy capacity in 2025

A.6.5 Biomass co-firing

It has been assumed that a maximum of 713MW will be included in the regional renewable energy capacity in the form of biomass cofired at coal power stations.

A.6.6 Imported biomass

The following schemes have been assumed to operate using biomass imported into the region: Drax Ouse (290MW), Drax Heron (290MW), Stallingborough Helius (65MW).

Capabilities on project:
Building Engineering - Sustainability

A.6.7 Renewable energy pathway modelling

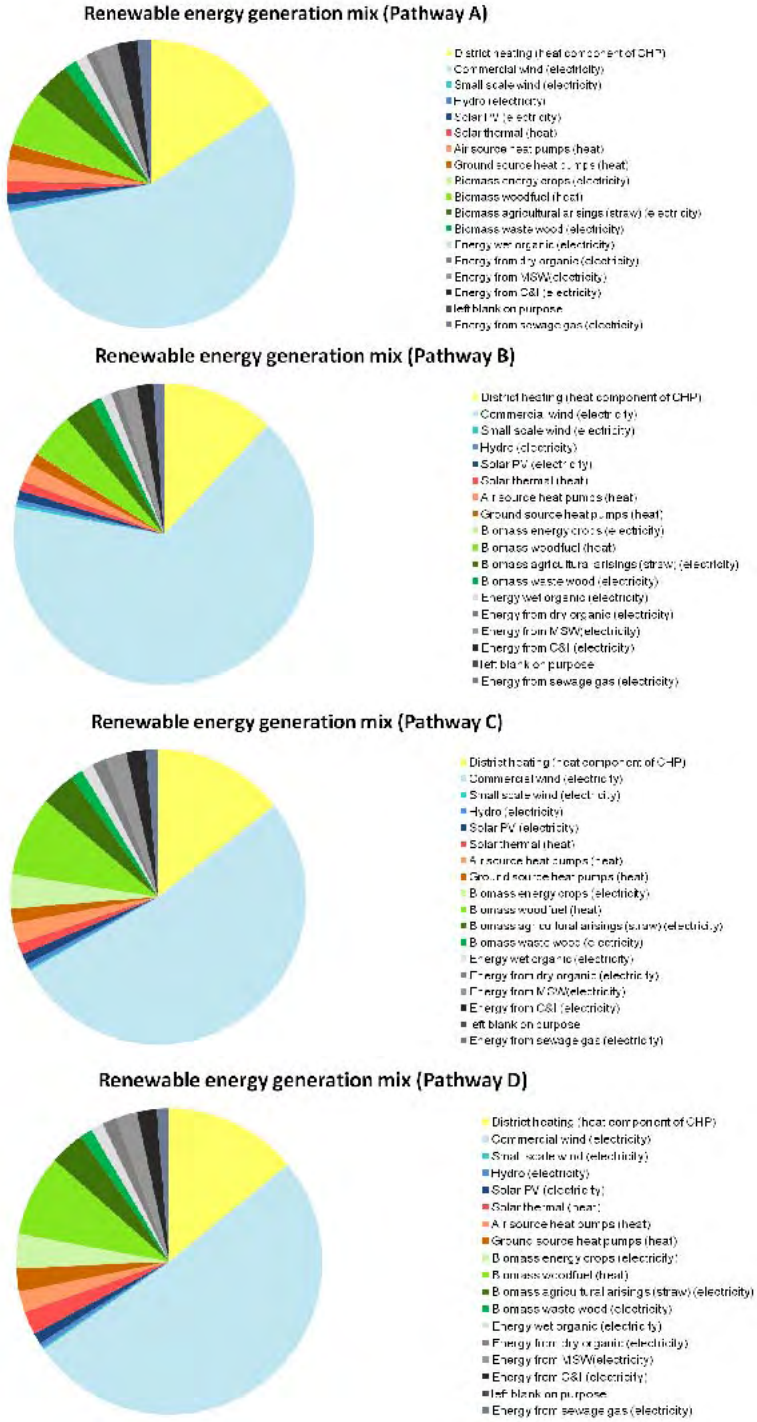


Figure 59 Breakdown of renewable energy for scenario modelling

Pathway A – EQUAL EFFORT / Technology	Maximum Potential by 2025 (MW)	Potential under scenario		Currently operational and consented (MW)
		%	MW	
Electricity				
Large wind	2702	50%	1351	427
Energy from waste				
MSW	28	100%	28	18
C&I	53	50%	26.5	
sewage gas	8	100%	7.68	8
food waste	16	50%	8	4.5
animal manures (livestock)	30	0	0	0
poultry litter	35	50%	17.5	13.5
Biomass				
co-firing	713	50%	357	104
straw	93	50%	46.5	30
waste wood	17	100%	17	31
energy crops	185	0	0	0
Hydro	26	50%	13	3
Micro generation (small/ micro wind, PV)	261	50%	130.5	??
Imported biomass (excl. Co-firing)	645	50%	322.5	65
Total			**2325**	**704**
Heat				
Heat pumps				
ASHP	149	50%	75	???
GSHP	109	50%	55	???
Solar water heating	353	50%	177	???
Wood chip boilers	450	50%	225	30
Heat from renewable CHP	868	50%	155	45
Total			**685**	**75**

Table 31 Assumptions used to model Pathway A - Equal effort across all sectors

Pathway B – HIGH WIND / Technology	Maximum Potential by 2025 (MW)	Potential under scenario		Currently operational and consented (MW)
		%	MW	
Electricity				
Large wind	2702	75%	2027	427
Energy from waste				
MSW	28	100%	28	18
C&I	53	50%	26.5	
sewage gas	8	100%	7.68	8
food waste	16	50%	8	4.5
animal manures (livestock)	30	0	0	0
poultry litter	35	50%	17.5	13.5
Biomass				
co-firing	713	50%	357	104
straw	93	50%	46.5	30
waste wood	17	100%	17	31
energy crops	185	0	0	0
Hydro	26	50%	13	3
Micro generation (small/ micro wind, PV)	261	50%	130.5	??
Imported biomass (excl. Co-firing)	645	50%	322.5	65
Total			**3000**	**704**
Heat				
Heat pumps				
ASHP	149	50%	75	???
GSHP	109	50%	55	???
Solar water heating	353	50%	177	???
Wood chip boilers	450	50%	225	30
Heat from renewable CHP	868	50%	155	45
Total			**685**	**75**

Table 32 Assumptions used to model Pathway B – Effort to increase the uptake of commercial scale, wind (onshore)

Pathway C – HIGH BIOMASS / Technology	Maximum Potential by 2025 (MW)	Potential under scenario		Currently operational and consented (MW)
		%	MW	
Electricity				
Large wind	2702	50%	1351	427
Energy from waste				
MSW	28	100%	28	18
C&I	53	50%	26.5	
sewage gas	8	100%	7.68	8
food waste	16	75%	12	4.5
animal manures (livestock)	30	0	0	0
poultry litter	35	75%	26.25	13.5
Biomass				
co-firing	713	75%	535	104
straw	93	75%	69.75	30
waste wood	17	100%	17	31
energy crops	185	25%	46	0
Hydro	26	50%	13	3
Micro generation (small/ micro wind, PV)	261	50%	130.5	??
Imported biomass (excl. Co-firing)	645	75%	483.75	65
Total			**2746**	**704**
Heat				
Heat pumps				
ASHP	149	50%	75	???
GSHP	109	50%	55	???
Solar water heating	353	50%	177	???
Wood chip boilers	450	75%	338	30
Heat from renewable CHP	868	50%	220	45
Total			**863**	**75**

Table 33 Assumptions used to model Pathway C – Effort to increase the uptake of biomass

Pathway D – HIGH HEAT / Technology	Maximum Potential by 2025 (MW)	Potential under scenario		Currently operational and consented (MW)
		%	MW	
Electricity				
Large wind	2702	50%	1351	427
Energy from waste				
MSW	28	100%	28	18
C&I	53	50%	26.5	
sewage gas	8	100%	7.68	8
food waste	16	75%	12	4.5
animal manures (livestock)	30	0	0	0
poultry litter	35	75%	26.25	13.5
Biomass				
co-firing	713	75%	535	104
straw	93	75%	69.75	30
waste wood	17	100%	17	31
energy crops	185	25%	46	0
Hydro	26	50%	13	3
Micro generation (small/ micro wind, PV)	261	50%	130.5	??
Imported biomass (excl. Co-firing)	645	75%	483.75	65
Total			**2746**	**704**
Heat				
Heat pumps				
ASHP	149	50%	75	???
GSHP	109	75%	82	???
Solar water heating	353	100%	353	???
Wood chip boilers	450	75%	338	30
Heat from renewable CHP	868	100%	440	45
Total			**1287**	**75**

Table 34 Assumptions used to model Pathway D – Effort to increase the uptake of heat generation renewable technologies

Capabilities on project:
Building Engineering - Sustainability

A.7 Commercial scale wind energy resource

A.7.1 Natural resource and assumptions for energy generation

The natural resource for wind energy is based on the wind speed, which has been derived from the UK wind speed database. This is known to often overestimate wind speeds in comparison to actual measured wind speeds; however, they are modelled at 45m height whereas the large scale wind turbines modelled in this study are 85m to hub height, where wind speeds are likely to be significantly higher.

A capacity factor has been assumed of 30% has been assumed for commercial scale wind energy generation.

A.7.2 Technically accessible resource

The technically accessible resource refers to the potential for energy generation based on the performance of the generating equipment. A standard turbine size of 2.5MW has been assumed, with rotor diameter of 100m, hub height of 85m and tip height of 135m.

It has been assumed that the available land area could support 9 MW of installed capacity per square kilometre. This is equivalent to 3.6 turbines per square kilometre, using the standard turbine size introduced above.

A.7.3 Physically accessible resource

The physically accessible resource has been identified using GIS mapping, based on areas where it is physically impracticable to develop turbines. These constraints are summarised in Table 35 and include development on roads, railways and in close proximity to high voltage, overhead power lines.

A.7.4 Economically viable resource

The economically viable commercial scale wind energy resource has been identified through engagement with stakeholders in the region. This takes into account areas where commercial scale wind turbines are unlikely to be permitted, due to concerns over their impact on highly sensitive landscapes, for example.

The constraints affecting the economically viable resource are summarised below in Table 36. It should be noted these constraints represent issues that may affect the size or scale of commercial scale wind energy deployment. These should not necessarily preclude wind energy development and all planning applications should be assessed on a case by case basis.

A number of constraints that may affect the size or scale of wind turbines but have not been included in the assessment are described in Table 37.

Constraint on physically accessible resource	Justification for applying constraint	Source of dataset
Wind speeds below 5 m/s	The DECC methodology states that this represents the wind speed below which commercial scale wind turbines will not operate efficiently.	UK wind speed database (NOABL)
Buffer of 150m either side of major carriageways	This constraint has been applied in accordance with the DECC methodology, which suggests that a buffer of "topple distance plus 10%" should be considered.	OS Strategi
Buffer of 150m either side of railway lines.	This constraint has been applied in accordance with the DECC methodology, which suggests that a buffer of "topple distance plus 10%" should be considered.	OS Strategi
Buffer of 3 rotor diameters, equivalent to 300m, either side of high voltage, overhead power lines	This constraint is based on National Grid's current policy that "consideration should be given to reducing the minimum layback of wind turbines from overhead power lines to three rotor diameters."[55]	
Buffer of 5m to represent main rivers	This constraint has been applied in accordance with the DECC methodology.	OS Strategi
Buffer of 4m to represent secondary rivers	This constraint has been applied in accordance with the DECC methodology.	OS Strategi
Buffer of 2.5m to represent canals	This constraint has been applied in accordance with the DECC methodology.	OS Strategi
Exclusion of lakes and reservoirs	This constraint has been applied in accordance with the DECC methodology.	OS Strategi
Buffer of 5km from airports and other aerodromes	This constraint has been applied in response to consultation with the major airports in the region and with Defence Estates, who are responsible for safeguarding MoD operations.	Defence Estates CAA
Exclusion of MoD estate	This constraint has been applied in accordance with the DECC methodology and in response to consultation with Defence Estates, who are responsible for safeguarding MoD operations. The constraint has been applied to take into account possible adverse effects arising from impingement on physically safeguarded surfaces.	Defence Estates

Table 35 Issues constraining the physically accessible resource for commercial wind energy generation (considered in Part B of study).

[55] National Grid – internal use only, Review of the Potential Effects of Wind Turbine Wakes on Overhead Transmission Lines, TR (E) 453 Issue 1 – May 2009

A.7.5 Landscape sensitivity

The main barrier to deployment of commercial scale wind turbines is visual impact. This study has adopted the methodology in SREATS for assessing landscape sensitivity. The study used the descriptions provided by the 26 National Character Areas within and around Yorkshire and Humber to characterise the sensitivity of a landscape and its capacity to accommodate change. A sensitivity score from low to high was then applied based upon physical and perceptual criteria, including:

Physical criteria -	Landform and shape
	Settlement
	Landscape pattern
	Visual composition
	The effect of the other character areas
Perceptual criteria -	How the landscape is experienced
	Remoteness/modification/naturalness

It should be noted that although this approach takes into consideration visual composition, i.e. the nature of the views within the landscape, and an understanding of how the landscape is experienced, it does not take into consideration the scale of potential viewers.

These criteria were brought together to give an overall combined sensitivity score, which was combined with the biodiversity assessment to generate a four tier hierarchy of sensitivity zones. A cap was applied to each zone for the maximum size of wind farm that could be accommodated due to the landscape sensitivity

Zone 1 - Areas of greatest sensitivity to wind energy development and therefore least opportunity for development.

Zone 2 - Areas of high sensitivity to wind energy development, with little opportunity for development other than some very localised sites where limited proposals could be accommodated if all potential impacts on natural heritage interests were fully explored and mitigated against.

Zone 3 - Areas with some sensitivity to wind energy development. Within these areas, there is likely to be scope to accommodate development of an appropriate scale, siting and design and taking regard of cumulative impact.

Zone 4 - Areas with the lowest sensitivity to wind energy development and the greatest opportunity for development.

The Delivering Sustainable Energy in North Yorkshire study (2005) provided an assessment of wind turbine development in North Yorkshire and incorporated a sensitivity assessment based on landscape character. Although the findings of the two studies are similar, there is some variation in the sensitivity assigned to the following locations:

Teesdale Lowlands – This area is shown as low sensitivity in the SREATS study sensitivity study, but is found to be of medium or medium-low sensitivity in the North Yorkshire study due to the more localised scale of assessment.

Vale of Pickering and Yorkshire Wolds – Within the SREATS study this area was covered by two landscape units, whereas it was covered by eleven landscape units in the North Yorkshire study. As such, the North Yorkshire study has been able to refine the understanding of sensitivity in this area considerably. It found that 'the eastern part of the Vale of Pickering and the plateau of the Yorkshire Wolds, to be of medium-high sensitivity'. 'In the western part of the vale, the landscape is more open, and of larger scale, with a less distinctive relationship with the hills to north and south. The coastal areas are more settled, with more evidence of man's activities and a busier character than the more tranquil inland areas. For these different reasons, the western part of the Vale of Pickering and the coastal area around Scarborough and Filey are considered to be of lower sensitivity than the National Character Areas 26 and 27 as a whole'.

Harrogate area – The area around Harrogate, from Harrogate Toto Otley and Blubberhouses is considered to be of lower sensitivity than the rest of National Character Area 22 which extends north along the eastern fringe of the Yorkshire Dales National Park. This is because there is a stronger settled influence in this area'.

Weningdale and Ribblesdale – This area has been identified as being of medium-high sensitivity to wind development in the North Yorkshire study, but of high sensitivity in the SREATS study.

A.7.6 Cumulative impact

Once the above constraints had been applied, the remaining area was subjected to a cumulative impact assessment. There is currently no nationally accepted methodology for undertaking strategic appraisals of the effects of more than one wind farm. This study has adopted a bespoke approach, which assesses the probability of a wind farm within the identified areas, and then examines the probability of neighbouring wind farms being developed.

Constraint on economically viable resource	Justification for applying constraint	Source of dataset
Zero deployment of wind turbines assumed in areas where the average annual wind speeds is below 6 m/s at 45m height above ground level.	Discussion with wind farm developers has suggested that this is the minimum wind speed considered viable for commercial scale wind energy generation.	UK wind speed database (NOABL)
Zero deployment of wind turbines assumed within areas within 600m of urban settlements	This constraint has been applied to residential properties to take into account potential adverse effects from wind turbine noise and/or visual dominance. There is no definitive guidance on this issue but the DECC methodology suggests that the minimum buffer distance that is required for a 2.5MW turbine is 600m. In practice, the minimum distance required between a wind turbine and residential properties is site specific and dependent on the characteristics of the proposed turbine, the ambient background noise and the local terrain.	OS address points database
Zero deployment of wind turbines within 500 m of existing wind turbines	Existing wind farms were assumed to cover an area $A\ in\ km2 = \frac{existing\ capacity\ in\ MW}{9MW/km2}$ This constraint has been applied to take into account the adverse turbulence effects produced by rotating turbine blades which could reduce energy output in nearby turbines.	Restats RenewablesUK Stakeholder consultation
Zero deployment of wind turbines assumed within 2km of National Parks	This constraint was applied in response to discussion with Natural England. It should be noted that this constraint was applied in order to quantitatively estimate the economically viable resource for the region. Existing planning policy makes clear that it is not appropriate to apply buffers around National Parks in assessment of planning applications.	MAGIC website
Zero deployment of wind turbines assumed within 2km of National Parks AONBs	This constraint was applied in response to discussion with Natural England. It should be noted that this constraint was applied in order to quantitatively estimate the economically viable resource for the region. Existing planning policy makes clear that it is not appropriate to apply buffers around AONBs in assessment of planning applications.	MAGIC website
Zero deployment of wind turbines assumed within 50m of areas designated as National Trails	This constraint was applied in response to consultation with Natural England.	Natural England
Zero deployment of wind turbines on areas	This constraint was applied in response to consultation with Natural England.	Natural England

Constraint on economically viable resource	Justification for applying constraint	Source of dataset
designated as Heritage Coast		
Zero deployment of wind turbines assumed within areas with international and national nature conservation designations (including SPAs, SACs, RAMSARs, SSSIs and NNRs)[56]	This constraint was applied in response to consultation with Natural England.	MAGIC website
Zero deployment of wind turbines in areas defined as ancient woodland	This constraint was applied in response to consultation with Natural England.	MAGIC website
Zero deployment of wind turbines in areas defined as sites of historic interest	This constraint was applied in response to consultation with Natural England.	MAGIC website
Zero deployment of wind turbines in areas with high landscape sensitivity	Classification of landscapes was taken from SREATS. In addition, the northern Dark Peak capacity area was classified as "high sensitivity," based on the South Pennines study	SREATS South Pennines study
Lower turbine density assumed in areas of medium to low landscape sensitivity	Low sensitivity was assigned to landscape capacity area 5 (i.e. can accommodate large wind farms), with a maximum of two further large wind farms, in addition to Ovenden Moor Wind Farm. Up to 7.5 MW was allowed within landscape capacity area 6. Up to 1 large wind farm was allowed in the south east within landscape capacity area 8 Up to 12.5 MW was allowed in the west or south west within landscape capacity area 8 and in landscape capacity area 9. Up to 15 MW was allowed in landscape capacity area 10.	SREATS South Pennines study
Zero deployment of wind turbines assumed in areas of deep peat	This constraint was applied in response to consultation with Natural England.	British Geological Survey

[56] The Conservation of Habitats and Species Regulations 2010, UK Statutory Instrument, April 2010

Constraint on economically viable resource	Justification for applying constraint	Source of dataset
Lower turbine density assumed in areas of high sensitivity to birds (assumed to be 2.25 MW/km^2)	This constraint was applied in response to consultation with Natural England.	RSPB
Lower turbine density in areas of medium sensitivity to birds (assumed to be 4.5 MW/km^2)	This constraint was applied in response to consultation with Natural England.	RSPB
Separation distance between all wind farms (i.e. established and future schemes) of 10km	This constraint was applied to take account of cumulative impact.	n/a
Additional resource added representing potential turbines in urban areas.	It was assumed that the following local authorities had potential for an additional10 MW (equivalent to 4 turbines) in urban areas: Scarborough, York, Selby, Harrogate, Bradford, Leeds, Calderdale, Kirklees, Wakefield, East Riding, North Lincolnshire, North East Lincolnshire, Barnsley, Doncaster, Sheffield, Rotherham	n/a

Table 36 Issues constraining the economically viable resource for commercial wind energy generation

Constraints excluded from assessment	Justification for not applying constraint
Green belt	Planning decisions on wind farm applications where the green belt has been a material consideration have not been consistent. It is therefore not clear whether green belts present an absolute constraint on wind energy development.
Local nature conservation designations (e.g. local nature reserves)	These have not been included as a constraint in accordance with national planning policy.
Electromagnetic links, such as radio links and microwave links	These have not been included as a constraint due to: (i) lack of accurate data on the location and physical characteristics of links; (ii) any buffer zones that should be maintained from links will be variable depending on negotiations with telecoms operators, who should be consulted during the planning of specific wind turbine sites
Air traffic control and radars (CAA and MoD) coverage	These areas were not constrained since there are already a number of wind farms located within these areas and a mitigating solution is likely to be found in the short to medium term to prevent degradation of performance.

Constraints excluded from assessment	Justification for not applying constraint
zones	
Precision Approach Radars coverage zones (MoD)	These areas were not constrained since there are already a number of wind farms located within these areas and a mitigating solution is likely to be found in the short to medium term to prevent degradation of performance.
Tactical training areas (MoD)	These areas were not constrained since there are already a number of wind farms located within these areas and a mitigating solution is likely to be found in the short to medium term to prevent degradation of performance.
Air defence radars (MoD)	Defence radars require clear line of sight to operate effectively. However, these areas were not constrained since there are already a number of wind farms within line of sight of these radars and a mitigating solution is likely to be found in the short to medium term to prevent degradation of performance.
Bridleways	The British Horse Society recommends that a distance of at least 200m, but preferable 4 tip heights (equivalent to 540m in this case) should be maintained from bridleways.[57] This constraint has not been applied in this case because we did not have a dataset that enabled us to spatially identify these areas.
Shadow Flicker	Some sources recommend that a distance of up to 10 rotor diameters from homes should be maintained to avoid shadow flicker.[58] This has not been applied as a constraint in this study because it can usually be mitigated and is unlikely to affect the rate or scale of wind farm deployment.
Proximity to the electrical grid	Discussion with the major district network operator (DNO) in the area and with wind farm developers implied that capacity of substations to accept incoming wind energy was a significant constraint, rather than distance of wind farm from connection point.
Areas of non-designated peat	We did not have a dataset that enabled us to spatially identify these areas

Table 37 Issues considered but not included in the assessment of the commercial wind energy resource

[57] The British Horse Society Advisory Statement on Wind Farms AROW20s08/1
[58] London Renewables/London Energy Partnership, Guidance Notes for Wind Turbine Site Suitability

A.8 Hydro energy resource

A.8.1 Natural resource and assumptions for energy generation

The natural hydro energy resource has been assessed using a recent Environment Agency study into the potential across England and Wales.[59]

A capacity factor has been assumed of 38% has been assumed for renewable electricity generation.

A.8.2 Technically accessible resource

High head schemes (above 2 metres) were excluded from the assessment.

A.8.3 Physically accessible resource

The physically accessible resource for hydro energy generation has been considered to be the same as the technically accessible resource.

A.8.4 Economically viable resource

The constraints affecting the economically viable hydro energy resource are shown below in Table 38.

Constraint on economically viable resource	Justification for applying constraint	Source of dataset
Zero deployment of hydro energy in areas of high environmental sensitivity.	Consultation with the Environment Agency.	Environment Agency
Zero deployment of hydro energy in areas where power output would be less than 10kW.	Consultation with the Environment Agency.	Environment Agency
Reduction in deployment of schemes	Only 25% of schemes are considered to come forward.	n/a

Table 38 Issues constraining the economically viable resource for hydro energy generation

[59] Mapping Hydropower Opportunities and Sensitivities in England and Wales: Technical Report, Entec UK on behalf of Environment Agency, 2010

A.9 Biomass resource

A.9.1 Natural resource and assumptions for energy generation

Energy crops

- Energy crops have been assumed to comprise short rotation coppice (SRC) and miscanthus. Existing areas of established SRC and miscanthus have been added to the land available for the natural resource.
- Land classifications have been taken from the 2008 DEFRA Horticultural Survey. Where data is not available by local authority, land has been allocated between SRC and miscanthus according to the Defra Energy Crop Opportunity Maps.
- A yield of 10 oven dried tonnes (odt) / hectare (ha) has been assumed for SRC crops and 15 odt/ha for miscanthus between 2010 and 2020.
- A yield of 11 odt/ha has been assumed for SRC crops and 16.5 odt/ha for miscanthus grown after 2020.
- All energy crops will be used in CHP plant, to maximise efficiency of use.
- 6,000 odt represents 1MWe of installed CHP electrical capacity. A ratio of heat to power output of $2MW_{th}$ to $1MW_e$ has been applied.
- A capacity factor of 90% has been assumed to estimate the annual electrical output based on installed capacity.
- A capacity factor of 50% has been assumed to estimate the annual heat output based on installed capacity. This is based on AECOM experience of conducting feasibility studies for CHP schemes and reflects the fact that not all heat output will be used.

Managed woodland

- The natural resource for managed woodland comprises brash, thinnings and poor quality final crops.[60]
- Existing areas of established short rotation forestry (SRF) have been added to the land available for the natural resource.
- Each local authority's share of the regional wood fuel resource is equal to the proportion of the total area of woodland in the region which is within the local authority boundary.
- The fuel from managed woodland is used solely for heat generation.
- The calorific value of the wood fuel resource is 12.5 GJ per oven dried tonne (odt). A conversion efficiency from wood fuel to heat of 80% has been assumed.
- A capacity factor of 30% has been used to estimate the likely installed capacity of wood fuel plant.

Industrial woody waste

- Industrial woody waste biomass consists of sawmill co-products from primary processing of timber and construction and demolition waste.
- Commercial and industrial waste wood has not been included in the assessment at this stage as it is excluded from the DECC methodology.
- The amount of waste wood in each local authority area has been estimated on the basis of their share of regional housing targets, using figures from the RSS.
- There will be an annual increase of 1% in the waste wood streams
- The available waste wood resource has been reduced by 50% to account for competing uses.
- Waste wood would be used in CHP plant, to generate both renewable heat and electricity.
- A fuel requirement of 6,000 odt would represent 1 MW_e of installed CHP capacity. A ratio of heat to power output of $2MW_{th}$ to $1MW_e$.
- A capacity factor of 90% has been assumed to estimate the annual electrical output.
- A capacity factor of 50% has been assumed to estimate the annual heat output. This is based on AECOM experience of conducting feasibility studies for CHP schemes and reflects the fact that not all heat output will be used.

Agricultural arisings (straw)

- Agricultural arisings consist of straw from production of wheat and oilseed rape.

[60] Renewable and Low Carbon Energy Capacity Study for Yorkshire and Humber Part B: Opportunities and Constraints Mapping – Draft Report, AECOM, April 2010

- Wheat straw yield = 58% of regional wheat yield. [61]
- Oilseed rape straw yield = 144% of regional oilseed rape yield.[61]
- Straw could be used for CHP with a typical heat to power ratio of 2:1
- 6,000 tonnes of baled straw would represent 1 MW of installed capacity.

A.9.2 Technically accessible resource

Energy crops

The technically accessible resource for cultivated energy crops has been ascertained by considering three scenarios, in accordance with the DECC methodology.

The medium scenario was selected to be most representative of the technically accessible resource. This assumed that energy crops could only be planted only on land no longer needed for food production. This comprises all abandoned arable land and pasture and has been defined as bare and fallow and temporary grassland.[61]

Figures provided in the DEFRA Agricultural and Horticultural Survey for England (2008) for permanent grassland were not available as a spatial dataset. In order to get an approximation of the distribution of permanent pasture and grassland, the following GIS datasets were used, available from the MAGIC website at www.magic.gov.uk. It should be noted that a number of datasets were not able to be used due to data corruption.

- Draft Coastal and Floodplain Grazing Marsh BAP Priority Habitat Inventory for England Version 1.1 Natural England;
- Draft Fen BAP Priority Habitat Inventory for England Version 1.2;
- Draft Lowland Heathland BAP Priority Habitat Inventory for England Version 1.2;
- Lowland Calcareous Grassland BAP Priority Habitat Inventory for England Version 2.0.1;
- Lowland Dry Acid Grassland BAP Priority Habitat Inventory for England Version 2.0.1 Natural England;
- Lowland Meadows BAP Priority Habitat Inventory for England Version 2.0.1;
- Millennium Greens (England);
- Traditional Orchards - Provisional (England);
- Undetermined Grassland BAP Habitat Inventory for England Version 2.0.1 Natural England;
- Upland Calcareous Grassland BAP Priority Habitat Inventory for England Version 2.0 Natural England;
- Upland Hay Meadows BAP Priority Habitat Inventory for England Version 2.0.1 Natural England.

Managed woodland

The technically accessible, managed woodland resource has been determined based on the distribution of woodland across the region.

Industrial woody waste

To account for competing uses, it has been assumed that only 50% of the natural waste wood resource is available for energy generation.

Agricultural arisings (straw)

To account for competing demand for straw, such as straw bedding, it has been assumed that 1.5 tonnes of straw is required per annum per head of cattle in the region, up to a maximum of 50% of the total straw yield. This has been subtracted from the natural resource.

A.9.3 Physically accessible resource

The physically accessible resource has been assumed to be the same as the technically accessible resource. However, It was assumed that existing biomass boiler installations contributed to installed capacity of managed woodland.

A.9.4 Economically viable resource

The constraints affecting the economically viable resource are summarised in Table 40 below. It should be noted these constraints will not necessarily preclude the cultivation of biomass and all planning applications should be assessed on a case by case basis.

A number of constraints that may affect the deployment of biomass but have not been included in the assessment are provided in Table 41.

[61] Consultation with DECC, April 2010

Type of biomass	Constraint on physically accessible resource	Justification for applying constraint	Source of dataset
Energy crops	Exclusion of permanent pasture/grassland	This constraint has been applied in accordance with the DECC methodology.	MAGIC database
Energy crops	Exclusion of woodland (ancient and managed)	Energy crops unlikely to be permitted.	National Inventory of Woodland
Energy crops	Exclusion of roads and tracks	Landscape unable to support energy crops.	OS Strategi
Energy crops	Exclusion of areas of hardstanding	Landscape unable to support energy crops.	OS Strategi
Energy crops	Exclusion of rivers and lakes	Landscape unable to support energy crops.	OS Strategi
Energy crops	Exclusion of nature conservation areas (NNR, RAMSAR, SAC, SPA, SSSI, Local Nature Reserves)	Energy crops unlikely to be permitted.	MAGIC database
Energy crops	Exclusion of historic designations (Scheduled Monuments, Registered Battlefields, World Heritage Sites)	Energy crops unlikely to be permitted.	MAGIC database

Table 39 Issues constraining the physically accessible resource for biomass energy generation

Type of biomass	Constraint on economically viable resource	Justification for applying constraint	Source of dataset
Energy crops	Reduction in deployment based on uptake of individual biomass boilers	See section A.3 for details.	AECOM uptake modelling
Industrial woody waste	Reduction in deployment of 50%	Due to competing uses.	n/a
Straw	Reduction in deployment	Due to competing need for animal bedding requirement.	n/a
Straw	Reduction in deployment of 50%	To account for straw left on fields as fertiliser.	n/a

Table 40 Issues constraining the economically viable resource for biomass energy generation

Type of biomass	Constraint excluded from assessment	Justification for not applying constraint
Energy crops	Public rights of way (PRoW).	It has been agreed with DECC that this will not be mapped, due to the lack of a comprehensive spatial dataset.
Energy crops	SPS cross compliance buffers	It has been agreed with DECC that this will not be mapped, due to the lack of a comprehensive spatial dataset.
Energy crops	Biodiversity impacts	Natural England has been consulted on whether block planting limits should be imposed in locations with national and international landscape designations. Natural England did not propose any limits in its response, although

Type of biomass	Constraint excluded from assessment	Justification for not applying constraint
		questioned the yields that may be achieved in the Moors National Park due to its altitude, which is not a landscape concern.
Energy crops	Water stressed areas	The Environment Agency has been consulted about the implications of planting energy crops in water stressed areas. The response stated that water stress classification is not really relevant to crop production, as it is defined by water companies on the basis of household demand. The Environment Agency has advised that the Catchment Area Management Strategy is used as a guide to the availability of water in major aquifers and rivers for irrigation purposes and has referred to the Optimum Use of Water for Industry and Agriculture report as a source of data on water required for irrigation of these and other crops.

Table 41 Issues considered but not included in the assessment of the biomass resource

A.10 Energy from waste

A.10.1 Natural resource and assumptions for energy generation

Wet organic waste

- Wet organic waste has been assumed to comprise slurry from cattle and pig farms and waste from food and drinks manufacturing.
- Figures for the number of cattle and pigs in the region have been taken from the Defra Agricultural and Horticultural Land Survey (2008).
- Each wet tonne of slurry produces 20m^3 of biogas and 1m^3 of biogas has an energy content of 5.8kWh.
- 225,000 tonnes of animal slurry represents 1MW$_e$ of installed CHP electrical capacity. A ratio of heat to power output of 2MW$_{th}$ to 1MW$_e$ has been applied.
- Wet organic waste will be used in CHP for electricity and heat production. Energy generation will be through biogas production.
- Up to 500,000 tonnes of food waste will be available for energy generation in the region, based on discussion with CO2 Sense.
- 32,000 tonnes of food waste represents 1MW$_e$ of installed CHP electrical capacity. A ratio of heat to power output of 2MW$_{th}$ to 1MW$_e$ has been applied.
- A capacity factor of 80% has been applied to the installed wet organic waste capacity to estimate the annual electrical output.
- A capacity factor of 50% has been assumed to estimate the annual heat output based on installed capacity. This is based on AECOM experience of conducting feasibility studies for CHP schemes and reflects the fact that not all heat output will be used.

Dry organic waste

- The natural resource for dry organic waste consists of the potential for energy generation from poultry litter.
- Data on the number of broiler birds in the region has been taken from the Defra Agricultural and Horticultural Survey (2008).
- Each bird produces 0.0432 tonnes of poultry litter per year per bird.
- The fuel from poultry litter is used solely for electricity generation.
- 11,000 tonnes of poultry litter represents 1MW$_e$ of installed CHP electrical capacity.
- A capacity factor of 80% has been used to estimate the likely energy generation from installed plant.

Municipal solid waste (MSW)

- MSW would be used in CHP plant, to generate both renewable heat and electricity.
- 10,000 tonnes of MSW would represent 1 MW$_e$ of installed CHP capacity. This takes into account the fact that approximately 35% of the MSW resource will be classed as renewable. A ratio of heat to power output of 2MW$_{th}$ to 1MW$_e$.
- A capacity factor of 80% has been assumed to estimate the annual electrical output.
- A capacity factor of 50% has been assumed to estimate the annual heat output. This is based on AECOM experience of conducting feasibility studies for CHP schemes and reflects the fact that not all heat output will be used.

Commercial and industrial waste

- C&I would be used in CHP plant, to generate both renewable heat and electricity.
- 10,000 tonnes of C&I would represent 1 MW$_e$ of installed CHP capacity. A ratio of heat to power output of 2MW$_{th}$ to 1MW$_e$ has been assumed.
- A capacity factor of 80% has been assumed to estimate the annual electrical output.
- A capacity factor of 50% has been assumed to estimate the annual heat output. This is based on AECOM experience of conducting feasibility studies for CHP schemes and reflects the fact that not all heat output will be used.

Landfill gas production

- Any plants operational before 2000 will not be in operation by 2020.
- The gas captured from landfill sites is used for electricity generation only.
- A capacity factor of 60% has been assumed to estimate the annual electrical output.

Sewage gas production

- All plants currently operational will be in operation by 2025.
- The gas captured from sewage gas sites is used for electricity generation only.
- A capacity factor of 42% has been assumed to estimate the annual electrical output.

A.10.2 Technically accessible resource

It has been assumed that 80% of the slurry resource can be collected for energy generation.

To account for competing uses, it has been assumed that only 50% of the food and drink waste resource is available for energy generation.

It has been assumed that all of the dry organic waste resource will be available for energy generation.

It has been assumed that 25% of the MSW resource and 50% of the C&I resource will be available for energy recovery by 2020.

No further constraints have been applied to calculate the technically accessible resource from landfill gas production and sewage gas production.

A.10.3 Physically accessible resource

The DECC methodology does not identify further constraints that could be applied to calculate the physically accessible resource.

A.10.4 Economically viable resource

The DECC methodology does not identify further constraints that could be applied to calculate the economically viable resource.

A.11 Solar energy

A.11.1 Natural resource and assumptions for energy generation

The sun's energy arrives at the earth's surface either as 'direct', from the sun's beam, or 'diffuse' from clouds and sky. The total or 'global' irradiation is the sum of these two components and, across the UK, the daily annual mean varies between 2.2kWh/m^2 to 3.0kWh/m^2 as measured on the horizontal plane. There is a very significant variation around this average value due to both seasonal and daily weather patterns.

A capacity factor of 9% has been assumed to calculate annual output, based on figures provided in DUKES (2009).

A.11.2 Technically accessible resource

The technically accessible, solar resource has been assessed based on the number of roofs across the region. Table 42 and Table 43 show the proportions of building types will be able to accommodate a solar water heating or solar PV system, in accordance with the DECC methodology

Suitable building types	Existing stock	New build development
Domestic (houses and flats)	25%	50%
Commercial	40%	5% from 2010-2013 * 10% from 2013-2018 * 30% from 2019 (PV) * 10% from 2019 (SWH)
Industrial	80%	5% from 2010-2013 * 10% from 2013-2018 * 30% from 2019 (PV) * 10% from 2019 (SWH)

Table 42 Suitable building types for solar panel installation. Assumptions taken from other sources than the DECC methodology are denoted with *.

Installed capacity	Solar PV	SWH
Domestic	2 kW	2kW
Commercial	5 kW	10 kW *
Industrial	10 kW *	10 kW *

Table 43 Installed capacities modelled for solar installations. Assumptions taken from other sources than the DECC methodology are denoted with *.

A.11.3 Physically accessible resource

It has been assumed that the physically accessible resource is the same as the technically accessible resource.

A.11.4 Economically viable resource

The assumptions for solar uptake in the existing stock are described in section A.3.

Assumptions for solar uptake in the new build stock are shown in Table 44 to Table 45.

Year of construction	Flats	Houses	Non domestic
2010	24%	40%	5%
2013	20%	45%	10%
2016 onwards	18%	45%	30%

Table 44 Modelled solar PV uptake in new build stock.

Year of construction	Flats	Houses	Non domestic
2010	24%	39%	5%
2013	19%	15%	10%
2016 onwards	0%	5%	10%

Table 45 Solar water heating uptake in new build stock.

A.12 Heat pumps

A.12.1 Natural resource and assumptions for energy generation

The assessment of the potential for heat pumps is based on the premise that most buildings (existing stock and new build) are suitable for the deployment of a heat pump.

A seasonal performance factor (SPF) of 320% and 250% has been applied to ground source heat pumps and air source heat pumps respectively, in order to calculate the renewable proportion of the total usable heat from the heat pump, Q_{usable}, based on the following formula [62]:

$$Renewable\ energy\ output\ = Qusable * (1 - (\frac{1}{SPF})$$

A capacity factor of 30% has been used to calculate the annual energy output from both types of heat pumps.

A.12.2 Technically accessible resource

It has been assumed that the following proportions of building types will be able to accommodate a heat pump (Table 46). It is considered unlikely that industrial buildings will have significant potential for heat pumps, as most are sheds with limited space heating and cooling demand.

	Existing stock (off grid properties)	Existing stock	New build development
Detached/semi detached homes	100%	75%	50%
Terraced homes	100%	50%	50%
Flats	100%	25%	50%
Commercial	100%	100%	100%
Industrial	0% *	0% *	0% *

Table 46 Suitable building types for heat pump installation. Assumptions taken from other sources than the DECC methodology are denoted with *.

	Size of heat pumps
Domestic	5 kW
Commercial	100 kW
Industrial	n/a

Table 47 Installed capacities modelled for heat pumps

A.12.3 Physically accessible resource

It has been assumed that the physically accessible resource is the same as the technically accessible resource.

A.12.4 Economically viable resource

The assumptions for heat pump uptake in the existing stock are described in section A.3. At the time of modelling, it was thought that air source heat pumps would be included within the renewable heat incentive, therefore this has been included in the modelling parameters.

Assumptions for heat pump uptake in the new build stock are shown in Table 48 to Table 49.

Year of construction	Flats	Houses	Non domestic
2010	0%	0%	3%
2013	0%	5%	3%
2016 onwards	0%	8%	10%

Table 48 Modelled ASHP uptake in new build stock.

Year of construction	Flats	Houses	Non domestic
2010	25%	5%	3%
2013	25%	8%	5%
2016 onwards	30%	10%	10%

Table 49 Modelled GSHP uptake in new build stock.

[62] Annex VII Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

A.13 Small scale wind energy

A.13.1 Natural resource and assumptions for energy generation

The natural resource for small scale wind energy generation is based on the wind speed.

A.13.2 Technically accessible resource

The technically accessible resource refers to the potential for energy generation based on the performance of the generating equipment. A standard turbine size of 6kW has been assumed.

A capacity factor has been assumed of 5% has been assumed for renewable electricity generation in urban and suburban areas and 15% in rural areas.

A.13.3 Physically accessible resource

The physically accessible resource has been identified using GIS mapping and the DECC methodology, based on the constraints shown in Table 51 below. This suggests that a wind “scaling factor” should be applied to the wind speeds, to take into account obstruction effects in built up areas that will reduce the wind speed. It should be noted these constraints do not take into account site-specific constraints such as actual building height and roof shape, neighbouring buildings, high trees and other physical obstacles. Such detailed analysis is only possible at the local authority level and is outside the scope of this study.

A.13.4 Economically viable resource

The assumptions for small wind turbine uptake in the existing stock are described in section A.3. Assumptions for small wind turbine uptake in the new build stock are shown in Table 50.

Year of construction	Flats	Houses	Non domestic
2010	1%	1%	1%
2013	1%	2%	2%
2016 onwards	2%	5%	5%

Table 50 Small wind turbine uptake in new build stock.

Constraint on physically accessible resource	Justification for applying constraint	Source of dataset
Wind speeds below 4.5 m/s	The DECC methodology states that this represents the wind speed below which small scale wind turbines are not viable.	UK wind speed database (NOABL)
Address points.	It has been assumed that all address points could accommodate one small scale wind turbine, in accordance with the DECC methodology. This is an extremely simplistic assumption. In practice, this number is likely to be substantially lower due to site-specific constraints. Of particular concern is the issue that many buildings will be linked to multiple address points, for example, shopping malls, office buildings and blocks of flats.	Ordnance Survey ADDRESS-POINT dataset
44% reduction in wind speed in urban areas	Applied in accordance with the DECC methodology.	UK wind speed database (NOABL) Defra Rural-Definition dataset
33% reduction in wind speed in suburban areas	Applied in accordance with the DECC methodology.	UK wind speed database (NOABL) Defra Rural-Definition dataset
Zero reduction in wind speed in rural areas	Applied in accordance with the DECC methodology.	UK wind speed database (NOABL) Defra Rural-Definition dataset

Table 51 Issues constraining physically accessible resource for small scale wind energy generation

Appendix B: Renewable energy resource by local authority

Appendix B Renewable energy resource by local authority

A description of the renewable energy resource for each local authority in Yorkshire and Humber has been provided in this appendix. These should be considered a high level summary of the resource and only facilities above 1 MW are discussed.

A detailed description of the resource at local authority level is beyond the scope of this study, but the Energy Opportunities Plans produced can be used to provide an evidence base for local development framework documents. Appendix B contains a copy of the Energy Opportunities Plan for each local authority and a summary of the maximum, economically viable resource by technology for each local authority. The technologies have been categorised as follows.

- Commercial scale wind energy;
- Hydro energy (small scale, low head);
- Biomass (including energy crops, managed woodland, industrial wood waste and agricultural arisings, or straw);
- Energy from waste (including AD 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).

All figures are rounded to the nearest MW. 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 dwelling. For the purposes of comparison, an average home has been assumed to have an annual energy demand of 0.015 GWh.

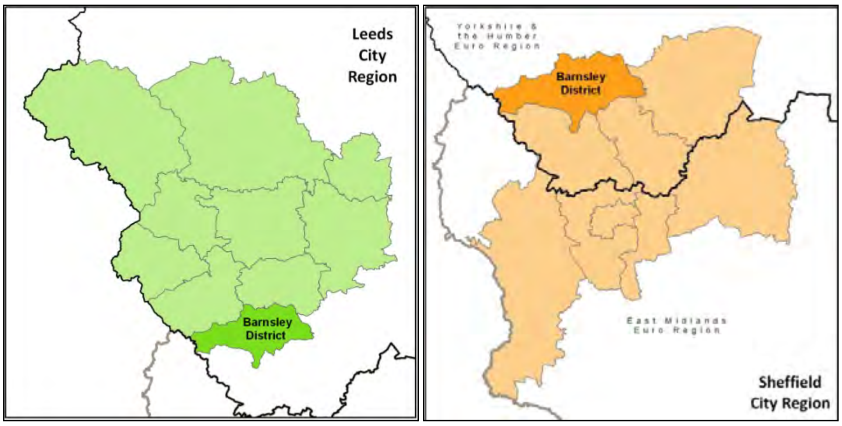
The following technologies are not included in the resource tables:

- Co-firing resource
- Offshore technologies.

B.1 Barnsley

Population: 225,900

Land area (km^2): 329



The borough of Barnsley is located in both the Leeds City sub-region and the South Yorkshire/Sheffield City sub-region. It is mainly rural to the west and urban/industrial to the east.

The town of Barnsley is the main urban centre and has sufficient heat density to support district heating networks. Recognising the Borough's district heating potential, Barnsley has implemented a program to connect buildings to a biomass heating scheme. The Council initiated the program with a number of its own public buildings. It has also established a local biomass supply chain from which to source its biomass heat supply.

In the more rural parts of the Borough, wind holds the greatest promise. Four wind farms are in operation or have been consented in the west of the district; Blackstone Edge, Hazlehead, Royd Moor, and Spicer Hill.

Capabilities on project:
Building Engineering - Sustainability

Barnsley	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	26	68	0	86	225	0	0%
Small scale wind	0	0	0	1	2	0	7%
Hydro	0	0	0	0	1	0	0%
Solar PV	1	1	0	11	9	0	0%
Solar thermal	0	0	17	0	11	1163	5%
Air source heat pumps	0	0	9	0	14	576	3%
Ground source heat pumps	0	0	1	0	2	87	1%
Biomass energy crops	0	0	9	5	78	629	2%
Biomass woodfuel	2	5	27	0	72	1821	8%
Biomass agricultural arisings (straw)	0	0	3	1	20	168	1%
Biomass waste wood	0	0	2	1	12	102	3%
Energy from waste wet	0	0	1	1	8	61	1%
Energy from waste poultry litter	0	0	0	0	0	0	0%
Energy from waste MSW	0	0	2	1	18	151	3%
Energy from waste C&I	0	0	3	2	26	216	2%
Energy from waste landfill gas	0	0	0	0	0	0	0%
Energy from waste sewage gas	0	1	0	0	5	0	0%
Total	29	75	92	110	578	6,131	

Table 52 Current capacity and renewable energy resource in Barnsley. Current" refers to facilities that are operational or have planning consent

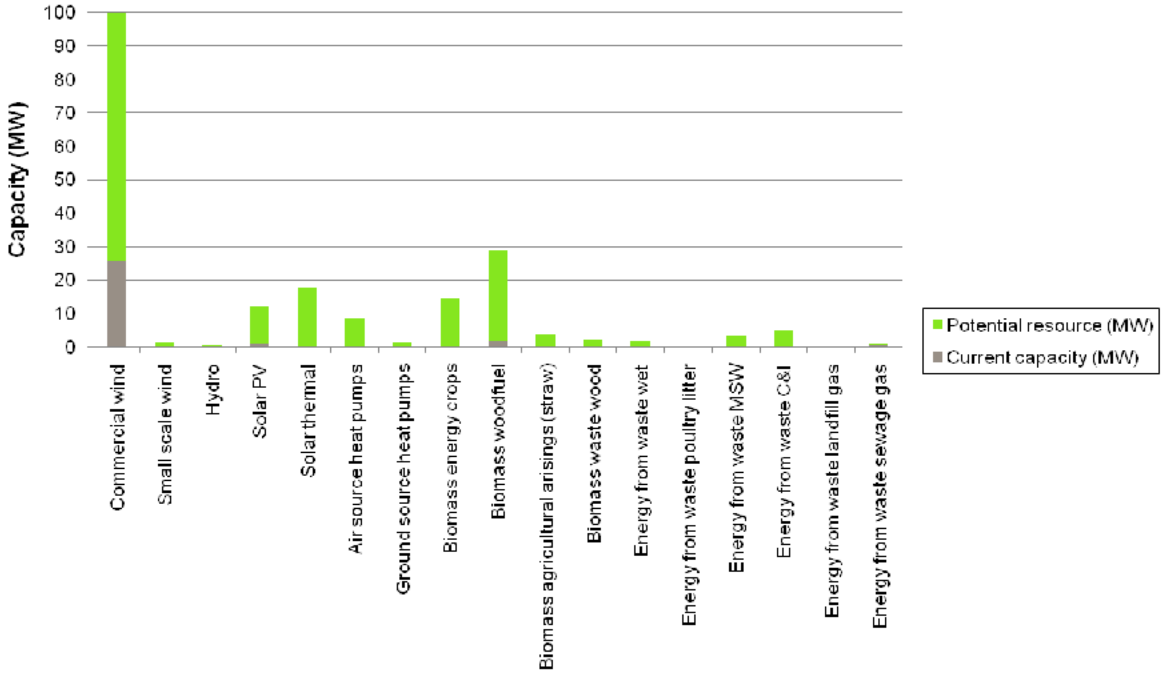


Figure 60 Current capacity and renewable energy resource in Barnsley. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

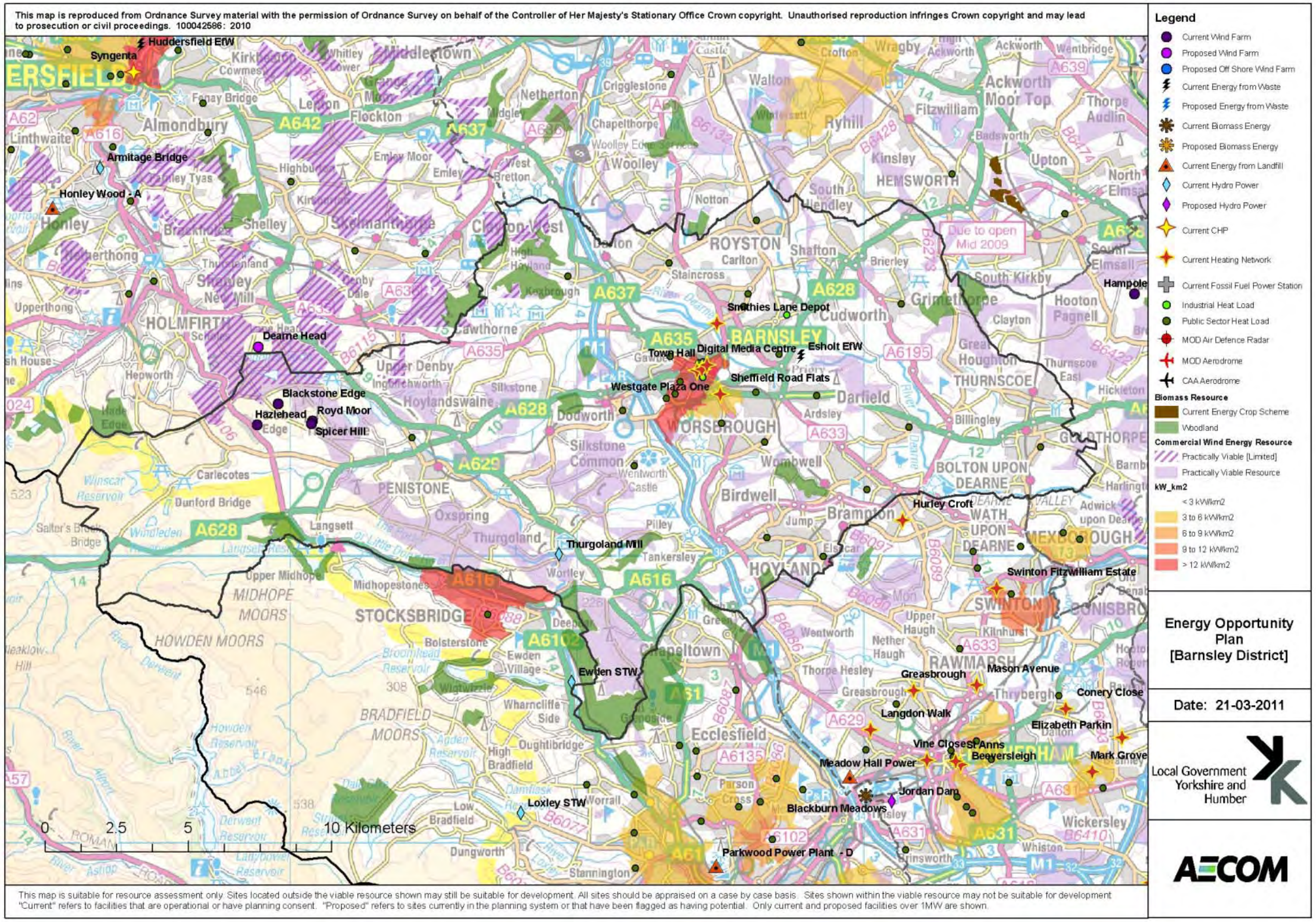


Figure 61 Energy opportunities plan for Barnsley. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.2 Bradford

Population: 501,700

Land area (km^2): 370

Bradford is located in the eastern part of the South Pennines, in the Leeds City Region. Although it is the fourth largest district in the country in terms of populations, around two-thirds of the district is rural with the majority of the population living in the urban centres of Bradford, Shipley, Bingley, Keighley and Ilkley.

The city of Bradford has the density necessary to support district heating networks. The Energy Opportunities Plan shows that there are many public buildings in the city that could provide anchor loads for such networks.

Other renewable energy opportunities in the district include wind and hydro opportunities. There is currently one hydro generation plant operating in Esholt, and a potential site identified at Greenholme Mills on the border with Harrogate district. Bradford’s hydro potential is among the best in the region and their installation should be sought and supported wherever feasible.

Planning permission was granted to BioGen Power in April 2010, to build the world's largest gasification based Energy Recovery Facility to be fuelled by residual waste in Bradford, capable of processing 160,000 tonnes of residual waste.

Bradford	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	0	0	0	70	183	0	0%
Small scale wind	0	0	0	2	3	0	13%
Hydro	1	2	0	4	14	0	0%
Solar PV	0	0	0	28	21	0	0%
Solar thermal	0	0	37	0	22	2440	10%
Air source heat pumps	0	0	25	0	40	1694	10%
Ground source heat pumps	0	0	2	0	4	131	1%
Biomass energy crops	0	0	4	2	35	284	1%
Biomass woodfuel	1	3	24	0	63	1603	7%
Biomass agricultural arisings (straw)	0	0	0	0	0	0	0%
Biomass waste wood	0	0	4	2	32	270	8%
Energy from waste wet	0	0	2	2	16	124	2%
Energy from waste poultry litter	0	0	0	0	0	0	0%
Energy from waste MSW	15	104	5	3	43	363	6%
Energy from waste C&I	0	0	10	5	78	659	6%
Energy from waste landfill gas	2	10	0	0	0	0	0%
Energy from waste sewage gas	2	6	0	1	14	0	0%
Total	21	126	139	120	682	9,269	

Table 53 Current capacity and renewable energy resource in Bradford. Current" refers to facilities that are operational or have planning consent

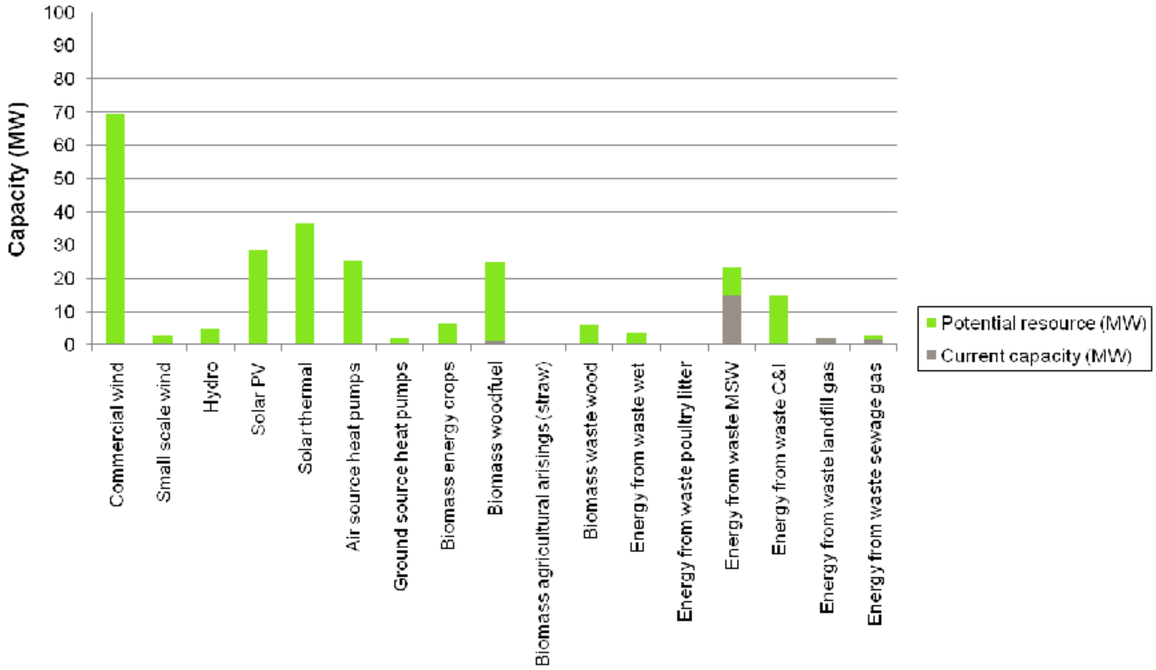


Figure 62 Current capacity and renewable energy resource in Bradford. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

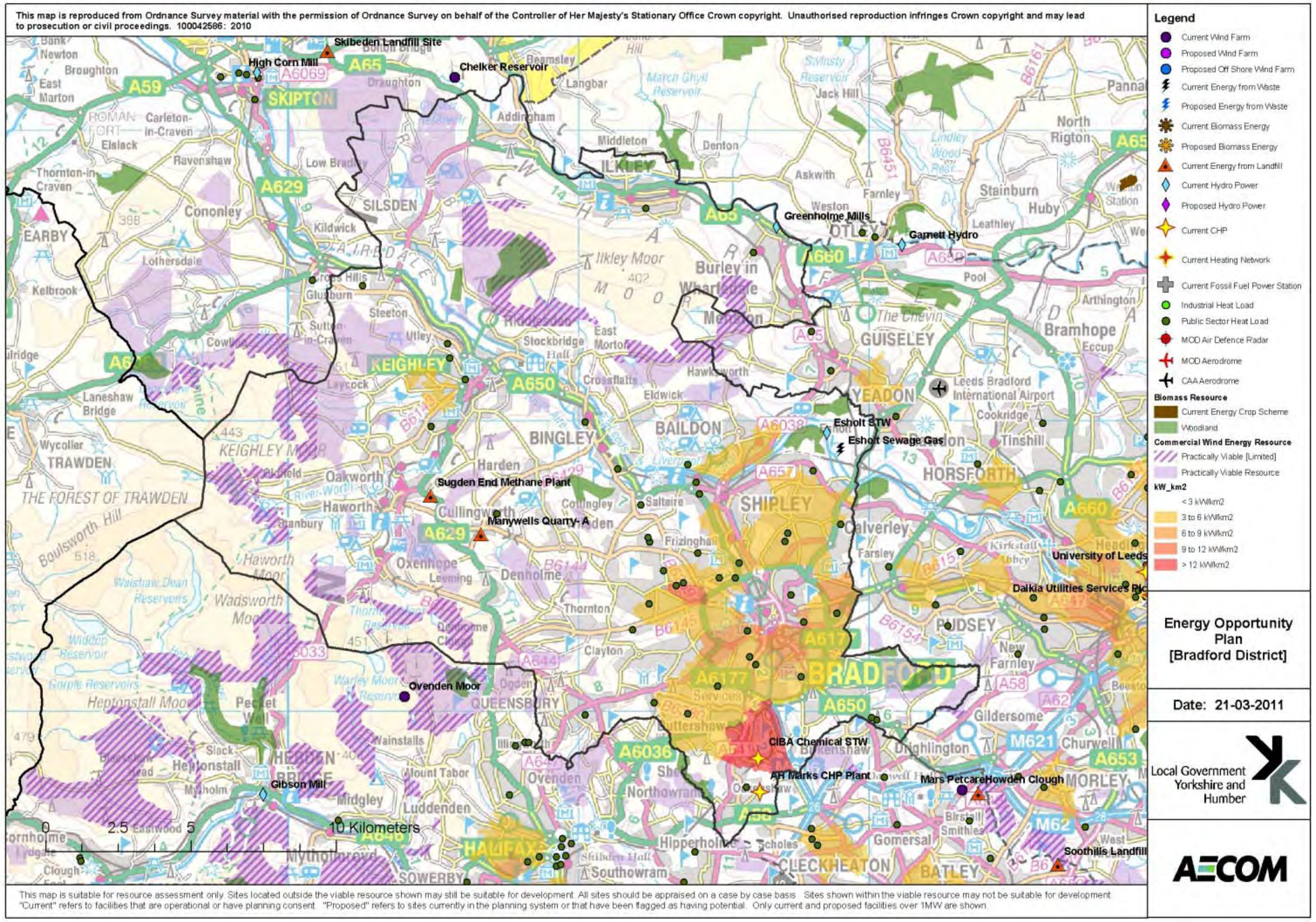


Figure 63 Energy opportunities plan for Bradford. "Current" refers to facilities that are operational or have planning consent. "Proposed" refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.3 Calderdale

Population: 200,100

Land area (km^2): 364

Calderdale is located on the western edge of Leeds City Region. Halifax is the largest urban area, containing heat density capable of supporting a heating network, and many public buildings that could provide anchor loads for a network. This is a prime example of a heating network which the Council can initiate and lead, encouraging other developments and buildings to connect to. Within the high heat density areas is a CHP plant located at Sonoco in the South.

Wind also has strong potential in the borough, although sites may have limited viability due to environmental reasons such as high sensitivity to birds (these areas are shown with purple hatching on the Energy Opportunities Plan). This conclusion was supported by the Landscape Capacity Study prepared by Julie Martin Associates on behalf of a number of South Pennine Authorities.[63] As part of developing their evidence base, Calderdale undertook a renewable energy and low carbon energy study with surrounding local authorities, which also suggested that wind is Calderdale's largest opportunity for renewable energy. Two wind farms have been granted planning permission: Todmorden Moor and Crook Hill in the west. A planning application has also been submitted for the repowering of the 9.2MW Ovenden Moor Wind Farm with larger turbines.

Calderdale Council has given planning consent to at least over 40 small wind turbines, representing over 0.5 MW_e of renewable energy capacity.

Biomass and microgeneration could also play a role in increasing the capacity of renewable energy. Hydro is also a promising renewable energy in the Borough, ranking among the top five in the region. There is currently only one hydro scheme, Hebden Bridge, operating in the centre of the Borough. With the potential to be a hydro leader in the Region, other hydro options should be explored.

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

Capabilities on project:
Building Engineering - Sustainability

Calderdale	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	37	96	0	110	290	0	0%
Small scale wind	1	1	0	1	1	0	3%
Hydro	0	0	0	2	8	0	0%
Solar PV	0	0	0	7	6	0	0%
Solar thermal	0	0	12	0	8	822	3%
Air source heat pumps	0	0	12	0	20	831	5%
Ground source heat pumps	0	0	1	0	2	87	1%
Biomass energy crops	0	0	5	3	41	333	1%
Biomass woodfuel	0	0	10	0	27	694	3%
Biomass agricultural arisings (straw)	0	0	0	0	2	17	0%
Biomass waste wood	0	0	1	1	8	67	2%
Energy from waste wet	0	0	1	1	10	79	1%
Energy from waste poultry litter	0	0	0	0	1	0	0%
Energy from waste MSW	0	0	2	1	14	114	2%
Energy from waste C&I	0	0	4	2	30	258	2%
Energy from waste landfill gas	1	6	0	0	0	0	0%
Energy from waste sewage gas	0	0	0	0	4	0	0%
Total	39	104	62	128	527	4,154	

Table 54 Current capacity and renewable energy resource in Calderdale. Current" refers to facilities that are operational or have planning consent

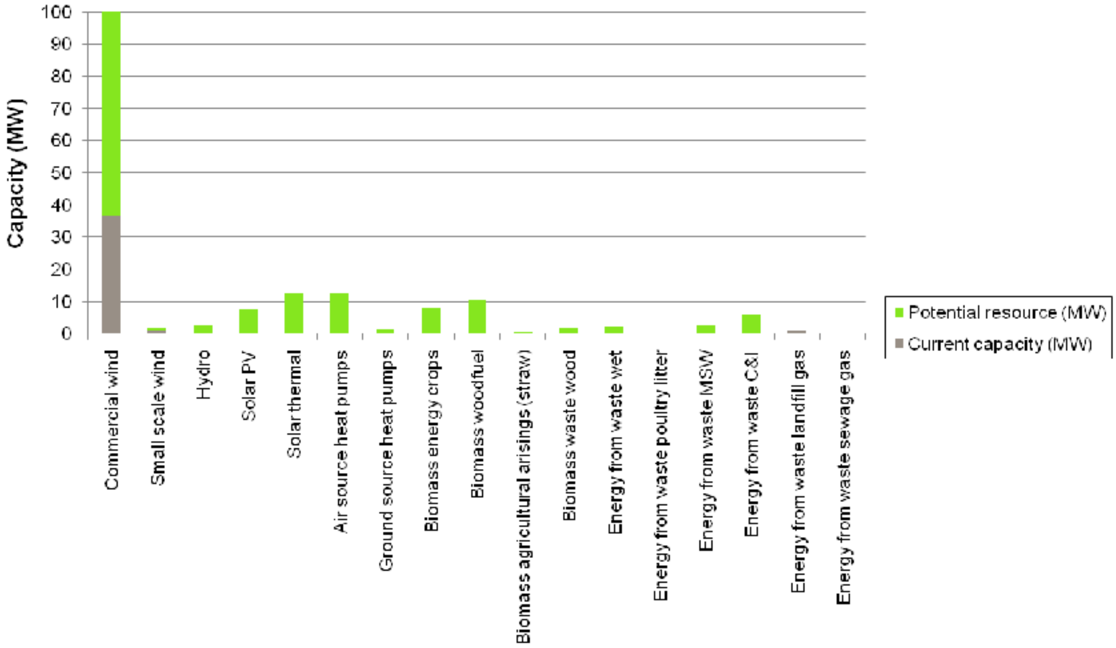


Figure 64 Current capacity and renewable energy resource in Calderdale. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

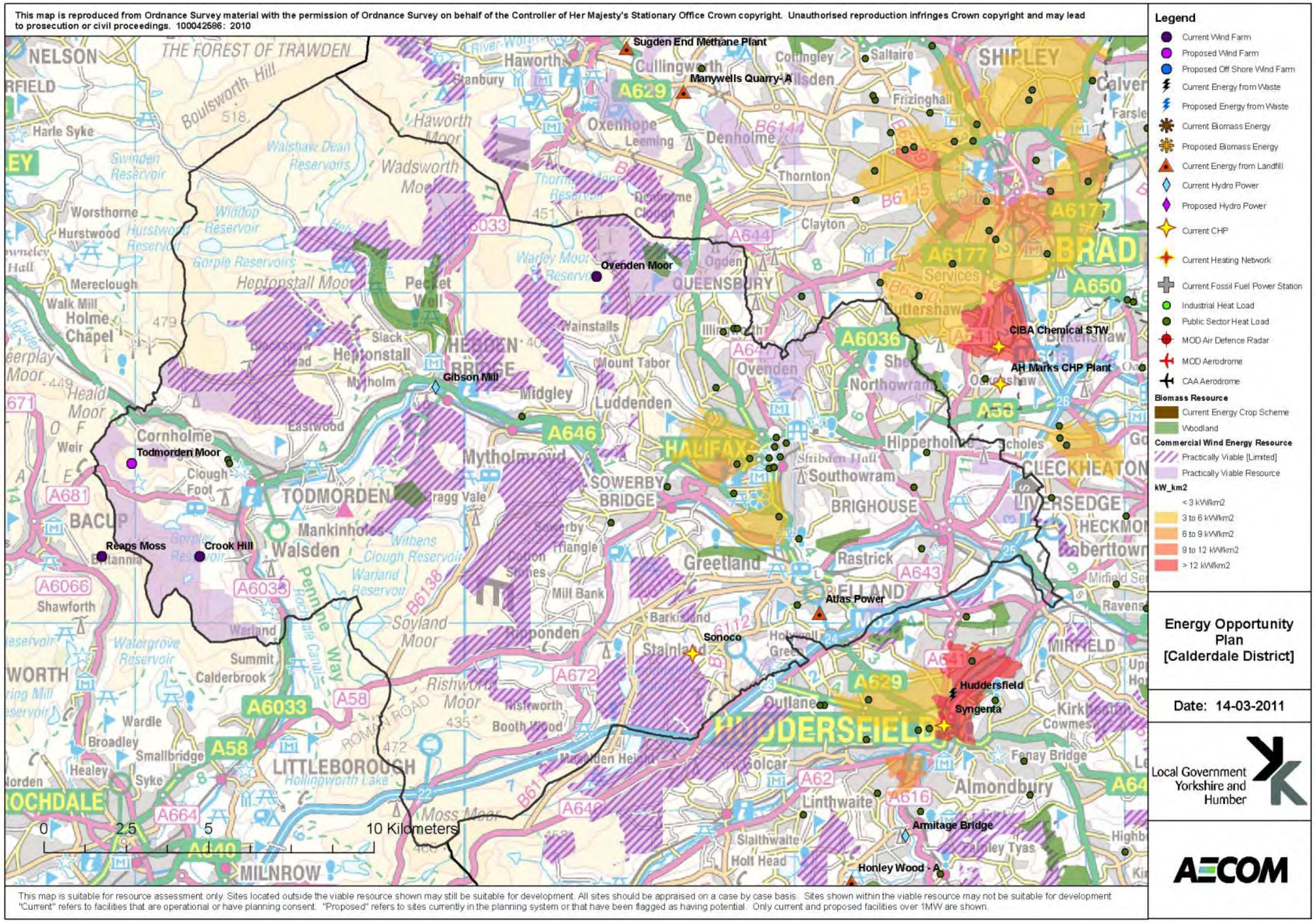


Figure 65 Energy opportunities plan for Calderdale. "Current" refers to facilities that are operational or have planning consent. "Proposed" refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.4 Craven

Population: 56,200

Land area (km^2): 1,177

Almost all of Craven district is located within the Yorkshire Dales National Park and consequently the potential for deployment of larger scale renewable energy technologies is severely restricted.

There are currently four wind turbines at Chelker Reservoir, and a planning application has been submitted to replace these with three larger turbines. Electricity is also generated at the 0.8 MW Skibeden Landfill site.

Craven is a rural district with limited potential for district heating. However, there are several areas of woodland which, with the development of an appropriate supply chain, could supply biomass to individual biomass boilers within the district and to the wider region.

There is some potential for hydro energy generation in Craven, with three schemes already operational or with planning permission; Settle Bridge End Mill, Grassington and High Corn Mill and a potential scheme identified at Halton Gill. There is also a commercial wind scheme called Windy Hill currently in the planning system. There is potential for microgeneration technologies throughout the district.

Craven	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	1	3	0	36	95	0	0%
Small scale wind	0	0	0	1	1	0	3%
Hydro	0	0	0	5	18	0	0%
Solar PV	0	0	0	2	2	0	0%
Solar thermal	0	0	4	0	2	245	1%
Air source heat pumps	0	0	6	0	9	378	2%
Ground source heat pumps	0	0	4	0	7	256	2%
Biomass energy crops	0	0	23	12	186	1506	4%
Biomass woodfuel	0	1	7	0	18	456	2%
Biomass agricultural arisings (straw)	0	0	1	0	7	56	0%
Biomass waste wood	0	0	0	0	3	25	1%
Energy from waste wet	0	0	3	3	30	230	4%
Energy from waste poultry litter	0	0	0	2	11	0	0%
Energy from waste MSW	0	0	1	0	6	49	1%
Energy from waste C&I	0	0	1	1	11	89	1%
Energy from waste landfill gas	1	6	0	0	0	0	0%
Energy from waste sewage gas	0	0	0	0	1	0	0%
Total	3	11	78	64	532	5,189	

Table 55 Current capacity and renewable energy resource in Craven. Current" refers to facilities that are operational or have planning consent

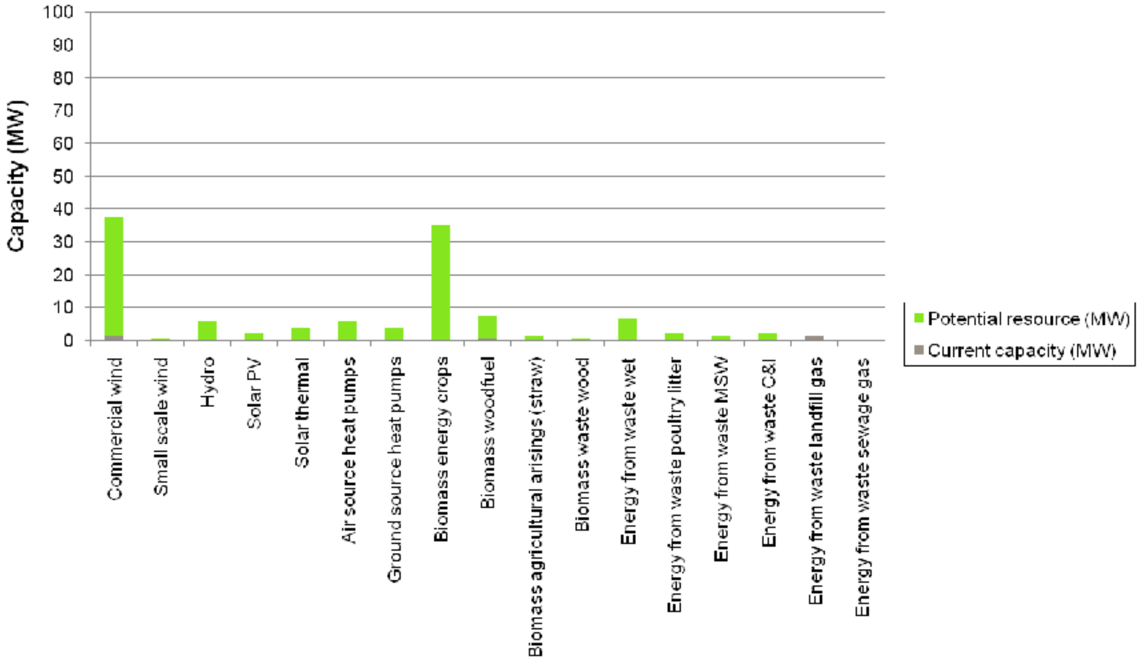


Figure 66 Current capacity and renewable energy resource in Craven. Current" refers to facilities that are operational or have planning consent.

Capabilities on project:
Building Engineering - Sustainability

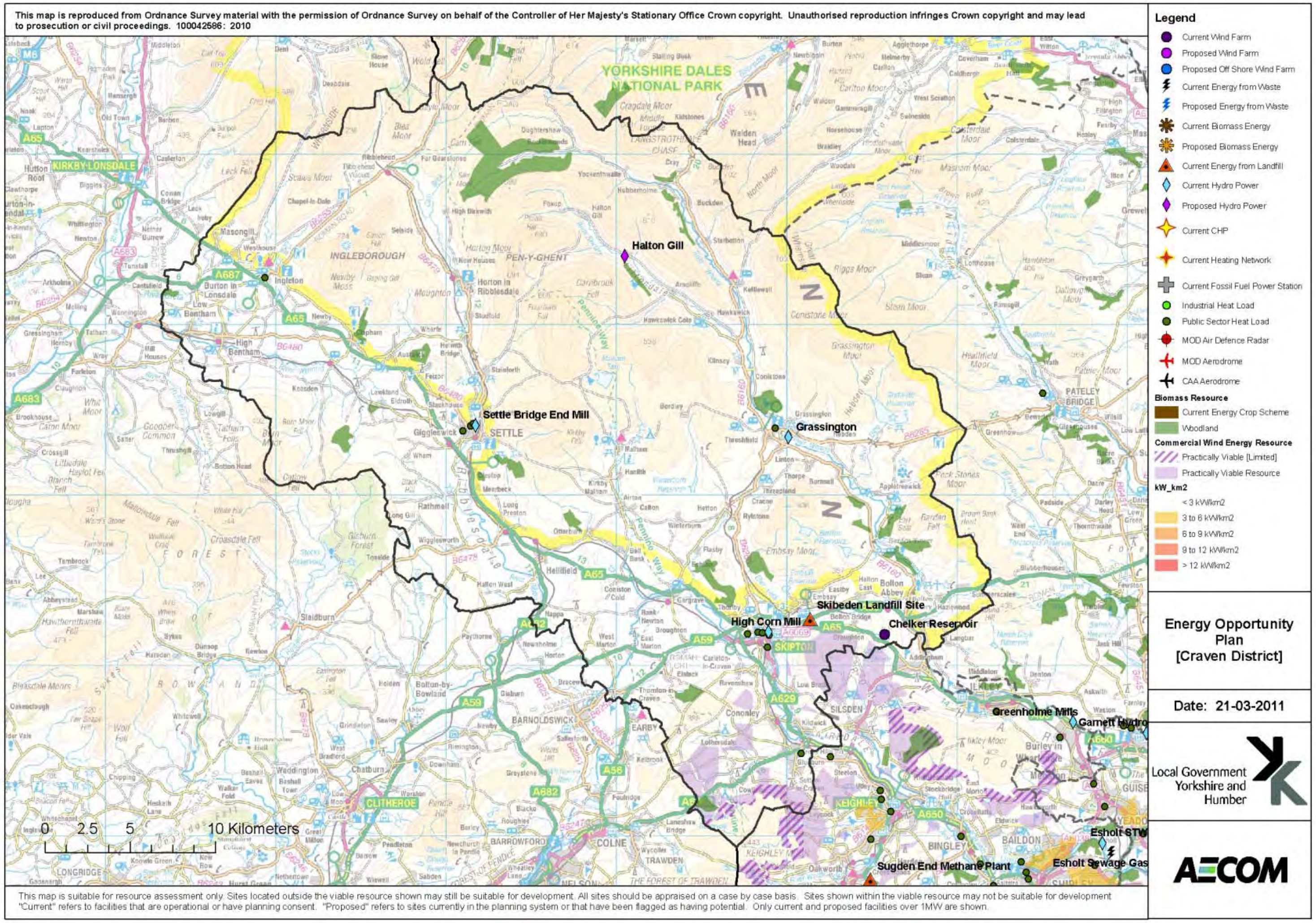


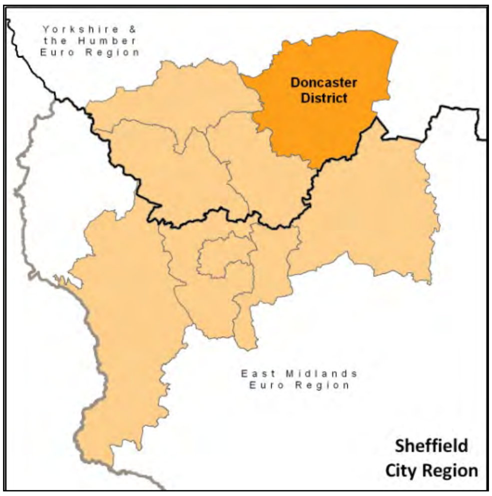
Figure 67 Energy opportunities plan for Craven. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

Capabilities on project:
Building Engineering - Sustainability

B.5 Doncaster

Population: 291,600

Land area (km^2): 568



Doncaster has a diverse settlement pattern; the main urban area of Doncaster with its town centre, employment areas and suburbs lies in the centre of the borough. Around it the borough is mainly rural, with a dozen market and coalfield towns and approximately 50 villages.

The town centre has sufficient heat density to support district heating networks, and there is a network located in Doncaster College. Swinton and parts of Mexborough also have the potential to support a district heating network.

Biomass is also an opportunity, which is being slowly developed in the Borough. A large 10MW biomass plant has been proposed at Briar Hill Farm and there are several locations in the borough where woodland could be managed to provide fuel. Energy from waste is another opportunity and a plant at Hampole Quarry has been proposed.

Doncaster has significant opportunities for commercial scale wind energy, although some of the borough is constrained by Robin Hood airport to the south.

Doncaster	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	91	239	0	298	784	0	0%
Small scale wind	0	0	0	1	2	0	7%
Hydro	0	0	0	0	1	0	0%
Solar PV	1	1	0	13	9	0	0%
Solar thermal	0	0	20	0	12	1304	6%
Air source heat pumps	0	0	11	0	17	722	4%
Ground source heat pumps	0	0	7	0	12	440	4%
Biomass energy crops	0	0	12	7	98	790	2%
Biomass woodfuel	0	1	24	0	62	1568	6%
Biomass agricultural arisings (straw)	8	56	8	4	61	519	3%
Biomass waste wood	0	0	2	1	15	123	4%
Energy from waste wet	2	10	1	1	13	95	1%
Energy from waste poultry litter	0	0	0	0	0	0	0%
Energy from waste MSW	10	67	4	2	28	234	4%
Energy from waste C&I	0	0	5	2	39	328	3%
Energy from waste landfill gas	10	51	0	0	0	0	0%
Energy from waste sewage gas	1	2	0	1	6	0	0%
Total	122	426	115	330	1,261	7,692	

Table 56 Current capacity and renewable energy resource in Doncaster. Current" refers to facilities that are operational or have planning consent

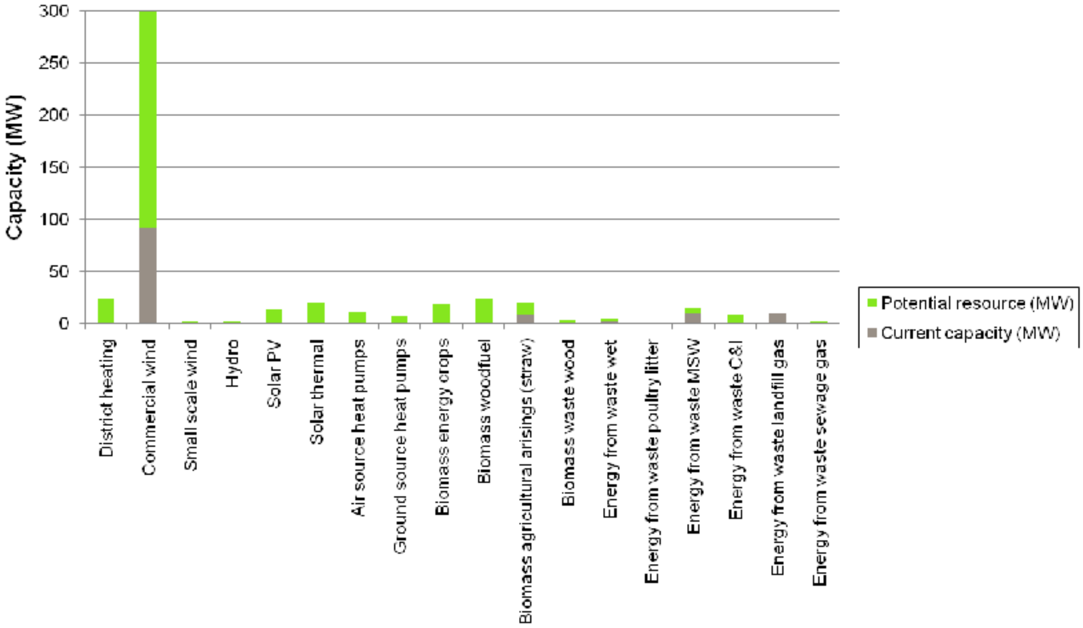


Figure 68 Current capacity and renewable energy resource in Doncaster. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

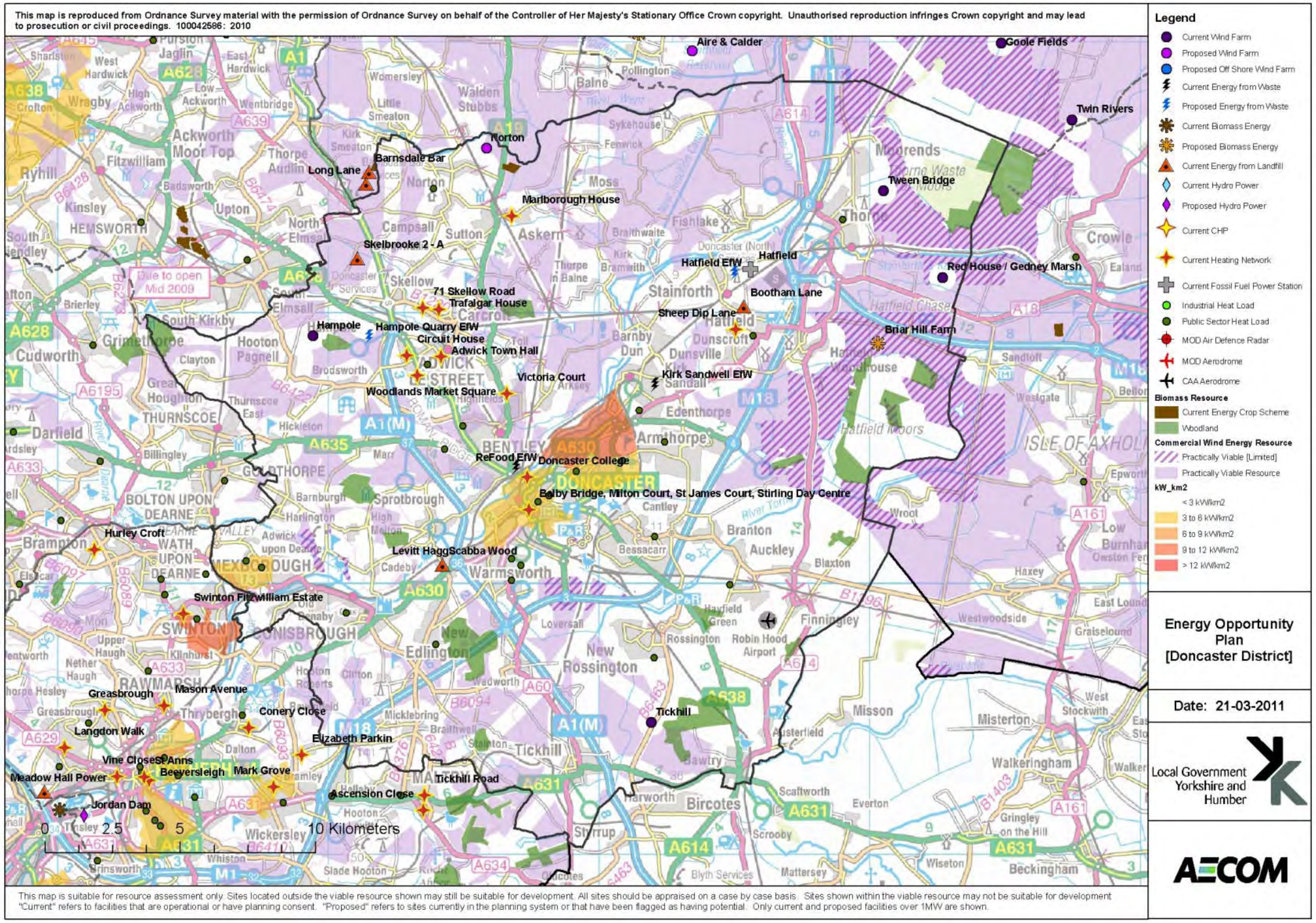


Figure 69 Energy opportunities plan for Doncaster. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.6 East Riding of Yorkshire

Population: 337,000

Land area (km^2): 2,479

East Riding of Yorkshire, one of the largest unitary authorities in the country. The largest town is Bridlington with 35,500 people. The other major settlements are Beverley (30,500), Goole (17,500), and the 'Haltemprice' settlements to the west of the City of Hull: Cottingham (17,000); Anlaby/Willerby/Kirkella (23,500); Hessle (15,000) and Driffield (12,000). However, over half the population live in rural communities.[64]

East Riding's renewable energy installed capacity is large and diverse. There is a collection of CHP plants in the south, with a cluster near Cottingham; Council run leisure centres that use CHP; an energy from landfill plant in the south and one in the northeast; energy crop schemes scattered throughout the area; a proposed energy from waste plant in the south; and 30MW of energy from burning straw consented in Goole, Tansterne, and at Gameslack Farm near Wetwang.

Currently, 278 MW of grid connected renewable energy proposals have been granted approval, with installed capacity of around 53 MW. While this is well over the Regional Spatial Strategy 2010 target for the East Riding of 41MW in terms of permitted capacity but not installed capacity, the target is not a ceiling. The Secretary of State commented in the decision on the Hall Wind farm proposal that "the Council's success in supporting renewable energy generation should not limit the support it gives to other future proposals."

To accommodate the increase in power generation, the current electricity grid requires upgrading.

This study has found that East Riding's greatest renewable energy resource is wind; the authority has the most potential for commercial scale wind energy in the Yorkshire and Humber Region. There are 2 wind farms in operation in the authority area; the 30MW Lisset Airfield Wind Farm and the 9MW Out Newton Wind Farm, and there are commercial scale wind turbines installed at Loftsome Bridge and Saltend Waste Water Treatment Works. There are 10 wind farms that have been granted planning permission and a further 3 are in the planning system currently awaiting a planning decision. As can be seen from the Energy Opportunities Plan, there is substantial opportunity for additional wind power to the east and west of the authority, whereas the north is constrained by landscape constraints.

There are a small number of biomass energy crop schemes. Outside of Hull, the Energy Opportunities Plan shows potential for district heating in Goole; the opportunity to connect to the pending straw biomass facility due to be constructed by Tesco at its distribution centre should be explored. As the largest urban area in East Riding, Bridlington also has potential for a district heating network. There is also potential within the Major Haltemprice Settlements, or built area of Hull.

The 2009 Annual Monitoring report states that "the average East Riding citizen produces more CO_2 domestically (this includes central heating fuel and electricity) than the Yorkshire and Humber average." It attributes this to the high proportion of detached homes in the authority. Whilst detached houses are often less energy efficient than flats and terraced homes, they also tend to have higher potential for microgeneration technologies such as solar PV and heat pumps.

The authority's success in rapidly adopting renewable energy presents a constraint to future adoption rates, particularly for wind energy. Many residents believe that there are already too many commercial scale wind farms in operation and political opposition appears to be growing.[65]

[64] Local Development Framework The Fifth Annual Monitoring Report, East Riding of Yorkshire Council, December 2009
[65] "Residents welcome rejection of wind farm after appeal", Yorkshire Post, January 2011

Capabilities on project:
Building Engineering - Sustainability

East Riding of Yorkshire	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	240	631	0	652	1714	0	0%
Small scale wind	0	0	0	3	4	0	15%
Hydro	0	0	0	0	0	0	0%
Solar PV	0	0	0	11	9	0	0%
Solar thermal	0	0	20	0	12	1309	6%
Air source heat pumps	0	0	15	0	23	971	6%
Ground source heat pumps	0	0	3	0	5	184	2%
Biomass energy crops	0	0	48	27	399	3232	9%
Biomass woodfuel	0	0	55	0	145	3687	15%
Biomass agricultural arisings (straw)	30	212	72	36	568	4802	26%
Biomass waste wood	0	0	2	1	14	115	3%
Energy from waste wet	2	10	5	5	47	357	5%
Energy from waste poultry litter	0	0	0	4	20	0	0%
Energy from waste MSW	0	0	4	2	34	291	5%
Energy from waste C&I	0	0	5	2	39	328	3%
Energy from waste landfill gas	3	18	0	0	0	0	0%
Energy from waste sewage gas	2	6	0	2	6	0	0%
Total	278	878	294	745	3,323	19,600	

Table 57 Current capacity and renewable energy resource in East Riding. Current" refers to facilities that are operational or have planning consent

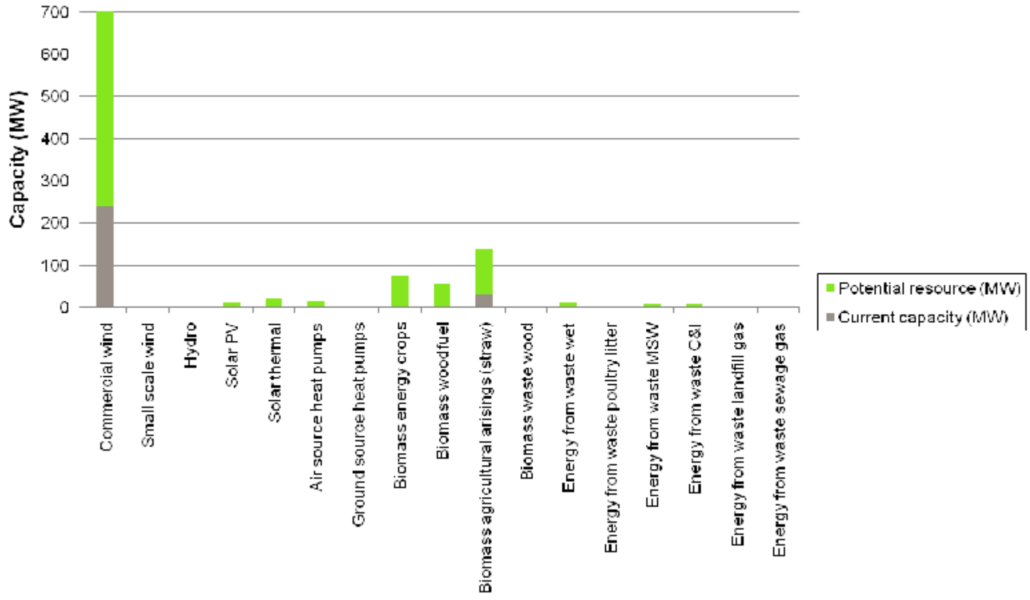


Figure 70 Current capacity and renewable energy resource in East Riding. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

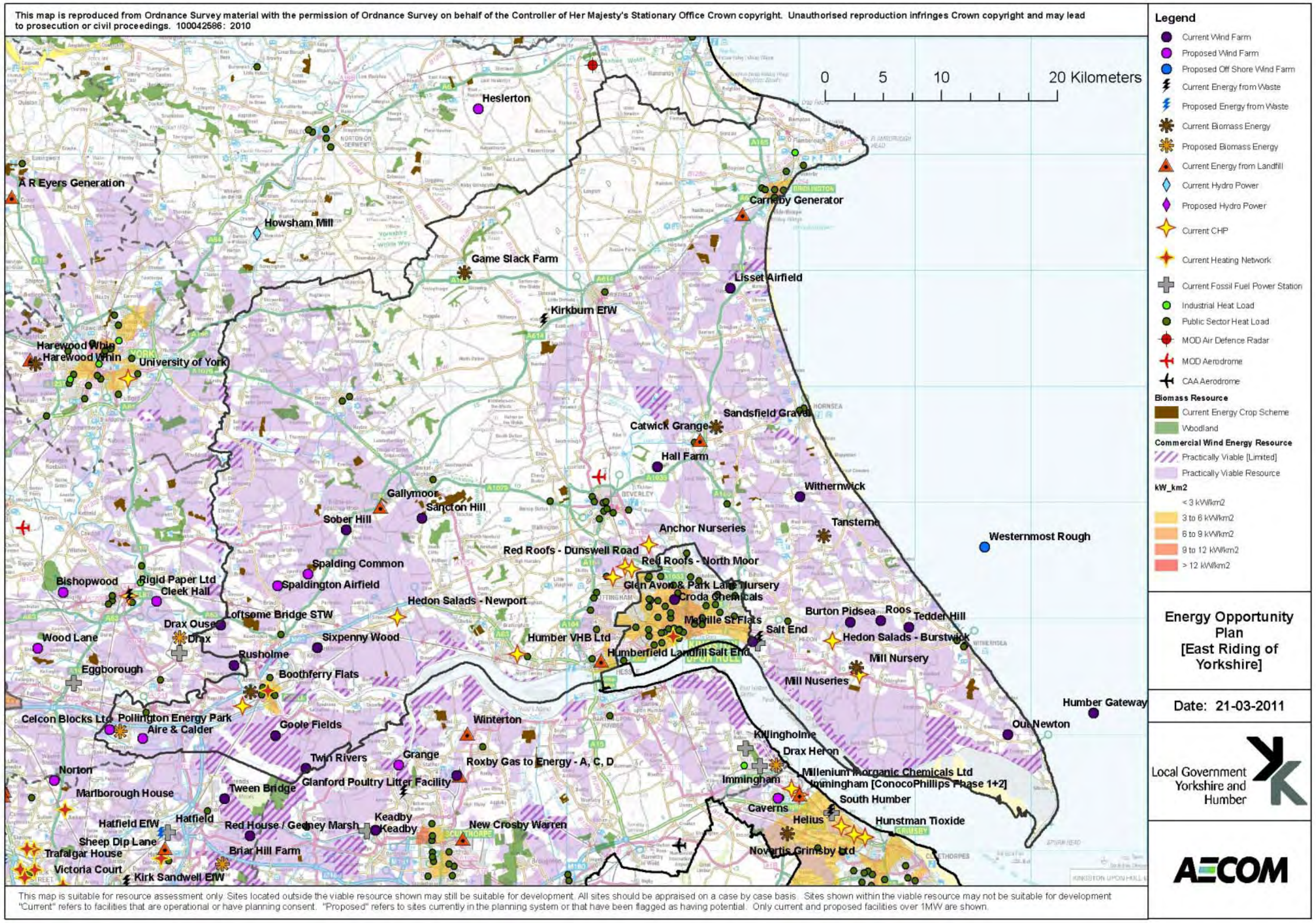


Figure 71 Energy opportunities plan for East Riding of Yorkshire. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only 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.

B.7 Hambleton

Population: 86,900

Land area (km^2): 1,311

Hambleton District is one of the largest districts in England. Sandwiched between the Yorkshire Dales and North York Moors National Parks, it is essentially rural.

About 75% of the district lies within the Vales of York and Mowbray (the drainage basins of the Rivers Ouse and Swale), which comprise low lying, fertile, intensively farmed arable land and run the entire length of the District from north to south. This limits the potential to grow energy crops for biomass. There is some woodland on the North York Moors National Park that could be managed to provide biomass.

There is significant potential for commercial scale wind in a band running from north to south through the middle of the district and there is some potential for hydro. The Seamer wind farm currently straddles the boundary between Hambleton (which as two turbines, representing 2MW of capacity) and Stockton. Other than that, the installed or consented base of renewables is limited to a few biomass crop schemes scattered through the district and two hydro power plants in Linton Lock and Aiskew water mill.

Capabilities on project:
Building Engineering - Sustainability

Hambleton	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	16	42	0	226	594	0	0%
Small scale wind	0	0	0	1	2	0	7%
Hydro	1	4	0	0	0	0	0%
Solar PV	0	0	0	3	2	0	0%
Solar thermal	0	0	5	0	3	320	1%
Air source heat pumps	0	0	7	0	10	443	3%
Ground source heat pumps	0	0	2	0	3	112	1%
Biomass energy crops	0	0	42	23	345	2794	8%
Biomass woodfuel	0	0	14	0	36	922	4%
Biomass agricultural arisings (straw)	0	0	15	7	116	982	5%
Biomass waste wood	0	0	0	0	3	28	1%
Energy from waste wet	0	0	4	3	35	264	4%
Energy from waste poultry litter	0	0	0	2	12	0	0%
Energy from waste MSW	0	0	1	1	9	74	1%
Energy from waste C&I	0	0	3	1	20	173	2%
Energy from waste landfill gas	0	2	0	0	0	0	0%
Energy from waste sewage gas	0	0	0	0	1	0	0%
Total	0	0	50	0	219	3333	9%

Table 58 Current capacity and renewable energy resource in Hambleton. Current" refers to facilities that are operational or have planning consent

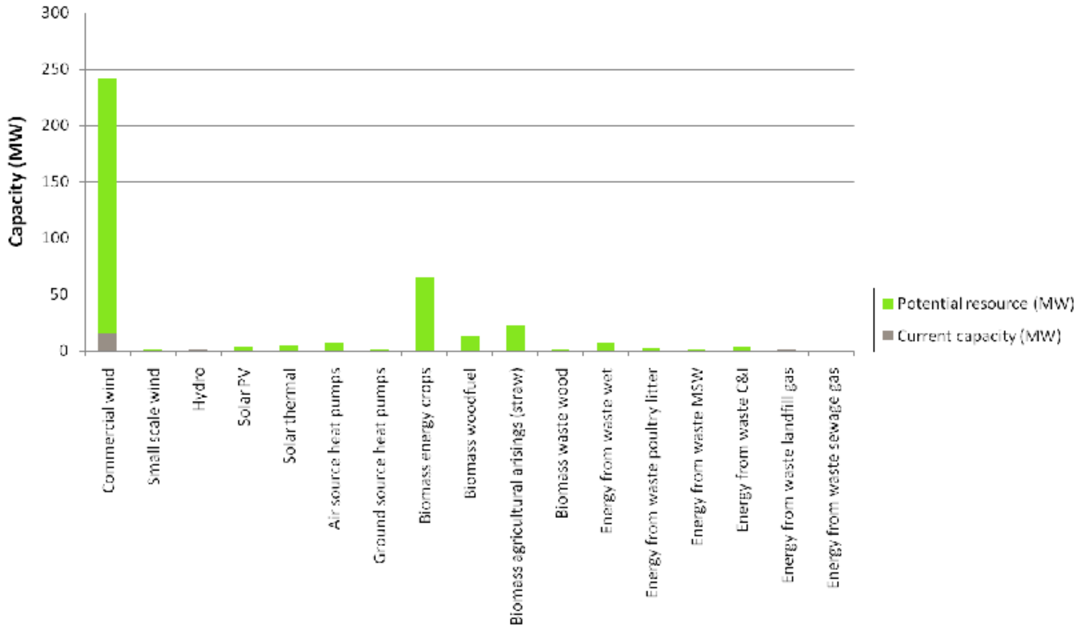


Figure 72 Current capacity and renewable energy resource in Hambleton. Current" refers to facilities that are operational or have planning consent.

Capabilities on project:
Building Engineering - Sustainability

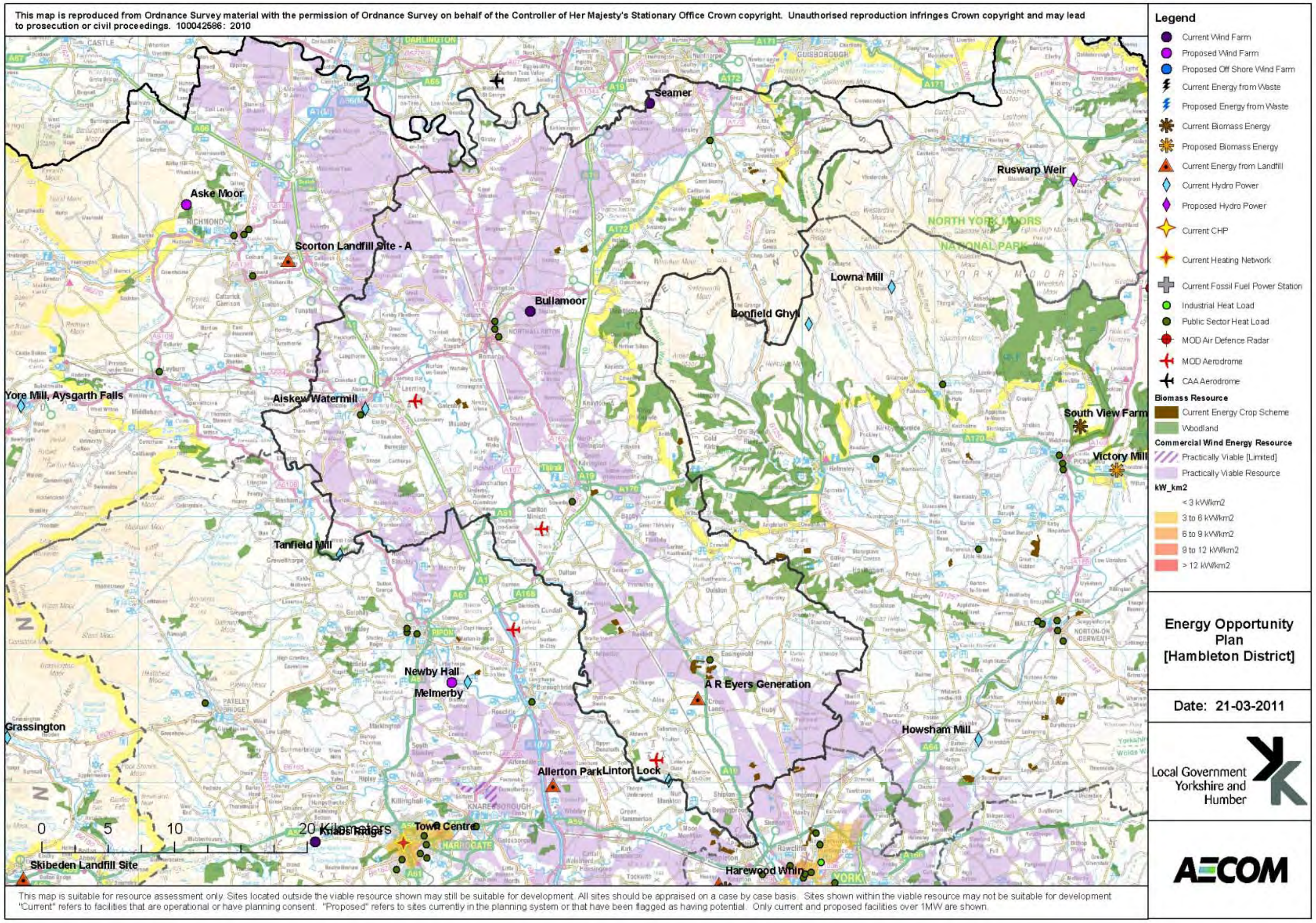
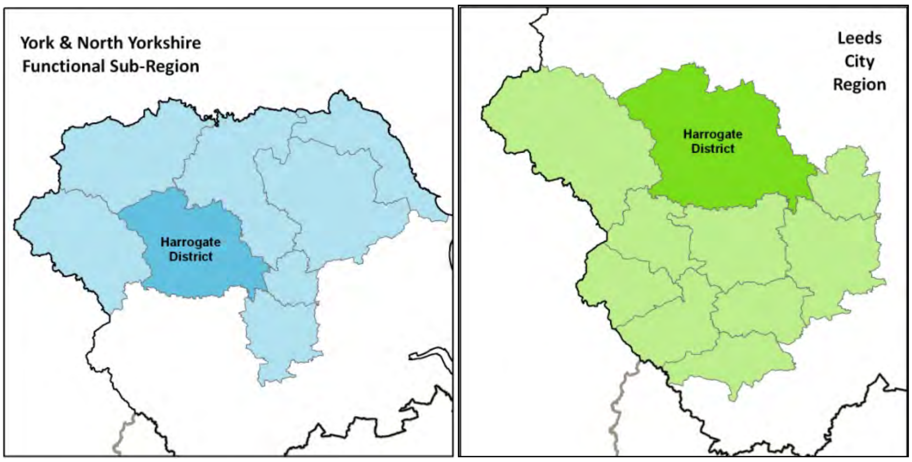


Figure 73 Energy opportunities plan for Hambleton. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.8 Harrogate

Population: 160,500

Land area (km^2): 1,308



The district of Harrogate is located in both the York and North Yorkshire and the Leeds City sub-regions. It is primarily rural with three main settlements: Harrogate Town, Knaresborough and Ripon and at least 120 smaller settlements including several small market towns.

Harrogate town centre has sufficient heat density to support district heating networks and one is already in place, connecting the municipal offices, Turkish baths, tourist information centre, Royal Hall, Hall M, Queen's suite, Springfield House, Harrogate International Centre, Hall D and the International Hotel. The system is currently at capacity however nearby potential opportunities for expansion have been identified, although these have not been examined in detail and are subject to agreement and major changes to the existing system design. The Energy Opportunities Plan shows that there are several public buildings with significant heat loads which could potentially form part of an expanded heat network.

Wind and biomass are two other main opportunities in Harrogate district, with significant potential for commercial scale wind energy in the east of the district. The only commercial scale wind installation at present is the Knabs Ridge Wind Farm, which consists of eight 2 MW wind turbines (i.e. total installed capacity of 16MW). A scoping study is currently being undertaken into the possibility of installing eight 2 MW turbines at Melmerby (north of Ripon). There is a small (0.08 MW) hydro scheme in operation at Newby Hall.

A planning application for an energy from waste facility at Allerton Park is expected to be submitted to the County Council in Spring 2011, to deal with the waste in North Yorkshire. About 256,000 tonnes of MSW and C&I will be incinerated to generate electricity and around 38,000 tonnes of waste will be treated in an anaerobic digester to generate electricity. It is not known if waste heat from the plant will be used to serve the energy demands of nearby buildings through a heating network.

Capabilities on project:
Building Engineering - Sustainability

Harrogate	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	16	42	0	126	331	0	0%
Small scale wind	0	0	0	1	1	0	4%
Hydro	0	0	0	1	3	0	0%
Solar PV	0	0	0	4	3	0	0%
Solar thermal	0	0	8	0	5	500	2%
Air source heat pumps	0	0	9	0	15	617	4%
Ground source heat pumps	0	0	3	0	5	188	2%
Biomass energy crops	0	0	31	17	257	2077	6%
Biomass woodfuel	1	2	10	0	26	666	3%
Biomass agricultural arisings (straw)	0	0	9	5	72	612	3%
Biomass waste wood	0	0	1	0	5	39	1%
Energy from waste wet	0	0	4	3	35	264	4%
Energy from waste poultry litter	0	0	0	2	12	0	0%
Energy from waste MSW	0	0	2	1	16	132	2%
Energy from waste C&I	0	0	4	2	35	298	3%
Energy from waste landfill gas	1	5	0	0	0	0	0%
Energy from waste sewage gas	0	0	0	0	2	0	0%
Total	19	51	123	163	1,007	8,204	

Table 59 Current capacity and renewable energy resource in Harrogate. Current" refers to facilities that are operational or have planning consent

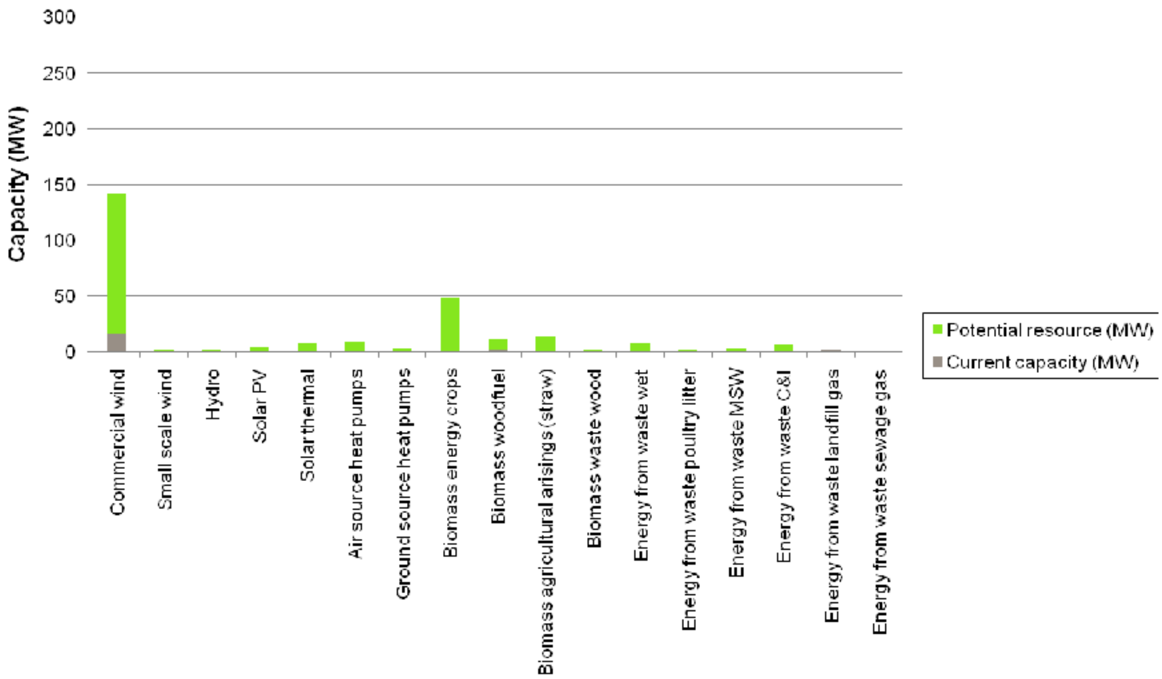


Figure 74 Current capacity and renewable energy resource in Harrogate. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

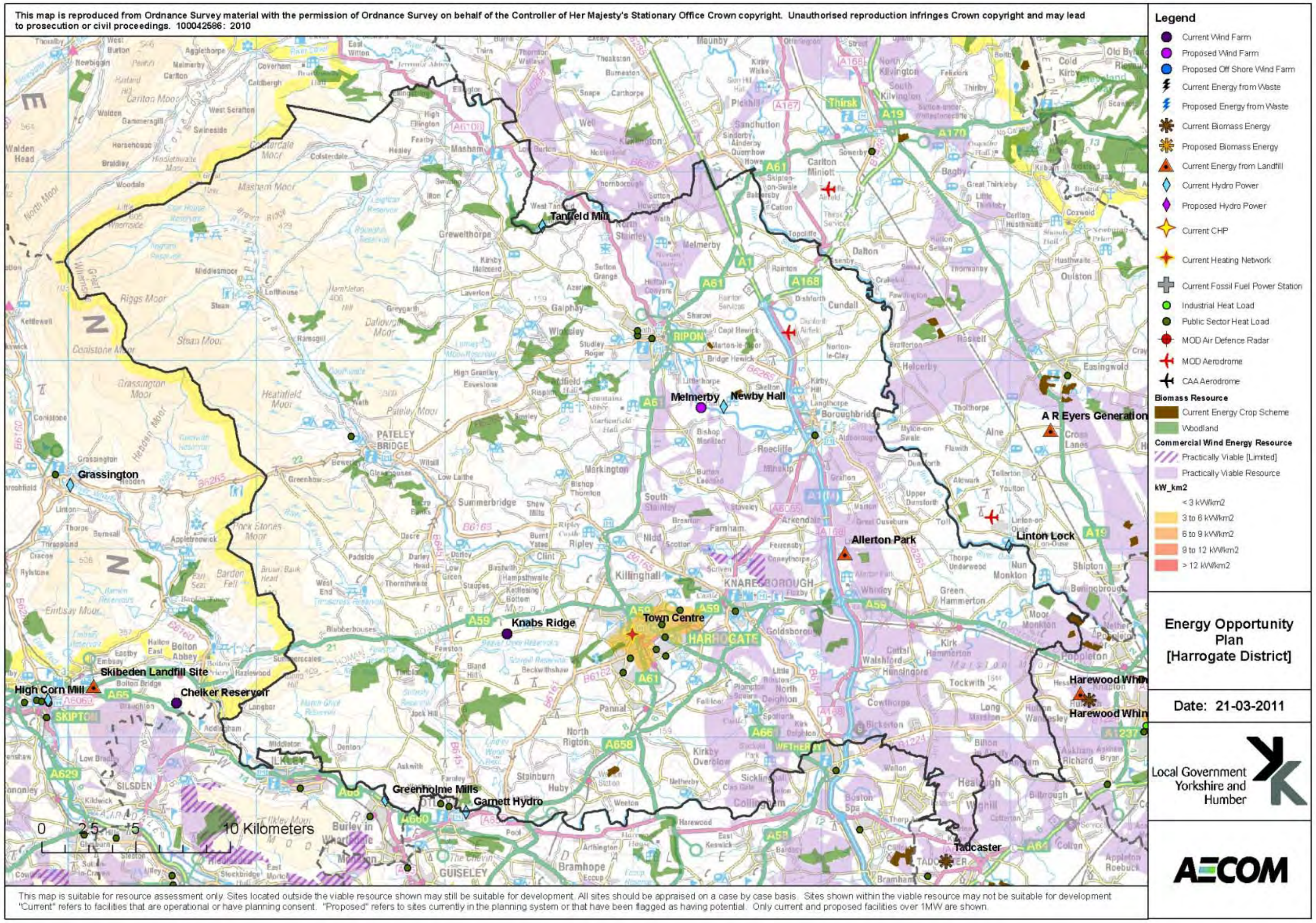


Figure 75 Energy opportunities plan for Harrogate. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.9 Kingston upon Hull, City of

Population: 258,700

Land area (km^2): 71

The city of Kingston-upon-Hull (Hull) is a relatively small local authority with little undeveloped land. The opportunities for renewable energy generation are generally limited to its significant potential for district heating with CHP. As the Energy Opportunities Plan shows, Hull already has communal heating networks serving the Boothferry flats and Melville Street flats and a number of Council owned properties located nearby areas with high heat densities. Therefore, the Council might consider initiating new networks or expansion of the existing heat networks – becoming leaders and catalysts for low carbon energy in the process.

Given the built up nature of the district, using the building stock for microgeneration technologies would be another way for the council to champion renewable energy. For example, installing solar PV on Council housing stock would increase the energy performance of those properties, contribute towards local energy and carbon targets and allow the Council to take advantage of the feed-in tariff, which could potentially make it a profitable venture. Larger scale solar PV installations, such as in car parks, or on expansive flat roofs, would maximise benefits from the feed-in tariff. Urban wind turbines could also be a significant opportunity, as the 2MW wind turbine at the Croda Chemicals site demonstrates.

Hull's other energy opportunities include generation of energy from waste. Planning permission has been granted for an energy from waste facility at Saltend which will generate electricity from up to 240,000 tonnes of local municipal and business waste per annum, sufficient to the demand of 20,000 homes.[66] It is not known whether there are plans to use the waste heat from the process in district heating networks, although the Energy Opportunities Plan shows that this could be viable in the vicinity of the plant.

The area already hosts BP's centre for research and technology which develops new biofuel technologies. The University of Hull is also undertaking similar research into renewable energy, including options marine renewable energy sources. These two centres might present an opportunity to establish a biofuel technology research hub in Hull.

As part of this study, AECOM were given access to the draft executive summary of the "Renewable Energy Potential and Energy Efficiency in New Developments" report, produced by AEA as part of the evidence base for Hull's Local Development Framework. This suggests that Hull City Council sets a planning requirement for new development sites to generate at least 10% of their energy from renewables. The study also suggests that targets for renewable energy should be set of 20% electricity and 9% heat by 2025, whilst aiming for 36.5MW_e of electrical grid capacity by 2025.

[66] Salt End Energy from Waste Facility Community Liaison Group Panel Notes, November 2010

Capabilities on project:
Building Engineering - Sustainability

Kingston Upon Hull, City of	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	2	5	0	12	32	0	0%
Small scale wind	0	0	0	1	1	0	3%
Hydro	0	0	0	0	0	0	0%
Solar PV	0	0	0	9	7	0	0%
Solar thermal	0	0	16	0	10	1064	5%
Air source heat pumps	0	0	10	0	16	697	4%
Ground source heat pumps	0	0	20	0	37	1354	13%
Biomass energy crops	0	0	0	0	0	0	0%
Biomass woodfuel	0	0	2	0	5	134	1%
Biomass agricultural arisings (straw)	0	0	0	0	0	0	0%
Biomass waste wood	0	0	1	1	10	88	3%
Energy from waste wet	0	0	3	2	25	186	3%
Energy from waste poultry litter	0	0	0	0	0	0	0%
Energy from waste MSW	20	140	3	1	23	197	3%
Energy from waste C&I	0	0	6	3	45	382	4%
Energy from waste landfill gas	0	0	0	0	0	0	0%
Energy from waste sewage gas	0	0	0	0	5	0	0%
Total	22	146	74	29	272	4,955	

Table 60 Current capacity and renewable energy resource in Hull. Current" refers to facilities that are operational or have planning consent

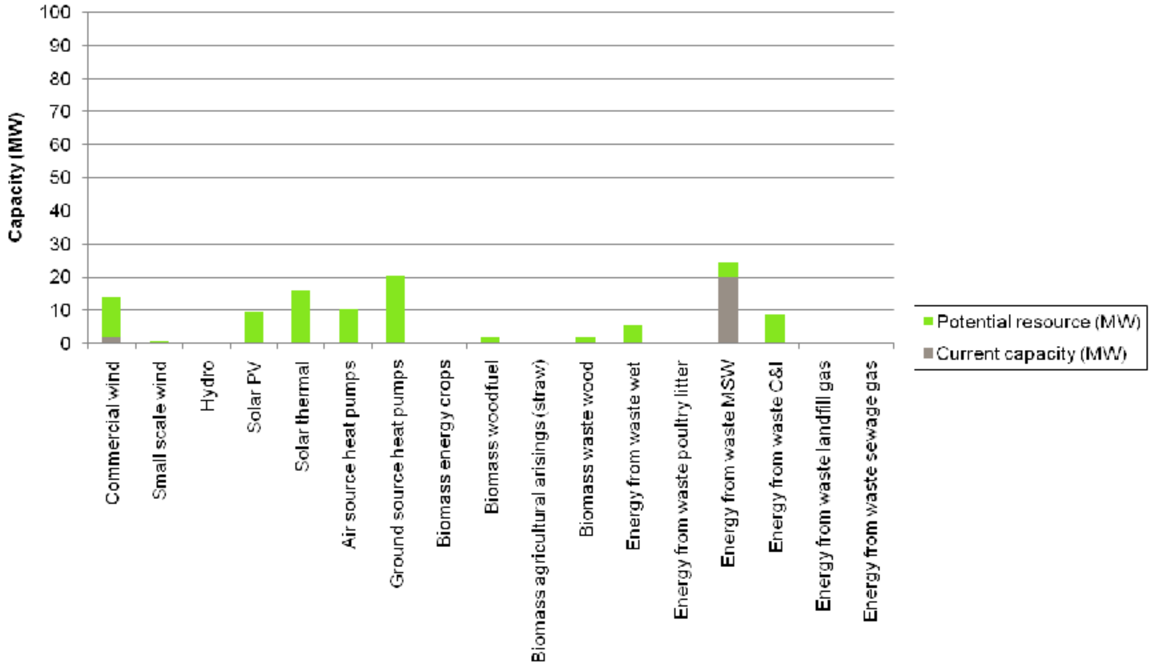


Figure 76 Current capacity and renewable energy resource in Hull. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

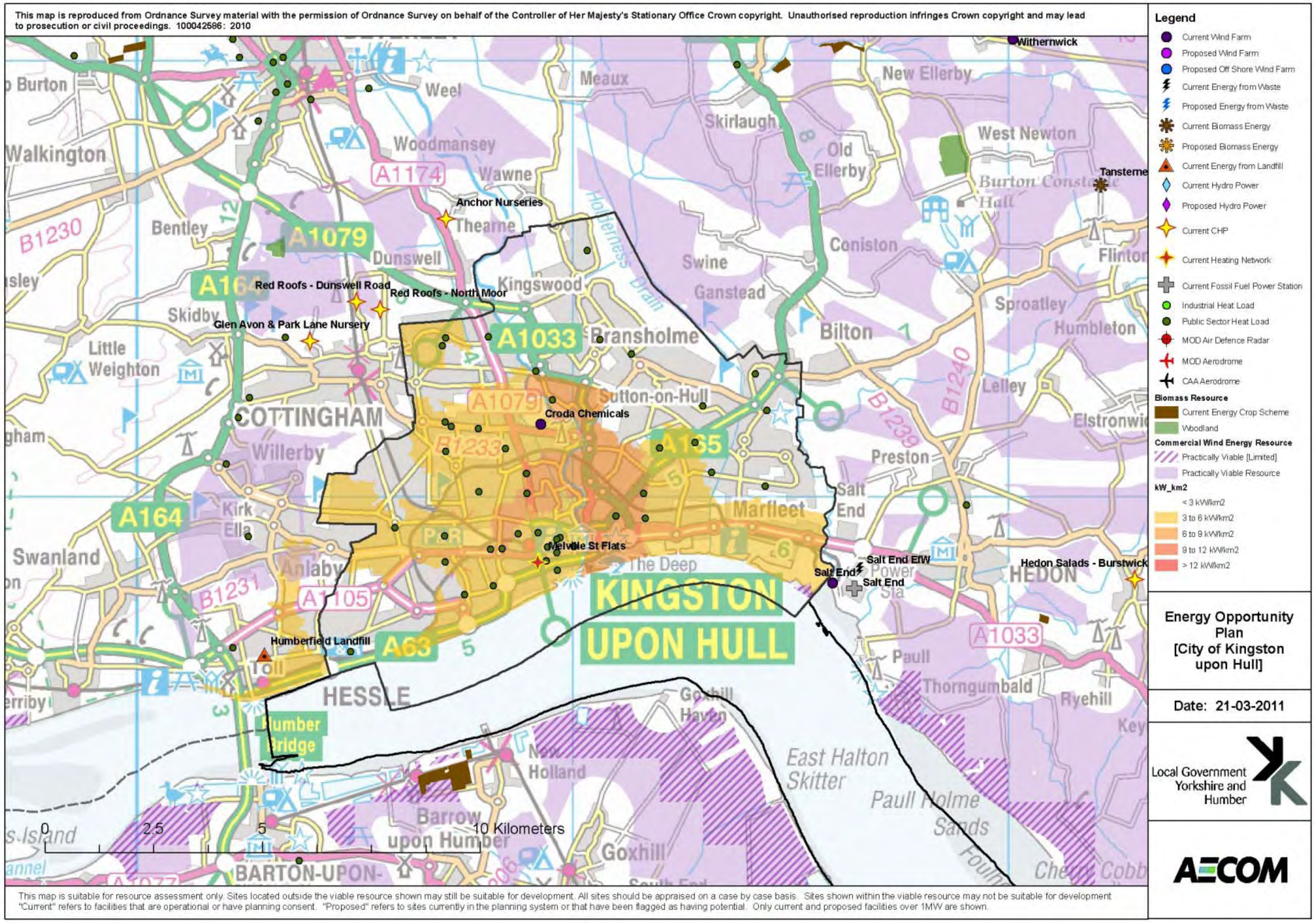


Figure 77 Energy opportunities plan for City of Kingston Upon Hull. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only 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.

Capabilities on project:
Building Engineering - Sustainability

B.10 Kirklees

Population: 403,900

Land area (km^2): 409

Kirklees is located on the western edge of the Yorkshire and Humber region within the Leeds City Region and part of Kirklees is within the Peak District National Park. The district contains a diverse mix of land uses with the main urban areas in the north and west containing the majority of the population. Huddersfield is the largest settlement of the district, and its centre of administration.

Huddersfield has a high heat density, capable of supporting district heating networks through most of the area. Waste heat from the Huddersfield energy-from-waste plant could potentially be used in nearby buildings, and the Syngenta CHP plant could also be connected. Batley and Dewsbury in the north east of the district have the potential to also implement a district heating networks, with a number of public buildings identified on the Energy Opportunities Plan that could provide suitable anchor loads.

As part of developing the evidence base for their Core Strategy, Kirklees undertook a renewable energy and low carbon energy study with surrounding local authorities. The study suggested that wind is Kirklees' largest opportunity for renewable energy, with biomass and micro-generation playing a less substantial role.

This study concurs that there is some potential for commercial scale wind but this does have a number of constraints. For example, there are constraints on bird and landscape sensitivity affecting the viable resource. The 10 MW Dearne Head Wind Farm in currently going through planning.

Hydro is also a promising renewable energy in the borough, with the sixth highest potential in the region. There are, however, no hydro schemes in operation or proposed.

Kirklees has quite a lot of solar microgeneration already installed, for example, solar PV on 121 homes at the Primrose Hill Solar Village. Kirklees Council also intends to install solar PV systems on 40 homes and 3 community centres in the Hillhouse area of Huddersfield, as part of a 'Low Carbon Communities Challenge' partnership project called 'Greening the Gap'.

Kirklees	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	0	0	0	129	339	0	0%
Small scale wind	0	0	0	1	2	0	7%
Hydro	0	0	0	2	8	0	0%
Solar PV	1	1	0	16	12	0	0%
Solar thermal	0	0	26	0	16	1748	7%
Air source heat pumps	0	0	21	0	33	1411	8%
Ground source heat pumps	0	0	31	0	56	2049	19%
Biomass energy crops	0	0	7	4	60	484	1%
Biomass woodfuel	0	0	18	0	47	1182	5%
Biomass agricultural arisings (straw)	0	0	1	0	8	64	0%
Biomass waste wood	0	0	3	1	20	170	5%
Energy from waste wet	0	2	2	1	14	106	2%
Energy from waste poultry litter	0	0	0	0	1	0	0%
Energy from waste MSW	10	70	5	2	37	309	5%
Energy from waste C&I	0	0	8	4	62	525	5%
Energy from waste landfill gas	4	20	0	0	0	0	0%
Energy from waste sewage gas	1	5	0	1	9	0	0%
Total	17	98	145	164	827	9,642	

Table 61 Current capacity and renewable energy resource in Kirklees. Current" refers to facilities that are operational or have planning consent

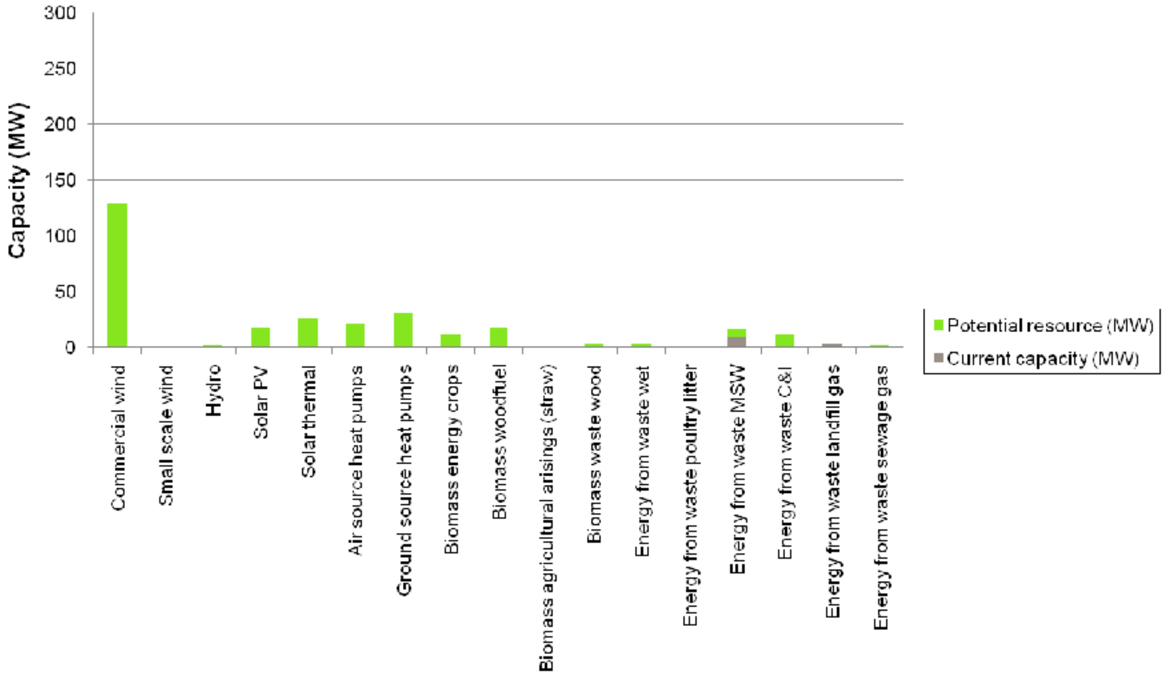


Figure 78 Current capacity and renewable energy resource in Kirklees. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

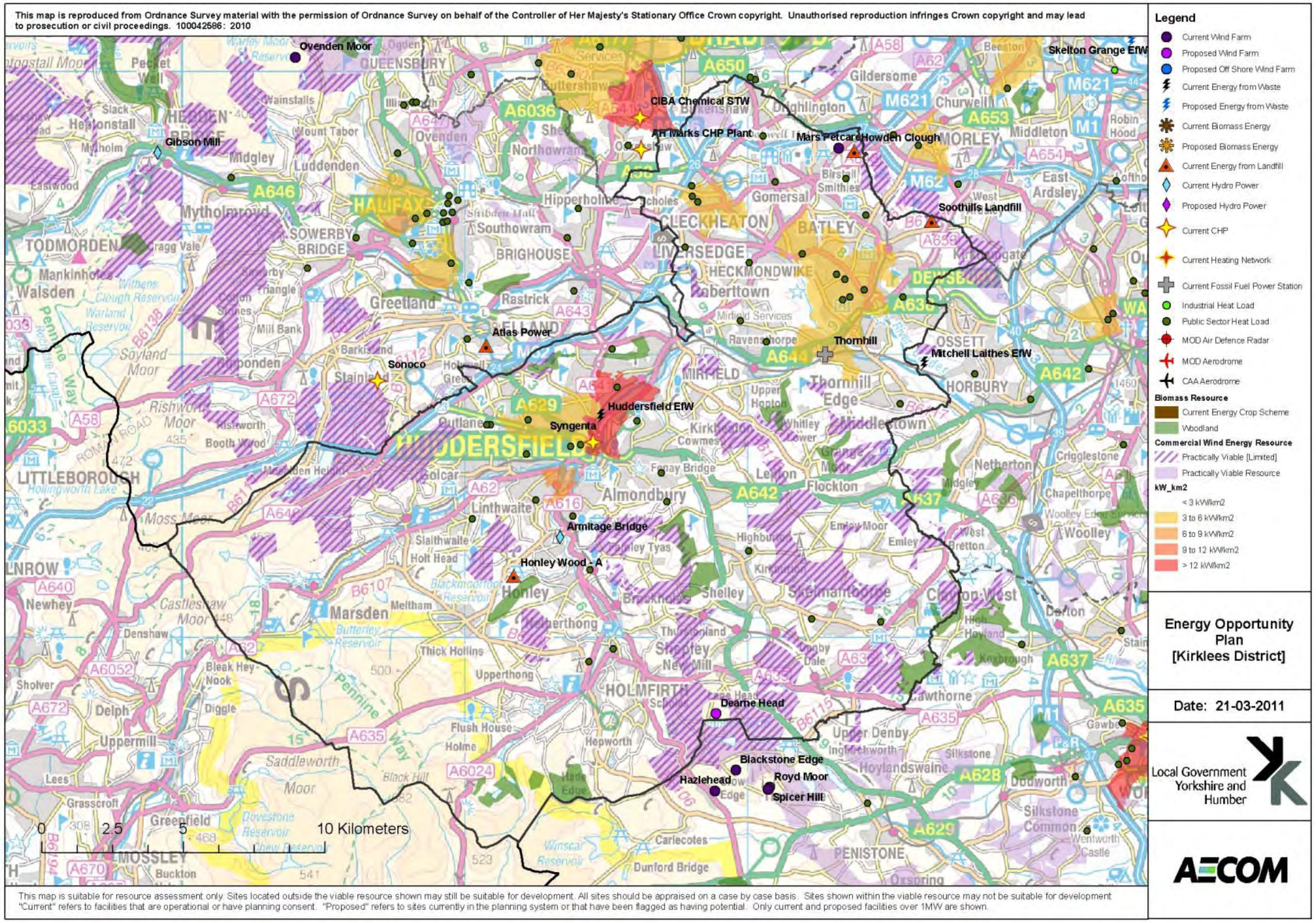


Figure 79 Energy opportunities plan for Kirklees. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.11 Leeds

Population: 770,800

Land area (km^2): 552

Leeds is the regional capital. The main urban area covers 28% of the district and is surrounded by a number of free standing market towns (including Otley and Wetherby).

As one of the UK's largest cities, it has a large area with high heat density. There is an existing district heating network in the city centre shared between the General Infirmary and the University of Leeds which is powered by a 15 MW_e CHP plant. There are many public buildings in close proximity to the network, which could act as anchor loads if the network were to be expanded. Surrounding towns and suburbs – Yeadon, Horsforth, Pudsey, Morley, Rothwell, and Garforth – also exhibit potential to support district heating networks.

Despite being quite urban with two airports and several environmentally designated areas, Leeds also has some potential for commercial scale wind energy, particularly in the east of the district.

Hydro is also a promising renewable energy in the district, ranking among the top five in the region. There is currently only one hydro scheme, Garnett Hydro, which borders on Harrogate to the north. With the potential to be a hydro leader in the region, other hydro options should be explored.

Capabilities on project:
Building Engineering - Sustainability

Leeds	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	0	0	0	80	211	0	0%
Small scale wind	0	0	0	3	4	0	15%
Hydro	0	0	0	3	9	0	0%
Solar PV	0	0	0	44	33	0	0%
Solar thermal	0	0	60	0	37	4012	17%
Air source heat pumps	0	0	31	0	49	2083	13%
Ground source heat pumps	0	0	4	0	8	285	3%
Biomass energy crops	0	0	10	6	85	692	2%
Biomass woodfuel	0	0	33	0	87	2219	9%
Biomass agricultural arisings (straw)	0	0	3	1	20	173	1%
Biomass waste wood	0	0	6	3	51	431	13%
Energy from waste wet	0	0	3	3	28	211	3%
Energy from waste poultry litter	0	0	0	0	0	0	0%
Energy from waste MSW	0	0	7	4	55	468	8%
Energy from waste C&I	0	0	19	9	148	1254	12%
Energy from waste landfill gas	9	45	0	0	0	0	0%
Energy from waste sewage gas	0	0	0	0	23	0	0%
Total	9	46	223	156	1,051	14,885	

Table 62 Current capacity and renewable energy resource in Leeds. Current" refers to facilities that are operational or have planning consent

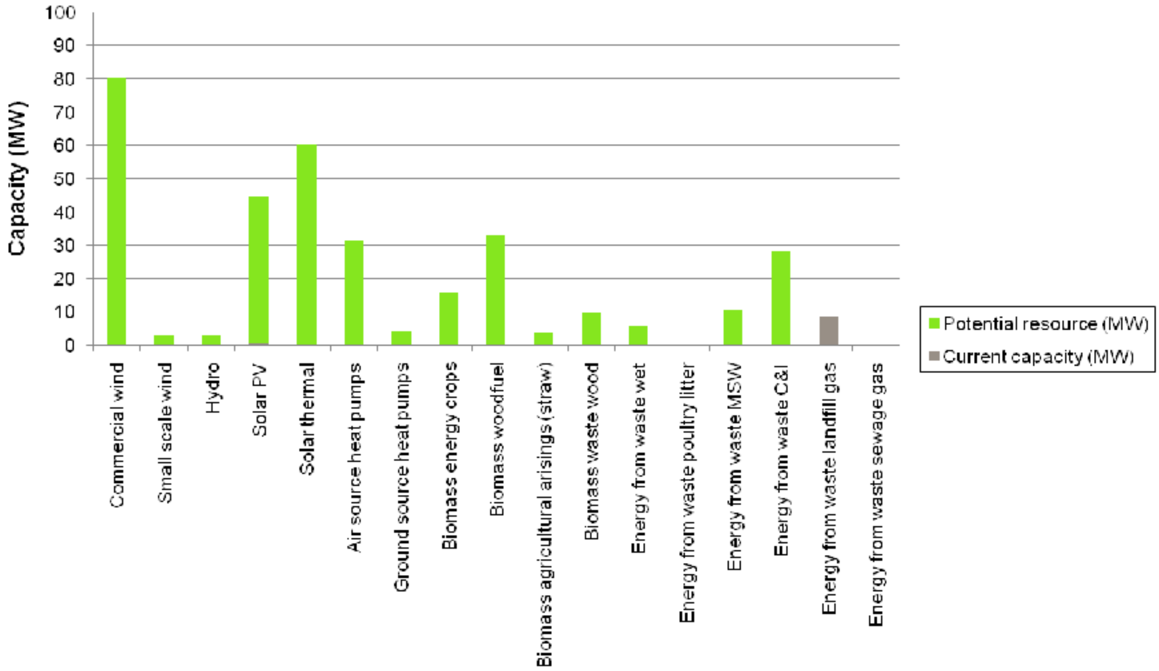


Figure 80 Current capacity and renewable energy resource in Leeds. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

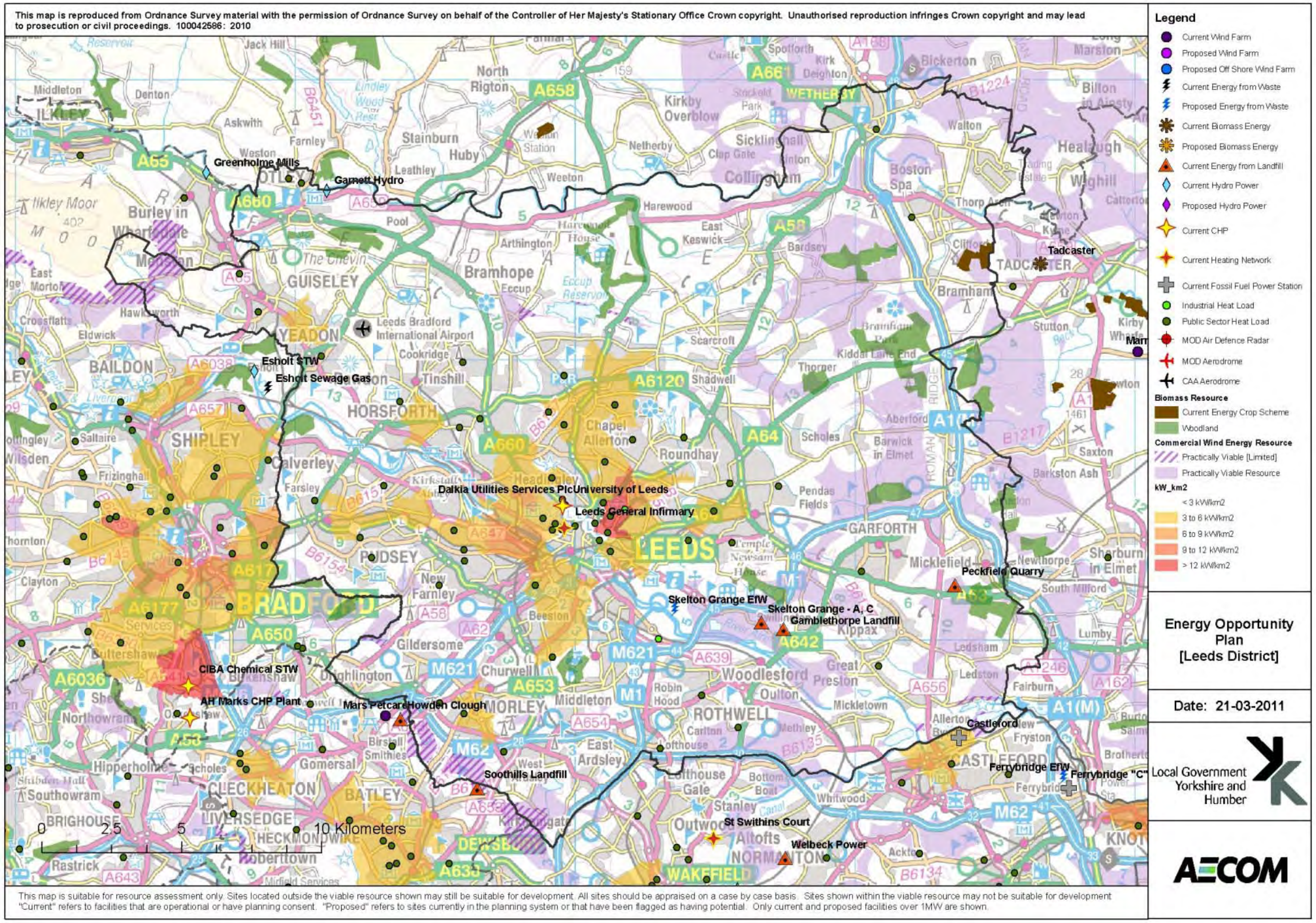


Figure 81 Energy opportunities plan for Leeds. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.12 North East Lincolnshire

Population: 158,200

Land area (km^2): 192

North East Lincolnshire is a relatively small, unitary authority and includes the port towns of Grimsby and Immingham, the seaside resort of Cleethorpes, a range of villages of varying size and composition, and the attractive landscape of the Lincolnshire Wolds. Opportunities for renewable energy generation in North East Lincolnshire are fairly limited and are centred around the towns of Grimsby, Immingham, and Cleethorpes, which could be viable for district heating networks. There are already two CHP plants on the outskirts of Grimsby, and one in Immingham.

The study has found that there are very few opportunities for commercial wind and hydro. However, there are significant opportunities for the borough to become a hub in terms of processing waste and biomass for energy generation.

The borough is at the heart of the Humber Trade Zone with the biggest port complex in the UK. The Docks and industrial complex in and around Immingham together with the refineries in Killingholme and the adjacent North Lincolnshire Authority have come to be known as the South Humber Bank Energy Corridor with facilities to handle liquid, solid and renewable fuels.[67]

Although there do appear to be significant opportunities for growing biomass, the area's excellent transport links and access to the Humber Estuary could make it a hub for biomass fuel processing. The 65 MW Helius biomass plant outside of Stallingborough will require up to 850,000 tonnes of sustainably sourced feedstock each year, primarily wood-based material. Drax and Siemens Project Ventures have also announced plans to develop a 290 MW biomass plant at the south west edge of the Port of Immingham. It is expected to process 1.4 million tonnes of biomass annually and although imported biomass will initially make up much of the fuel source, Drax have stated that they are "keen to develop the use of indigenous biomass fuels where available and the company is encouraging the development of local energy crops."[68]

North East Lincolnshire Council is currently updating its waste strategy, which was published in 2004. It already treats around 56,000 tonnes per annum of its residual MSW at the 3.2MW$_e$ Newlincs Energy from Waste and CHP incinerator in Grimsby. Its preferred approach to meeting the waste targets set out in the strategy is to use a second CHP facility located at the same site. The Energy Opportunities Map has not identified any users for the 3MW waste heat that is also produced.

Whilst a review of the opportunities from offshore renewable energy technologies are outside the scope of this study, it should be noted that as the Ports of Grimsby and Immingham are the UK's largest, they offer the capacity and resources to service offshore wind farms from here. Providing skills training for employment in this industry is important to supporting the development of this industry. Also, Pulse Tidal have installed a 0.15 MW tidal stream energy generator in the Humber estuary off the coast of North East Lincolnshire. This is connected to the grid at the Millennium Inorganic Chemicals plant.

[67] North East Lincolnshire Local Development Framework Annual Monitoring Report 2010, Balfour Beatty, December 2010
[68] Heron Renewable Energy Plant, Drax website accessed January 2011, http://www.draxpower.com/biomass/renewable_energy_plants/heron_plant/

Capabilities on project:
Building Engineering - Sustainability

North East Lincolnshire	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	0	0	0	235	618	0	0%
Small scale wind	0	0	0	0	0	0	2%
Hydro	0	0	0	0	0	0	0%
Solar PV	0	0	0	5	4	0	0%
Solar thermal	0	0	9	0	6	633	3%
Air source heat pumps	0	0	7	0	10	434	3%
Ground source heat pumps	0	0	12	0	21	767	7%
Biomass energy crops	0	0	6	3	45	367	1%
Biomass woodfuel	0	0	3	0	9	228	1%
Biomass agricultural arisings (straw)	0	0	5	2	39	333	2%
Biomass waste wood	0	0	1	0	6	51	2%
Energy from waste wet	0	0	1	0	5	37	1%
Energy from waste poultry litter	0	0	0	3	13	0	0%
Energy from waste MSW	6	42	2	1	15	128	2%
Energy from waste C&I	0	0	3	2	25	214	2%
Energy from waste landfill gas	1	5	0	0	0	0	0%
Energy from waste sewage gas	1	3	0	1	3	0	0%
Total	0	0	12	0	52	798	2%

Table 63 Current capacity and renewable energy resource in North East Lincolnshire. Current" refers to facilities that are operational or have planning consent

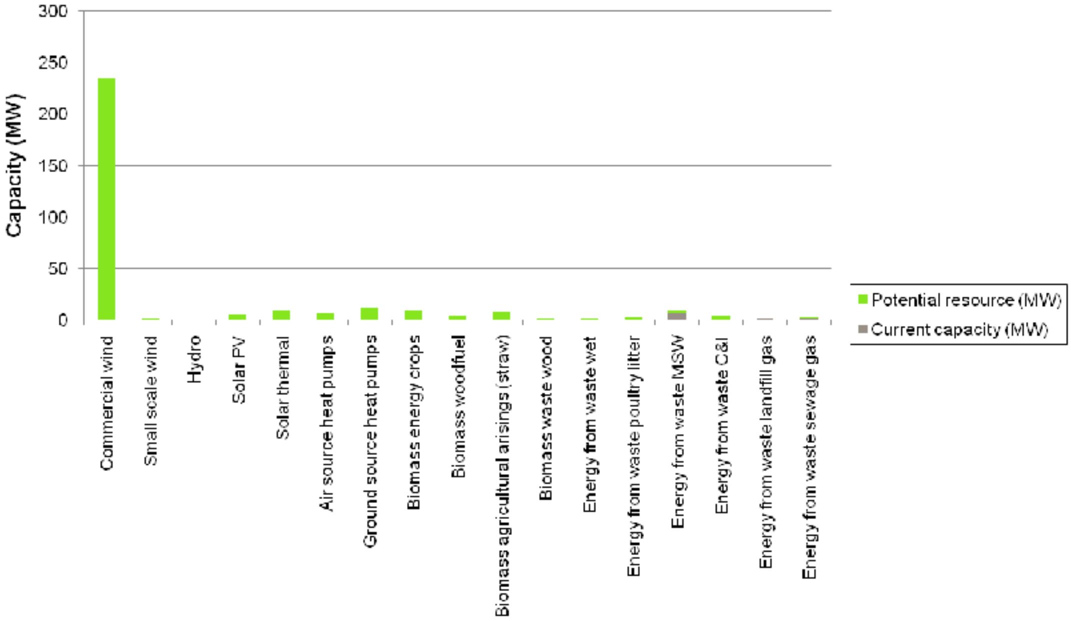


Figure 82 Current capacity and renewable energy resource in North East Lincolnshire. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

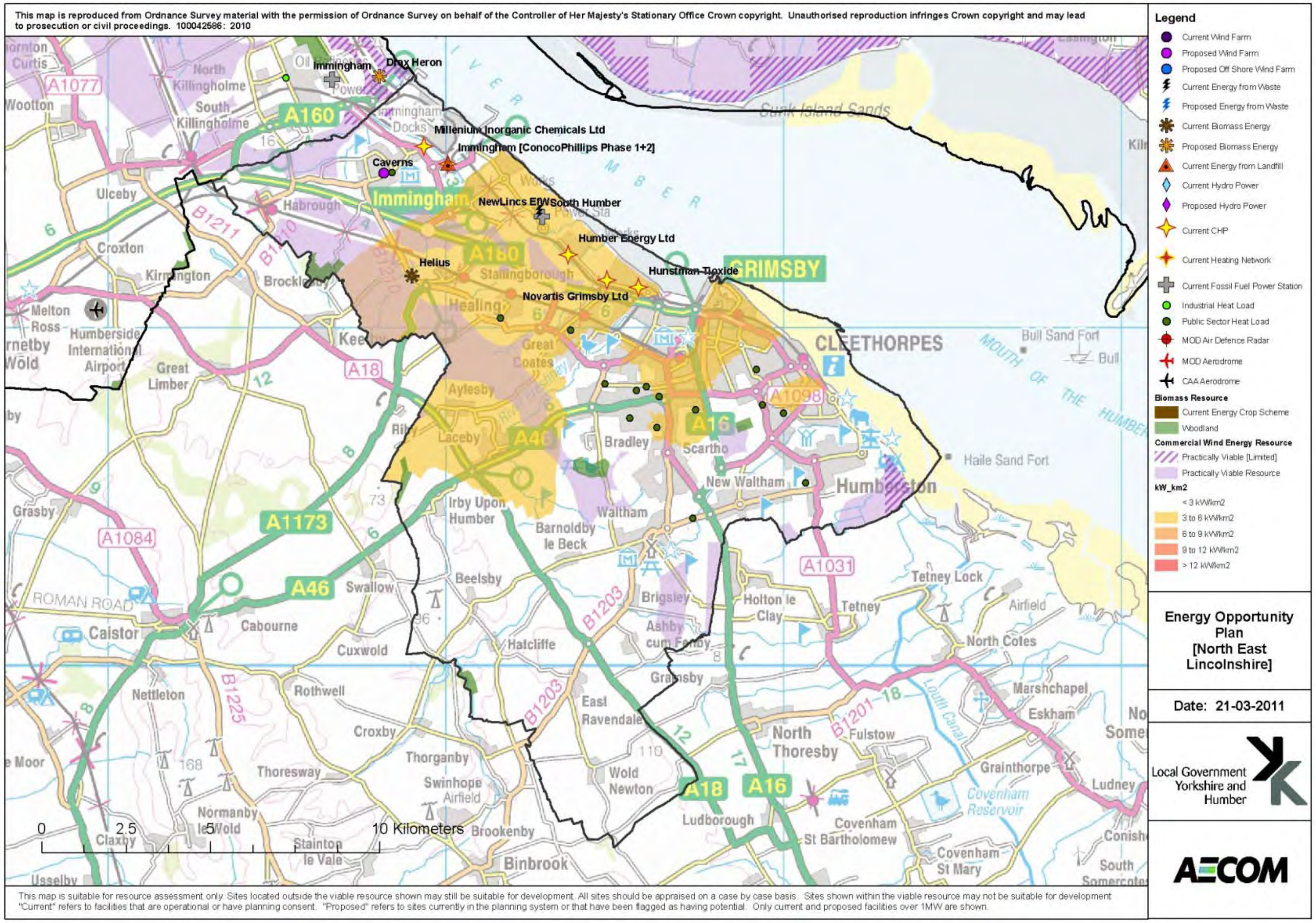


Figure 83 Energy opportunities plan for North East Lincolnshire. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only 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.

Capabilities on project:
Building Engineering - Sustainability

B.13 North Lincolnshire

Population: 160,300

Land area (km^2): 846

North Lincolnshire is a mostly rural unitary authority with almost 90% of land being in agricultural use. Almost half the population reside in North Lincolnshire's principal urban area of Scunthorpe and Bottesford. A further 25% live in the towns of Barton upon Humber and Brigg, the smaller market towns of Epworth, Crowle, Kirton in Lindsey and Winterton, and in the larger villages of Messingham and Broughton. The remainder of the population is dispersed widely amongst the many villages and rural hamlets scattered throughout North Lincolnshire.[69]

It traditionally been an area of energy generation; with 4 major gas power stations (Immingham, Glanford Brigg, Keadby and Killingholme) comprising 2,400 MW of capacity. Centrica Brigg Ltd are proposing to construct a new 2,000 MW power station adjacent to the existing Glanford Brigg Power Station, which will reach the end of its nominal design life in 2018.[70]

North Lincolnshire has a huge energy demand compared to the size of its population, predominantly caused by the loads at the Humber and Lindsey oil refineries.

The opportunities for renewable energy generation in North Lincolnshire are relatively homogenous: there is very little hydro energy potential and the mostly rural population rules out district heating (although the Energy Opportunity Plan shows clear potential for a linear district heating network in Scunthorpe connecting public sector buildings to the west of the A15).

The main renewable energy opportunities are focused around wind power, with much of the land having minimal constraints. The 8 turbine, 16 MW Bagmoor Wind Farm has been in operation since August 2009 and is expected to provide enough electricity for 10,800 homes. The large 34 turbine, 85 MW Keadby Wind Farm is currently in construction and is expected to provide enough electricity for around 38,000 homes.

Biomass energy generation is also an attractive option. There are already a number of areas of biomass energy crop planting in the north of the district. The access to the river would make transport of biomass to other parts of the region straightforward.

Another significant opportunity for North Lincolnshire is injection of biogas into the grid. The gas infrastructure is well developed in this area, for example, an existing National Transmission System high pressure gas pipeline currently transports natural gas from Glanford Brigg power station compound to the south. The agricultural nature of the borough should encourage the development of anaerobic digestion facilities.

As a unitary authority, North Lincolnshire Council is responsible for the collection, recycling and disposal of municipal solid waste (MSW) arising in the authority. Its municipal waste strategy concluded that out of seven scenarios modelled (including a base case where waste continued to be diverted to landfill), the best score was achieved by a pyrolysis/gasification energy from waste facility from 2012, capable of processing 100,000 tonnes per annum. The public consultation on the draft waste strategy revealed that there is strong support for treating the non-recyclable component of waste produced by local residents in a facility located within the authority which recovers both electricity and heat from the waste.[71]

[69] Annual Monitoring report, North Lincolnshire Council, December 2009
[70] Brigg 2 Power Station Environmental Impact Assessment Scoping Report, Scott Wilson, September 2010
[71] North Lincolnshire Council's Municipal Waste Strategy 2008-2025, North Lincolnshire Council, September 2008

Capabilities on project:
Building Engineering - Sustainability

North Lincolnshire	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	105	276	0	188	493	0	0%
Small scale wind	0	0	0	2	2	0	9%
Hydro	0	0	0	0	0	0	0%
Solar PV	0	0	0	7	5	0	0%
Solar thermal	0	0	11	0	7	738	3%
Air source heat pumps	0	0	8	0	12	505	3%
Ground source heat pumps	0	0	11	0	19	701	7%
Biomass energy crops	0	0	16	9	133	1075	3%
Biomass woodfuel	0	0	30	0	78	1969	8%
Biomass agricultural arisings (straw)	0	0	26	13	203	1721	9%
Biomass waste wood	0	0	1	1	9	75	2%
Energy from waste wet	0	0	1	1	11	82	1%
Energy from waste poultry litter	14	72	0	13	69	0	0%
Energy from waste MSW	0	0	2	1	16	136	2%
Energy from waste C&I	0	0	4	2	28	236	2%
Energy from waste landfill gas	5	28	0	0	0	0	0%
Energy from waste sewage gas	1	2	0	1	4	0	0%
Total	125	379	133	237	1,194	8,842	

Table 64 Current capacity and renewable energy resource in North Lincolnshire. Current" refers to facilities that are operational or have planning consent

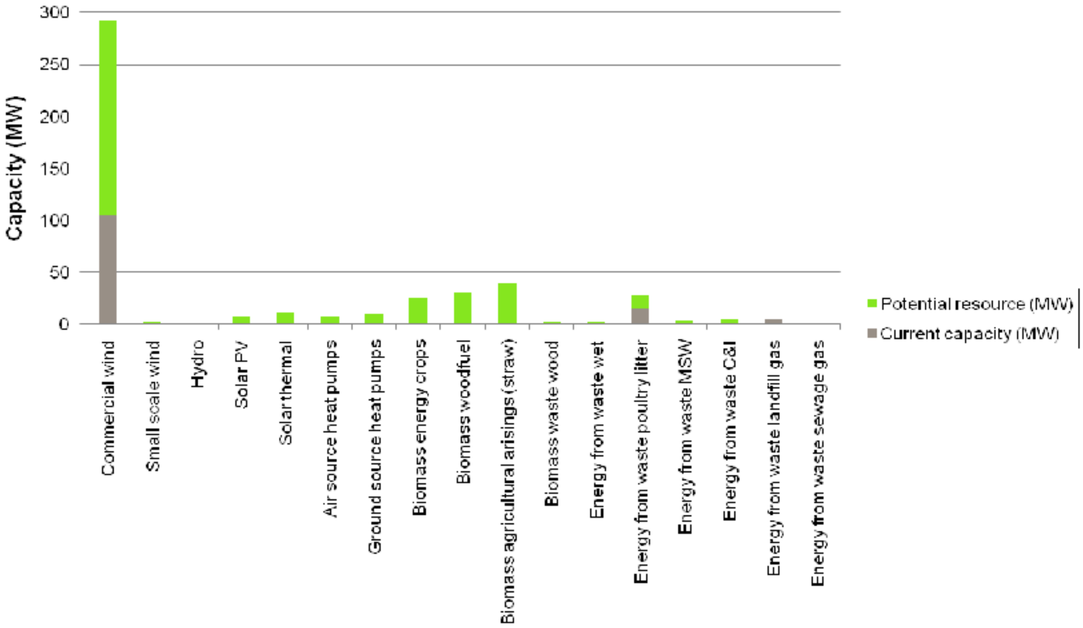


Figure 84 Current capacity and renewable energy resource in North Lincolnshire. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

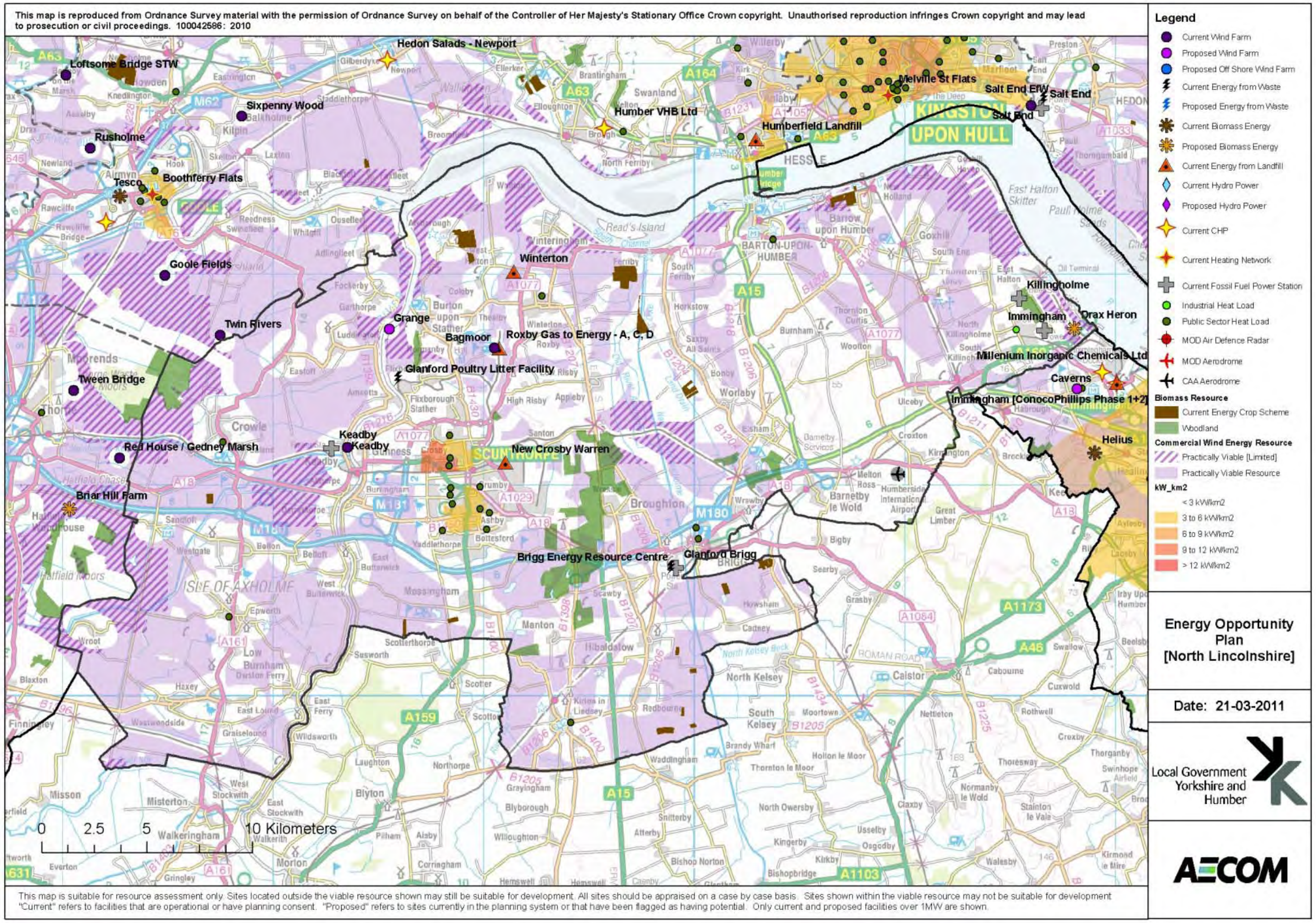


Figure 85 Energy opportunities plan for North Lincolnshire. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current 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.

B.14 Richmondshire

Population: 51,400

Land area (km^2): 1,318

Located in the northwest of the region, the Richmondshire district is dominated by the Yorkshire Dales National Park, where development of larger scale renewable energy technologies will be severely constrained. It is a rural district with one of the most sparsely populated districts in the country, which will also limit any potential for district heating.

However, the district does have some potential for hydro energy, with three schemes already operational or with planning permission; Gayle Mill, Bainbridge and Yore Mill. There is also some potential for commercial scale wind energy to the east of the district and for microgeneration technologies throughout the district.

Electricity is also generated at the 0.8 MW Scorton Landfill site near Brompton on Swale.

Capabilities on project:
Building Engineering - Sustainability

Richmondshire	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	0	0	0	85	223	0	0%
Small scale wind	0	0	0	1	1	0	3%
Hydro	0	0	0	2	8	0	0%
Solar PV	0	0	0	2	1	0	0%
Solar thermal	0	0	3	0	2	194	1%
Air source heat pumps	0	0	6	0	10	411	2%
Ground source heat pumps	0	0	8	0	14	510	5%
Biomass energy crops	0	0	25	14	204	1655	5%
Biomass woodfuel	0	0	7	0	20	500	2%
Biomass agricultural arisings (straw)	0	0	5	2	39	329	2%
Biomass waste wood	0	0	0	0	2	20	1%
Energy from waste wet	0	0	4	3	34	253	4%
Energy from waste poultry litter	0	0	0	2	12	0	0%
Energy from waste MSW	0	0	1	0	5	42	1%
Energy from waste C&I	0	0	1	0	5	39	0%
Energy from waste landfill gas	1	4	0	0	0	0	0%
Energy from waste sewage gas	0	0	0	0	1	0	0%
Total	1	5	89	113	713	5,960	

Table 65 Current capacity and renewable energy resource in Richmonshire. Current" refers to facilities that are operational or have planning consent

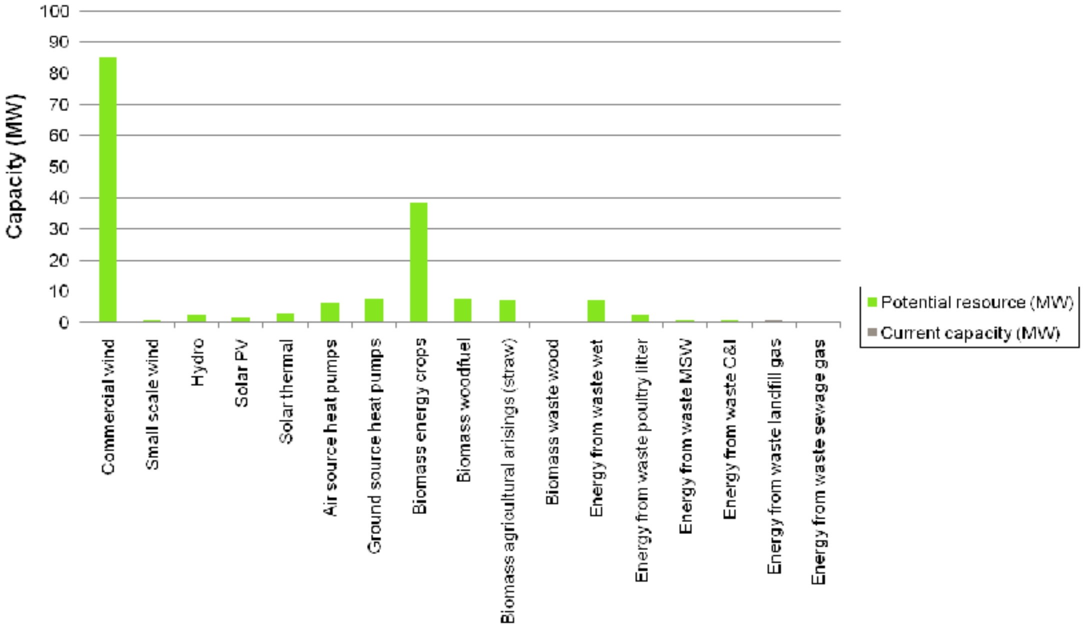


Figure 86 Current capacity and renewable energy resource in Richmondshire. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

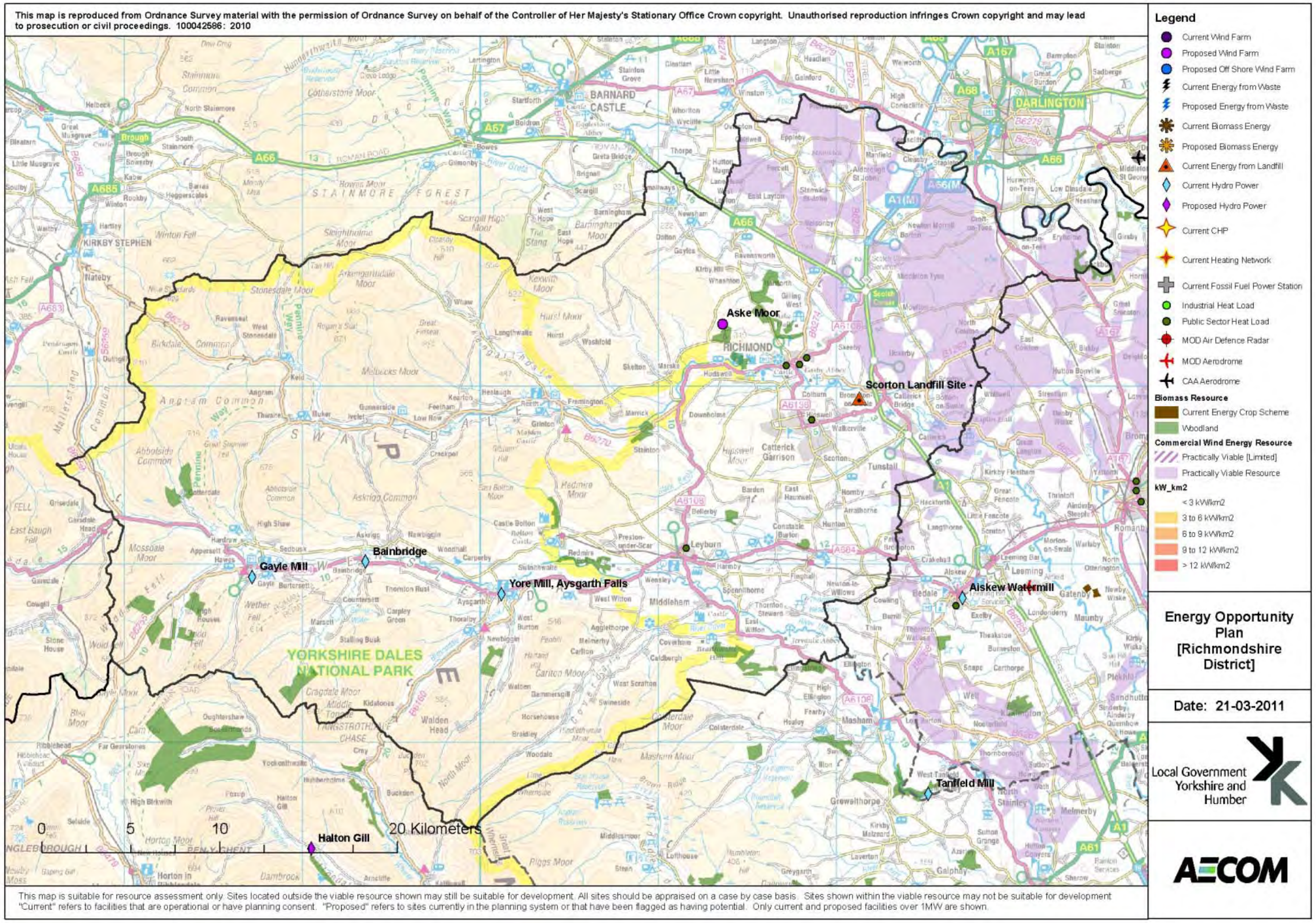


Figure 87 Energy opportunities plan for Richmondshire. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and 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.

Capabilities on project:
Building Engineering - Sustainability

B.15 Rotherham

Population: 250,000

The borough of Rotherham is located in South Yorkshire and was traditionally a major industrial centre based on coal and steel. Most of the traditional industries have now vanished, although there is still a steelworks at Aldwarke and a coal mine at Maltby.

Rotherham town centre has sufficient heat density to support heat networks, and there are several small scale networks covering estates throughout the borough.

Beyond the town centre and away from the Don Valley, Rotherham is largely (about 52%) rural. The borough has significant potential for commercial scale wind and also some potential for hydro; Jordan Dam has been identified as a potential site.

Capabilities on project:
Building Engineering - Sustainability

Rotherham	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	26	69	0	91	239	0	0%
Small scale wind	0	0	0	1	1	0	5%
Hydro	0	0	0	1	3	0	0%
Solar PV	1	1	0	12	9	0	0%
Solar thermal	0	0	18	0	11	1220	5%
Air source heat pumps	0	0	10	0	15	643	4%
Ground source heat pumps	0	0	6	0	11	390	4%
Biomass energy crops	0	0	7	4	59	476	1%
Biomass woodfuel	1	2	14	0	36	908	4%
Biomass agricultural arisings (straw)	0	0	5	2	38	320	2%
Biomass waste wood	0	0	2	1	14	116	3%
Energy from waste wet	0	0	1	1	11	84	1%
Energy from waste poultry litter	0	0	0	0	0	0	0%
Energy from waste MSW	0	0	2	1	20	166	3%
Energy from waste C&I	0	0	4	2	35	297	3%
Energy from waste landfill gas	1	6	0	0	0	0	0%
Energy from waste sewage gas	0	2	0	0	6	0	0%
Total	29	79	86	117	582	5,757	

Table 66 Current capacity and renewable energy resource in Rotherham. Current" refers to facilities that are operational or have planning consent

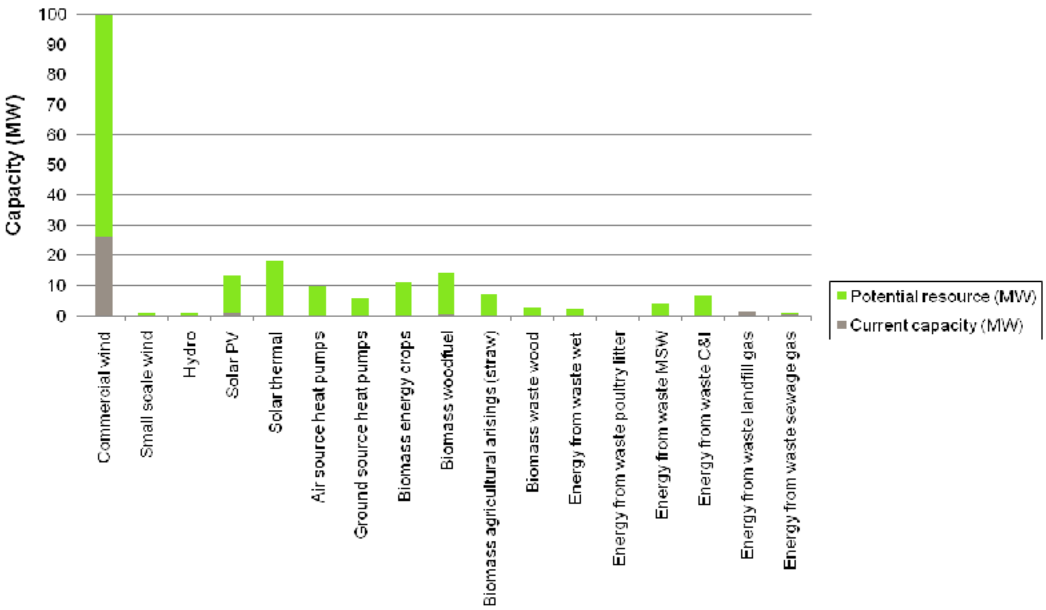


Figure 88 Current capacity and renewable energy resource in Rotherham. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

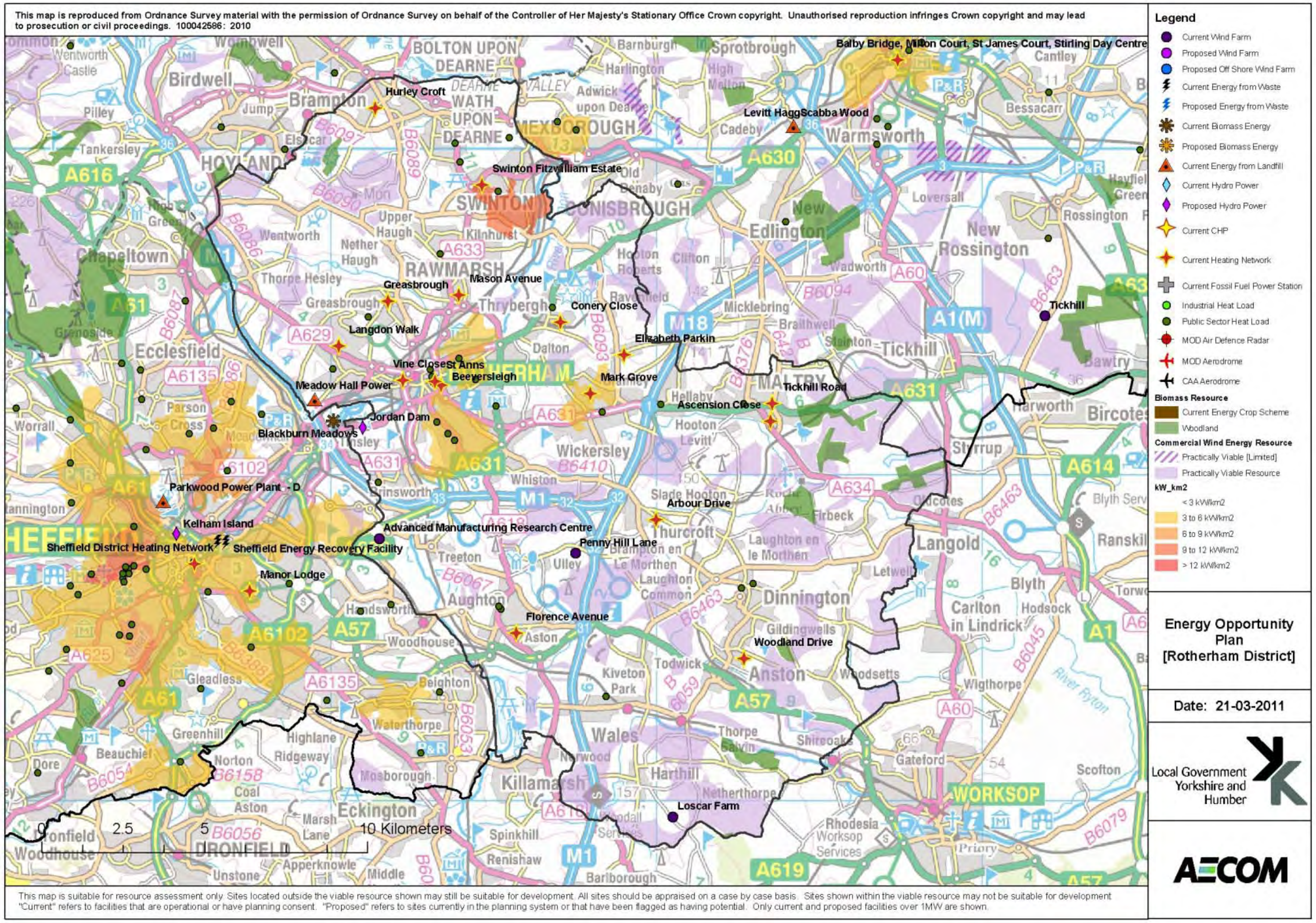


Figure 89 Energy opportunities plan for Rotherham. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.16 Ryedale

Population: 52,900

Land area (km^2): 1,507

Ryedale is a predominantly rural area which includes part of the North York Moors National Park. Almost half of the population reside within the main market towns of Malton, Norton, Helmsley, Kirkbymoorside and Pickering. The remainder reside in a range of rural settlements dispersed across the district.

There is some potential in Ryedale for commercial scale wind, in the south west of the district. Heslerton Wind Farm is in the planning process towards the east of the district, showing that sites shown outside the resource identified in the study may still be viable for development.

This study has not identified any new hydro potential, although there are existing schemes within the national park at Lowna Mill and Bonfield Ghyll, as well as to the south at Howsham Mill.

The Energy Opportunities Plan shows that Ryedale has significant potential for biomass. There are a few areas of biomass energy crop planting as well as one biomass plant operating at South View Farm, and one proposed in Victory Mill.

Capabilities on project:
Building Engineering - Sustainability

Ryedale	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	0	0	0	10	26	0	0%
Small scale wind	0	0	0	1	1	0	3%
Hydro	0	0	0	0	1	0	0%
Solar PV	0	0	0	2	1	0	0%
Solar thermal	0	0	3	0	2	204	1%
Air source heat pumps	0	0	6	0	9	385	2%
Ground source heat pumps	0	0	5	0	9	329	3%
Biomass energy crops	0	0	47	26	389	3148	9%
Biomass woodfuel	1	2	6	0	17	430	2%
Biomass agricultural arisings (straw)	8	56	13	7	105	885	5%
Biomass waste wood	0	0	0	0	2	20	1%
Energy from waste wet	0	0	4	4	37	281	4%
Energy from waste poultry litter	0	0	0	3	14	0	0%
Energy from waste MSW	0	0	1	0	5	45	1%
Energy from waste C&I	0	0	1	1	9	77	1%
Energy from waste landfill gas	0	2	0	0	0	0	0%
Energy from waste sewage gas	0	0	0	0	1	0	0%
Total	9	61	141	53	863	9,377	

Table 67 Current capacity and renewable energy resource in Ryedale. Current" refers to facilities that are operational or have planning consent

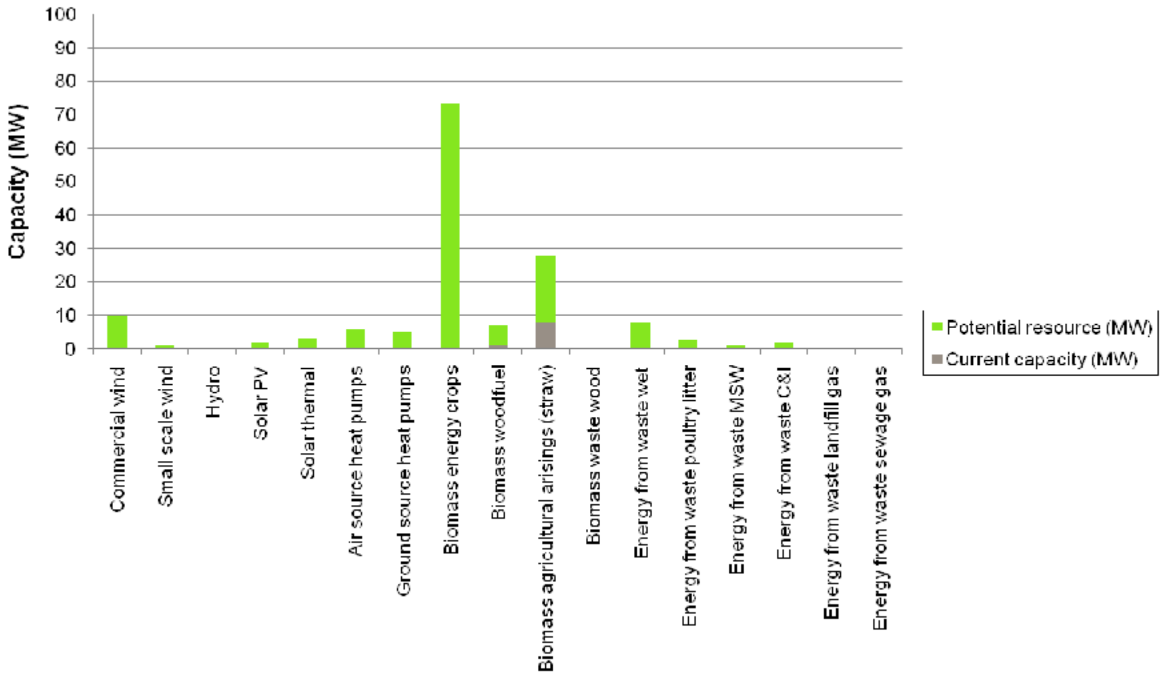


Figure 90 Current capacity and renewable energy resource in Ryedale. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

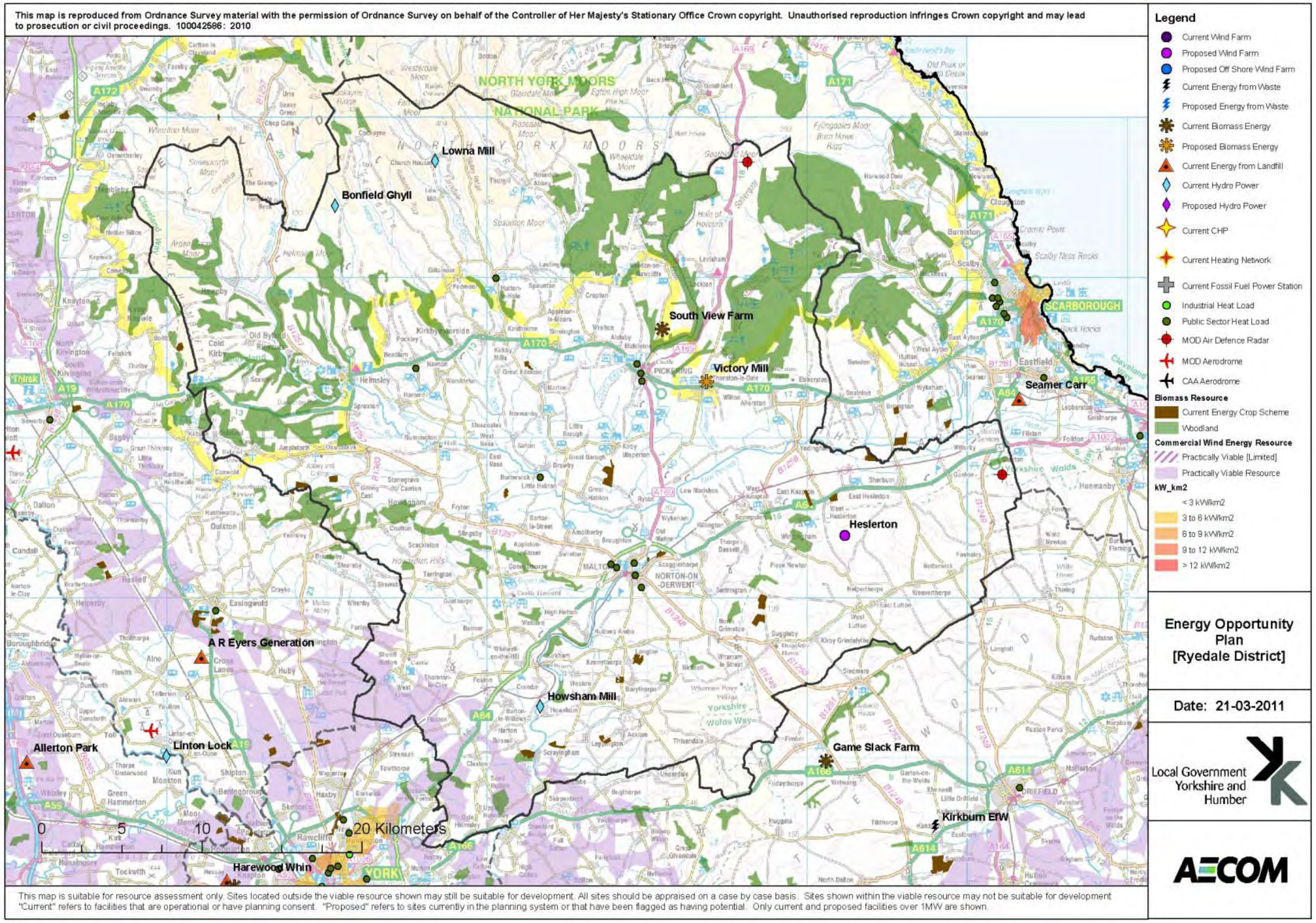


Figure 91 Energy opportunities plan for Ryedale. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.17 Scarborough

Population: 108,500

Land area (km^2): 817

The borough of Scarborough is located in the east of the region and covers a large stretch of the Yorkshire and Humber coast; its three principal towns, Scarborough, Whitby and Filey all sit on the coast. Scarborough borough is almost completely contained within the North York Moors National Park and therefore has almost no capacity for large scale renewable energy generation. There is potential for microgeneration technologies, for example, 20 kW turbine has received planning permission at Pilmoor Farm in Filey, and there is a biomass boiler at Fylingdales Village Hall which runs on wood pellets.

Also of note is a scheme is to upgrade Fylingdale's local electricity distribution grid into a 'smart grid' incorporating two-way communications, advanced sensors, and a remote SCADA system. This will also facilitate further deployment of community based renewable energy projects.[72]

There is some biomass energy crop planting in the south east of the borough and a potential hydro site has been identified at Ruswarp Weir. There are also extensive areas of woodland, which could be managed to provide biomass to the borough and to the rest of the region.

The Energy Opportunities Plan shows that Scarborough Town has sufficient heat density to support district heating networks, particularly in the centre.

[72] Agenda Item 17 Fylingdales Low Carbon Community Challenge Bid, Report to cabinet to be held December 2009

Capabilities on project:
Building Engineering - Sustainability

Scarborough	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	0	0	0	10	26	0	0%
Small scale wind	0	0	0	1	1	0	3%
Hydro	0	0	0	0	1	0	0%
Solar PV	0	0	0	5	3	0	0%
Solar thermal	0	0	7	0	4	486	2%
Air source heat pumps	0	0	12	0	20	830	5%
Ground source heat pumps	0	0	4	0	8	281	3%
Biomass energy crops	0	0	20	11	167	1354	4%
Biomass woodfuel	0	0	10	0	28	699	3%
Biomass agricultural arisings (straw)	0	0	5	2	36	301	2%
Biomass waste wood	0	0	1	0	7	56	2%
Energy from waste wet	0	0	2	2	20	150	2%
Energy from waste poultry litter	0	0	0	1	7	0	0%
Energy from waste MSW	0	0	2	1	12	105	2%
Energy from waste C&I	0	0	2	1	15	128	1%
Energy from waste landfill gas	10	52	0	0	0	0	0%
Energy from waste sewage gas	0	0	0	0	3	0	0%
Total	10	53	93	34	475	6,183	

Table 68 Current capacity and renewable energy resource in Scarborough. Current" refers to facilities that are operational or have planning consent

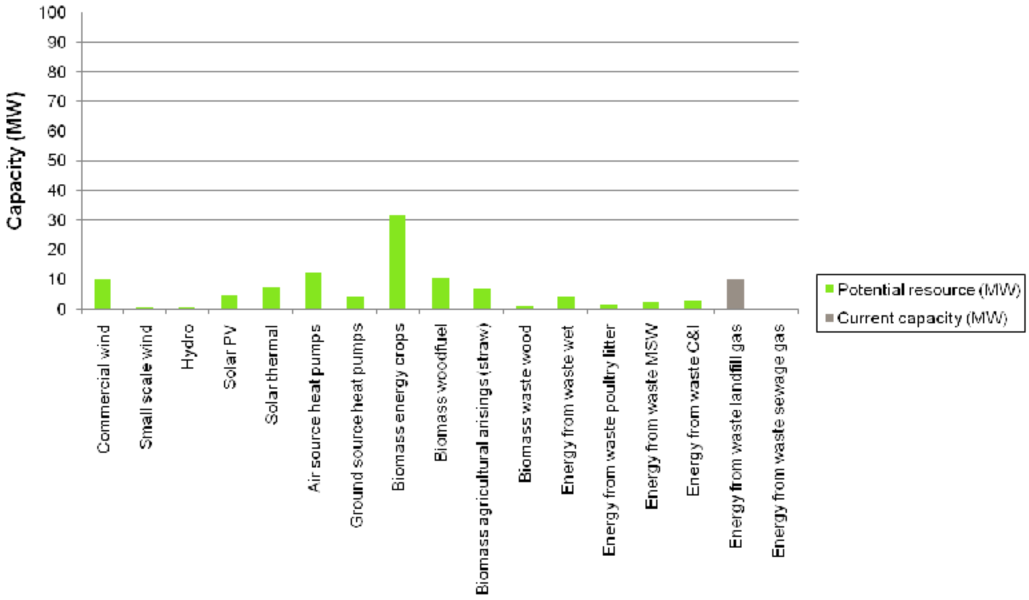


Figure 92 Current capacity and renewable energy resource in Scarborough. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

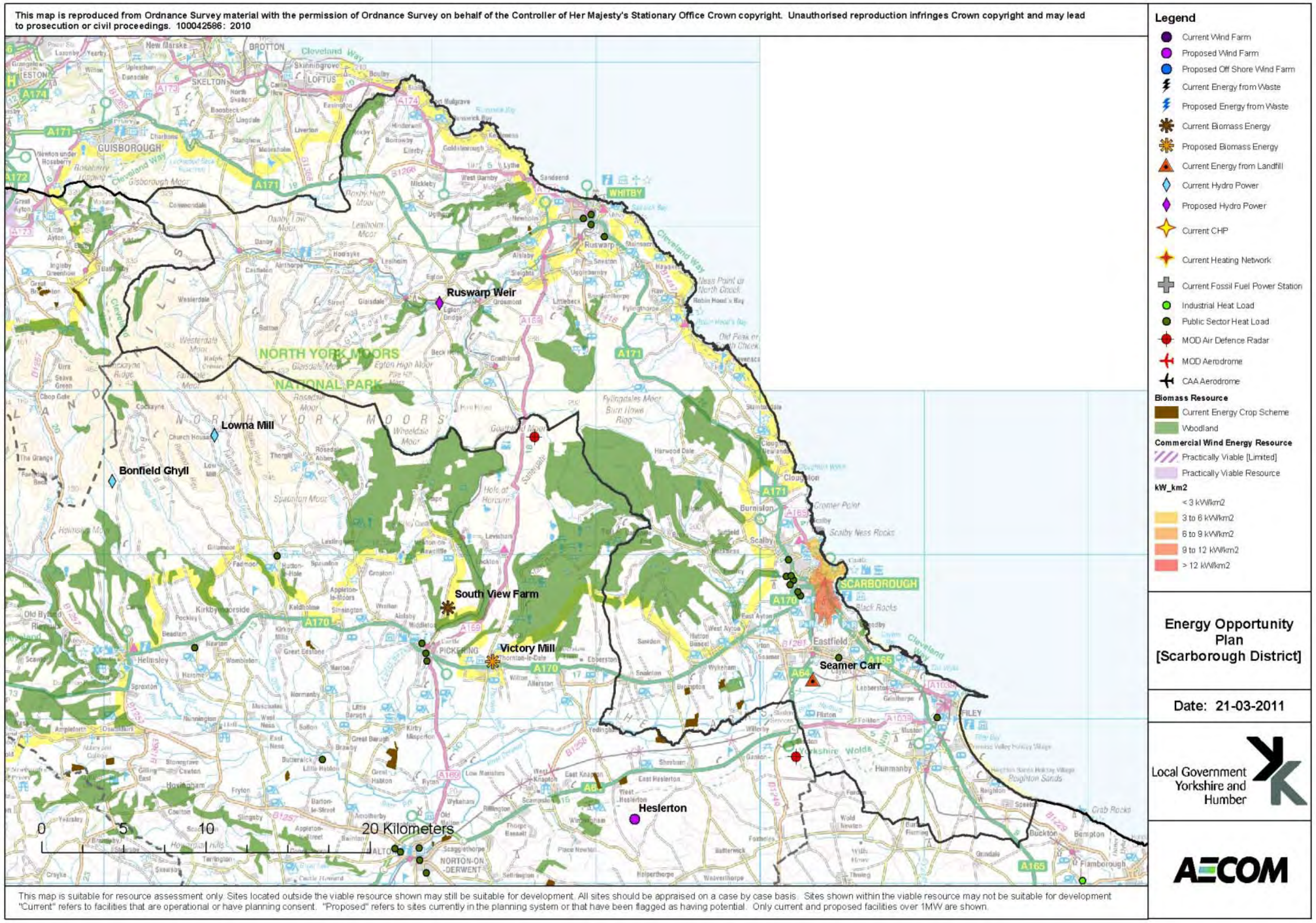


Figure 93 Energy opportunities plan for Scarborough. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and 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.

B.18 Selby

Population: 82,000

Land area (km^2): 599

Selby District is a relatively small, rural district and is the most southerly district in the York and North Yorkshire sub-region. It is also part of the Leeds City Region. Much of the district is relatively flat and low-lying, and is characterised by open, sparsely wooded arable landscapes including extensive areas of the highest quality agricultural land.

Historically Selby's economy has been dominated by agriculture, coal mining and the energy industries and there are two major coal fired power stations in the district, Drax and Eggborough.

The tradition of energy generation has continued into renewable energy generation: the district has two biomass plants in operation or with planning consent (the 4.7 MW John Smith's brewery in Tadcaster and the 52 MW Pollington Energy Park), and one large biomass plant awaiting Section 36 approval from central government (the 290 MW Drax Ouse plant).

Selby district also has one operational wind farm (the 12 MW Marr Wind Farm), one with planning consent (the 24 MW Rusholme Wind Farm) and three applications in planning (the 17.5 MW Bishopwood Wind Farm, the 15 MW Cleek Hall Wind Farm and the 32.3 MW Wood Lane Wind Farm).

Finally, Selby has an 8 MW anaerobic digestion facility processing 165,000 tonnes per annum commercial food waste at the Selby Renewable Energy Park and a 6MW plant processing factory effluent at the Greencore Group food processing facility in Selby town. Quarry View Poultry Farm also has a smaller biomass plant.

Selby has good resource for further renewable energy generation. Selby town has the heat density required to support a district heating network. Biomass is another large opportunity within the district, with existing biomass energy crop schemes near Tawton, Kirkby Wharfe, Stillingfleet, Riccall, Kellington and Haddlesey).

Outside of Selby town, the majority of the land is rural and holds significant promise for commercial scale wind energy.

Capabilities on project:
Building Engineering - Sustainability

Selby	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	36	95	0	271	712	0	0%
Small scale wind	0	0	0	1	1	0	5%
Hydro	0	0	0	1	3	0	0%
Solar PV	0	0	0	4	3	0	0%
Solar thermal	0	0	6	0	3	376	2%
Air source heat pumps	0	0	3	0	4	167	1%
Ground source heat pumps	0	0	7	0	13	461	4%
Biomass energy crops	0	0	10	5	81	657	2%
Biomass woodfuel	0	0	13	0	33	849	3%
Biomass agricultural arisings (straw)	5	33	8	4	65	547	3%
Biomass waste wood	0	0	1	0	5	44	1%
Energy from waste wet	8	41	4	3	34	258	4%
Energy from waste poultry litter	0	0	0	1	6	0	0%
Energy from waste MSW	0	0	1	1	8	67	1%
Energy from waste C&I	0	0	2	1	13	106	1%
Energy from waste landfill gas	1	7	0	0	0	0	0%
Energy from waste sewage gas	0	0	0	0	2	0	0%
Total	50	176	70	292	1,061	4,667	

Table 69 Current capacity and renewable energy resource in Selby. Current" refers to facilities that are operational or have planning consent

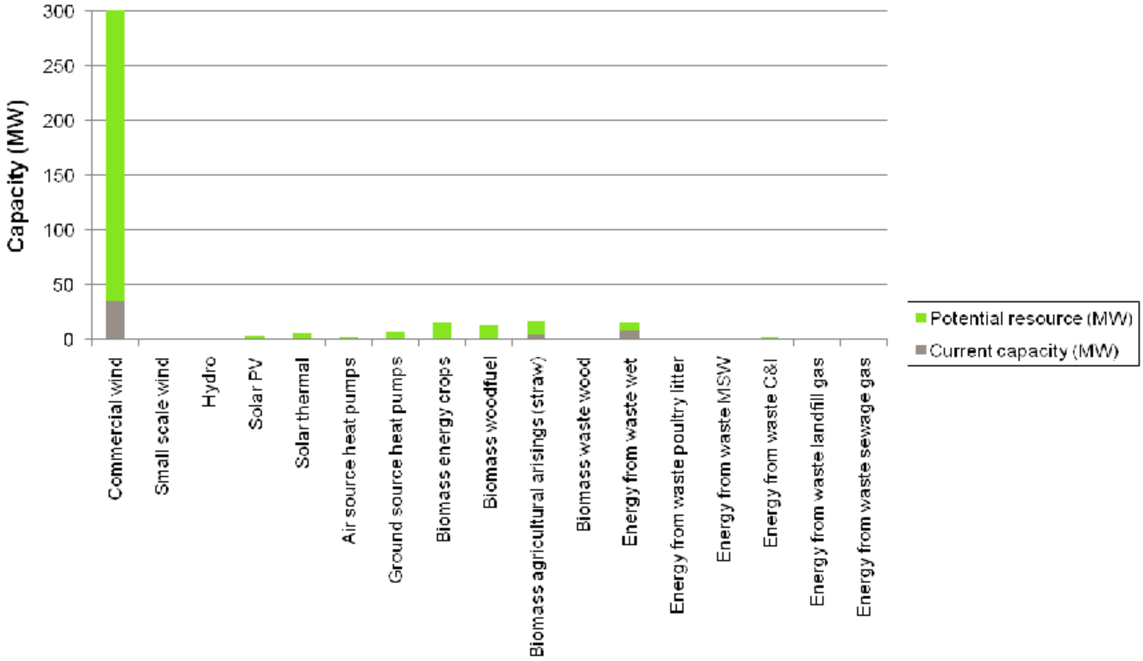


Figure 94 Current capacity and renewable energy resource in Selby. Current" refers to facilities that are operational or have planning consent.

Capabilities on project:
Building Engineering - Sustainability

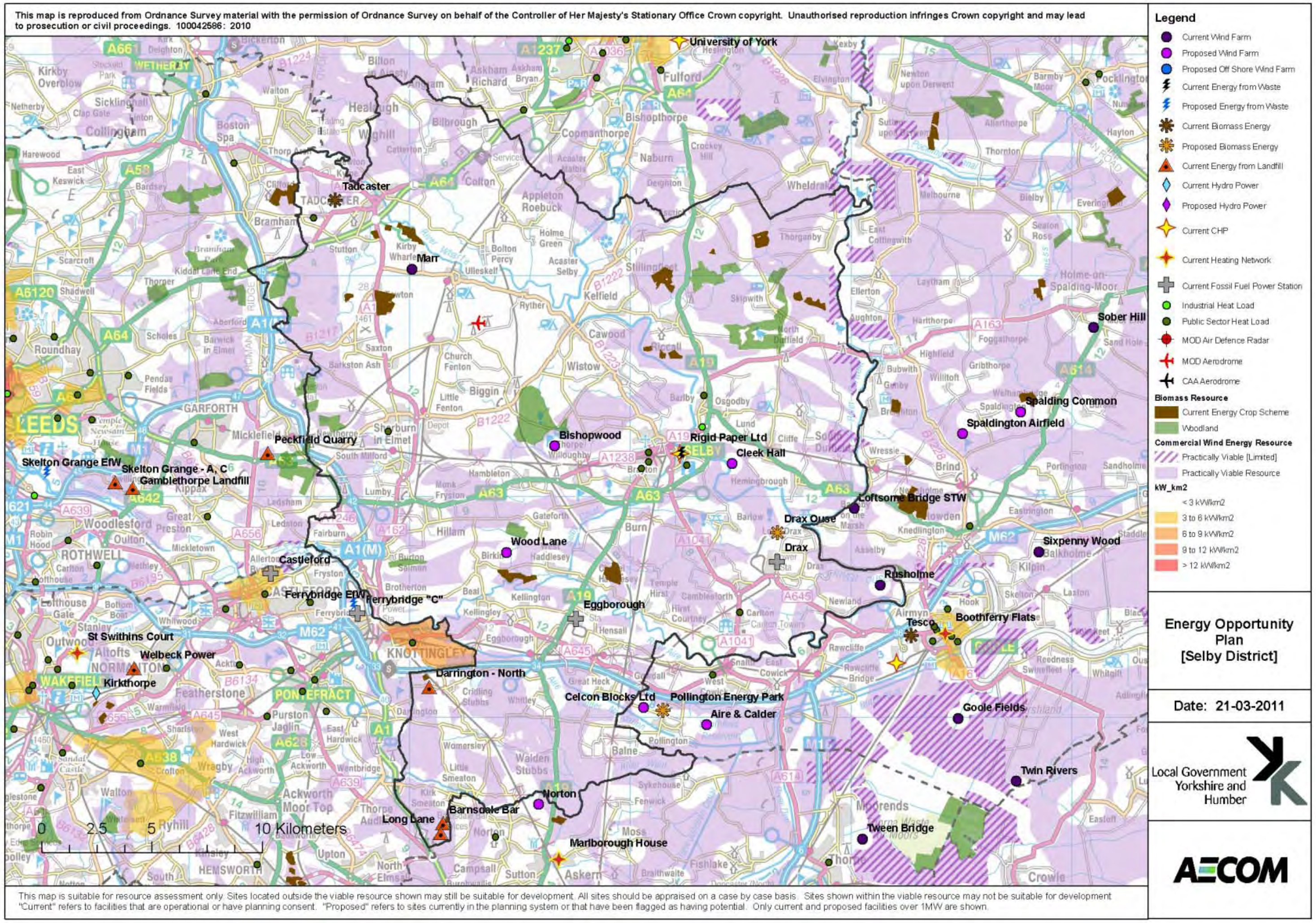


Figure 95 Energy opportunities plan for Selby. "Current" refers to facilities that are operational or have planning consent. "Proposed" refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

Capabilities on project:
Building Engineering - Sustainability

B.19 Sheffield

Population: 534,500

Land area (km^2): 368

Sheffield is located in South Yorkshire. It is geographically very diverse; the urban area nestles in a natural bowl created by seven hills and the confluence of five rivers.

The city of Sheffield's district heating network is the largest in the UK. It was established in 1988 and is still expanding. There are currently over 140 buildings connected to the network that benefit from low carbon energy generated from Sheffield's MSW. These include the Sheffield City Hall, the Lyceum Theatre and its two universities, in addition to a wide variety of other buildings such as hospitals, flats, shops, offices and leisure facilities. Around 2,800 homes, mainly in flats, are also connected to the scheme.

The urban nature of Sheffield provides substantial opportunity for the deployment of microgeneration technologies. Several of the police stations in Sheffield have installed 0.4MW_{th} biomass boilers, including Ecclesfield and Mossway police stations. Also of note is the Sheffield Solar Farm at the University of Sheffield's Hicks Building, which has been designed to provide a real-world test platform for solar PV technology and communicating the effectiveness of solar in northern latitudes.

There are two hydro schemes in the borough, at the Loxley and Ewden Sewage Treatment Works. A scheme has also been proposed at Kelham Island. This study has found that the hilly nature of the borough means that there is relatively high hydro resource which should be explored further.

Capabilities on project:
Building Engineering - Sustainability

Sheffield	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	0	0	0	14	36	0	0%
Small scale wind	0	0	0	1	2	0	7%
Hydro	0	2	0	2	5	0	0%
Solar PV	1	1	0	21	16	0	0%
Solar thermal	0	0	34	0	21	2254	10%
Air source heat pumps	0	0	21	0	32	1371	8%
Ground source heat pumps	0	0	9	0	16	581	5%
Biomass energy crops	0	0	0	0	1	12	0%
Biomass woodfuel	2	6	9	0	23	591	2%
Biomass agricultural arisings (straw)	25	175	0	0	0	3	0%
Biomass waste wood	0	0	2	1	17	143	4%
Energy from waste wet	0	0	2	2	18	134	2%
Energy from waste poultry litter	0	0	0	0	0	0	0%
Energy from waste MSW	20	140	4	2	35	298	5%
Energy from waste C&I	0	0	10	5	77	649	6%
Energy from waste landfill gas	11	58	0	0	0	0	0%
Energy from waste sewage gas	0	1	0	0	7	0	0%
Total	99	554	109	48	388	7,271	

Table 70 Current capacity and renewable energy resource in Sheffield. Current" refers to facilities that are operational or have planning consent

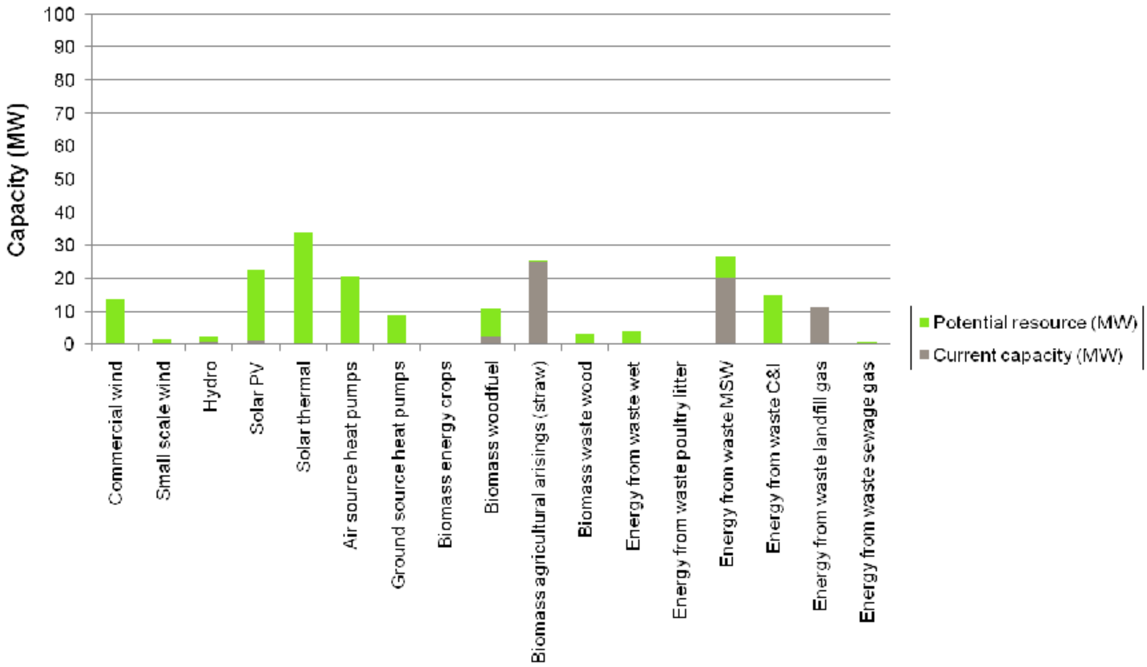


Figure 96 Current capacity and renewable energy resource in Sheffield. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

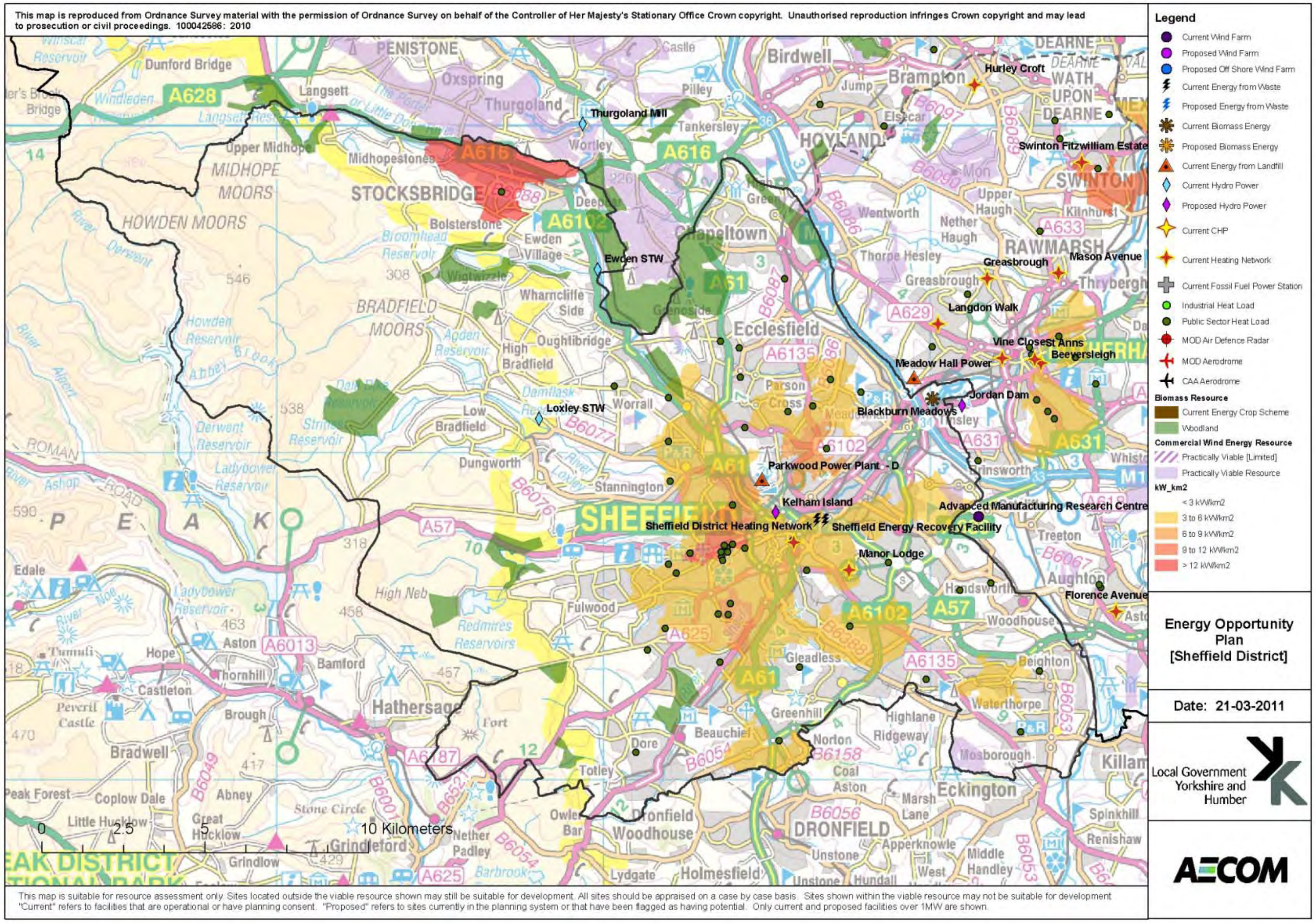


Figure 97 Energy opportunities plan for Sheffield. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

Capabilities on project:
Building Engineering - Sustainability

B.20 Wakefield

Population: 322,300

Land area (km^2): 339

Wakefield is located in the southeast of the Leeds City Region in the lower Calder valley. The north of the district is largely urban and is dominated in the west by Wakefield city. There is a large 1923 MW coal power station in the district at Ferrybridge “C” and a smaller 56 MW gas power station at Castleford.

SSE have submitted an application for an energy from waste plant on the Ferrybridge “C” site will process a range of fuels including waste wood and other types of biomass, sourced predominantly from the Yorkshire and Humber region.

The City of Wakefield, Castleford, and Knottingley all have the heat density required to support a district heating network.

Wakefield has some potential for commercial scale wind but not operational or consented schemes. Around 70% of Wakefield District lies within the Green Belt, most of which is rural in character, concentrated mainly in the south. These rural areas are largely in agricultural use, interspersed with parkland associated with large estates and are populated by a series of smaller towns and villages set within open countryside.

Capabilities on project:
Building Engineering - Sustainability

Wakefield	Current capacity (MW)	Current capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	0	0	0	79	208	0	0%
Small scale wind	0	0	0	2	2	0	8%
Hydro	0	1	0	1	5	0	0%
Solar PV	0	0	0	16	12	0	0%
Solar thermal	0	0	25	0	15	1663	7%
Air source heat pumps	0	0	13	0	20	838	5%
Ground source heat pumps	0	0	12	0	22	801	8%
Biomass energy crops	0	0	7	4	54	439	1%
Biomass woodfuel	1	3	40	0	105	2671	11%
Biomass agricultural arisings (straw)	0	0	3	2	25	213	1%
Biomass waste wood	0	0	2	1	19	160	5%
Energy from waste wet	0	0	3	3	26	195	3%
Energy from waste poultry litter	0	0	0	0	1	0	0%
Energy from waste MSW	0	0	4	2	29	245	4%
Energy from waste C&I	0	0	7	4	56	475	5%
Energy from waste landfill gas	15	76	0	0	0	0	0%
Energy from waste sewage gas	0	1	0	0	8	0	0%
Total	16	82	138	113	708	9,215	

Table 71 Current capacity and renewable energy resource in Wakefield. Current" refers to facilities that are operational or have planning consent

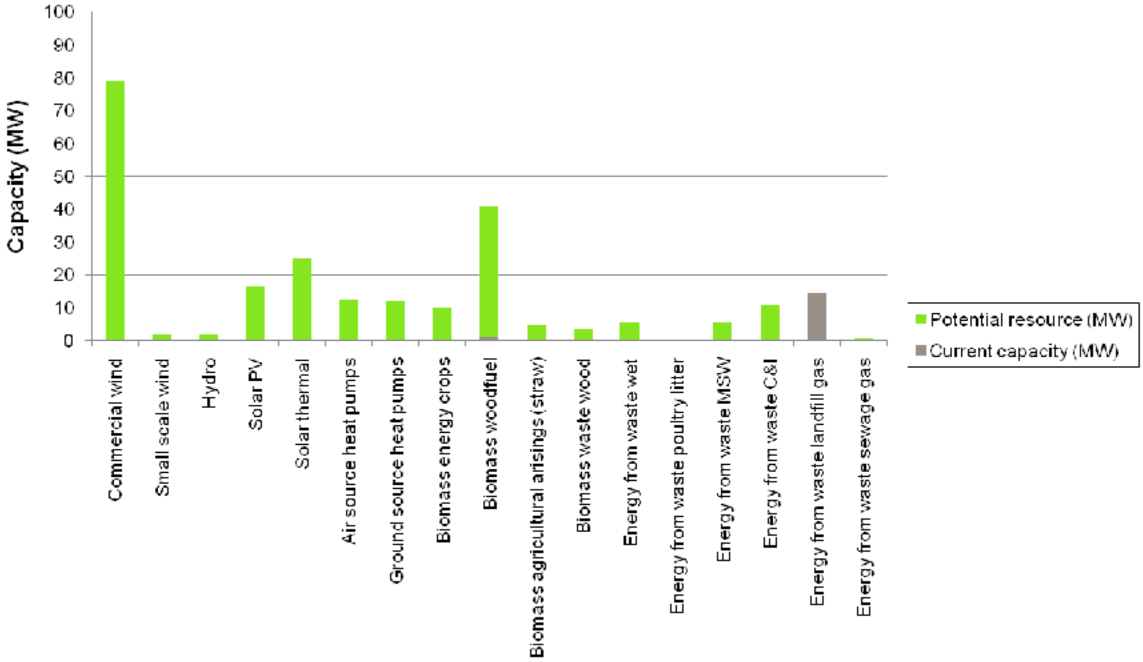


Figure 98 Current capacity and renewable energy resource in Wakefield. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

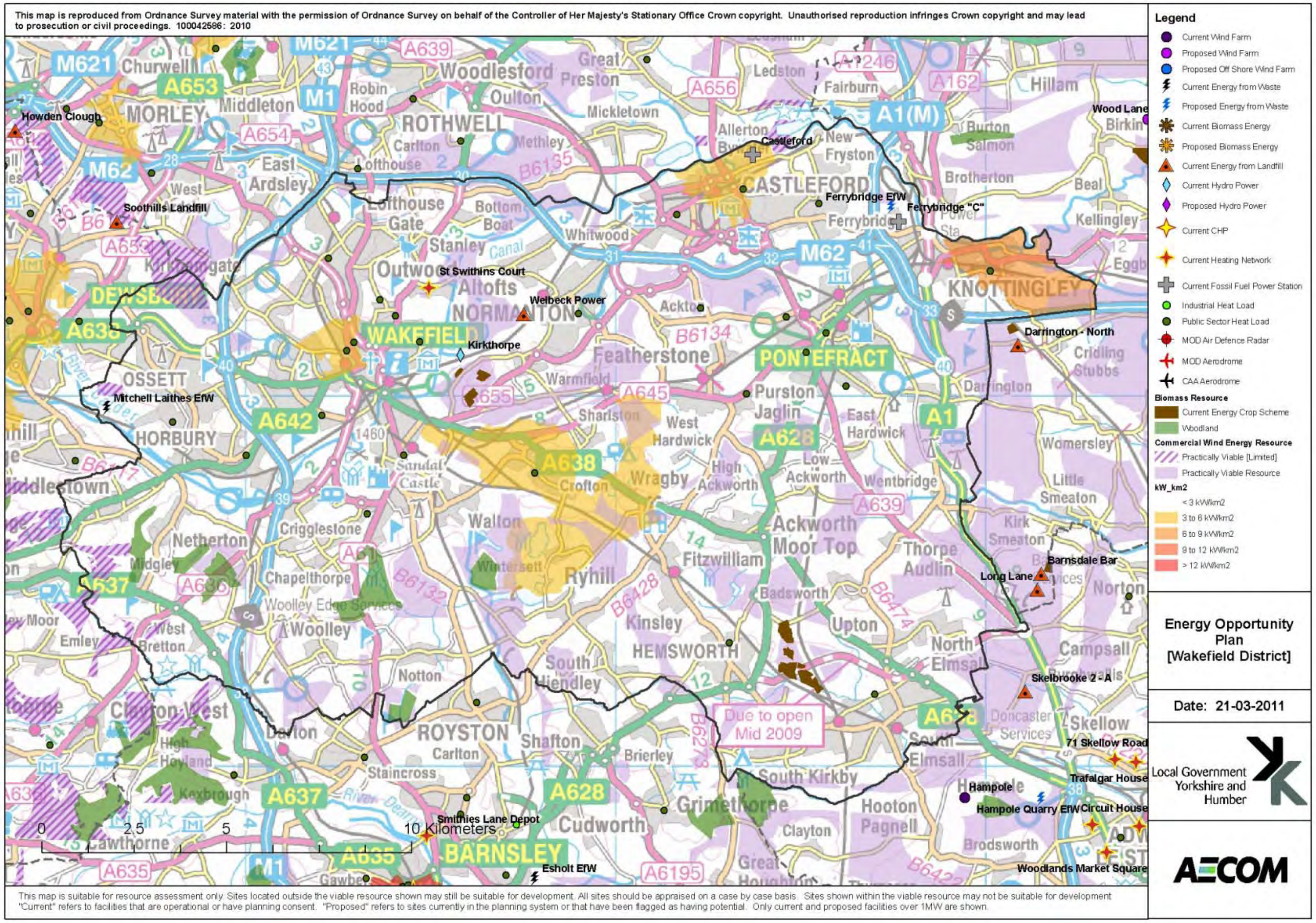
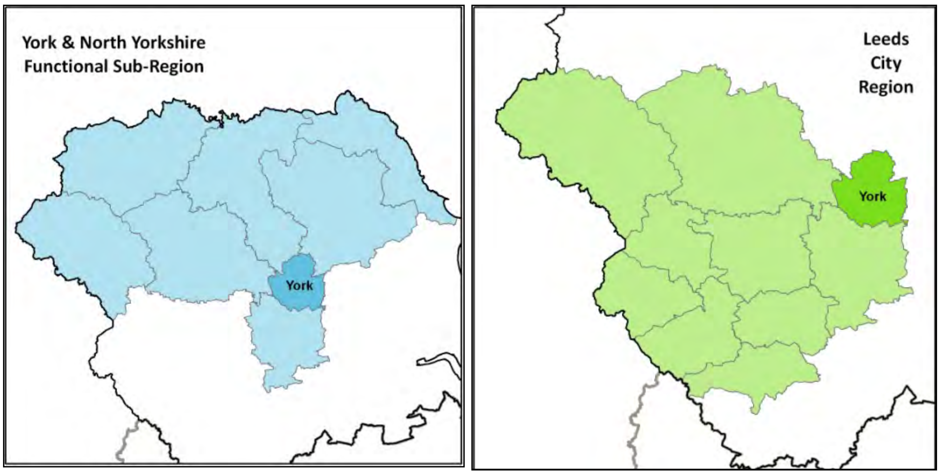


Figure 99 Energy opportunities plan for Wakefield. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

B.21 York

Population: 195,400

Land area (km^2): 272



Situated in both Leeds City Region and the York and North Yorkshire Sub-region. The majority of the population resides within the urban area surrounding the historic city centre but there are many small rural and semi rural settlements across the district.

There is significant potential for district heating networks in the city centre. The University of York has a CHP plant and a small biomass boiler with planning consent, which could take advantage of biomass from the nearby energy crop scheme at Earswick. This study has also found that York has significant resource for commercial scale wind energy, although local issues such as the historic setting of Yorkshire Minster may limit the resource.

York has quite a lot of smaller scale renewable energy generation already installed. The urban nature of the city centre presents opportunities for further microgeneration deployment, although this must be balanced with the need to protect the city's heritage environment.

Capabilities on project:
Building Engineering - Sustainability

York	Installed capacity (MW)	Installed capacity (GWh)	Potential resource - heat (MW)	Potential resource - electricity (MW)	Potential resource (GWh)	Potential resource (No of existing homes equivalent energy demand)	Potential resource (Proportion of regional resource)
Commercial wind	0	0	0	35	92	0	0%
Small scale wind	0	0	0	1	1	0	4%
Hydro	0	0	0	0	0	0	0%
Solar PV	0	0	0	10	7	0	0%
Solar thermal	0	0	13	0	8	861	4%
Air source heat pumps	0	0	9	0	14	600	4%
Ground source heat pumps	0	0	9	0	16	573	5%
Biomass energy crops	0	0	5	3	45	363	1%
Biomass woodfuel	3	8	7	0	19	483	2%
Biomass agricultural arisings (straw)	3	18	5	2	36	308	2%
Biomass waste wood	0	0	1	1	10	85	3%
Energy from waste wet	0	0	0	0	4	28	0%
Energy from waste poultry litter	0	0	0	0	0	0	0%
Energy from waste MSW	0	0	2	1	19	163	3%
Energy from waste C&I	0	0	4	2	32	274	3%
Energy from waste landfill gas	7	35	0	0	0	0	0%
Energy from waste sewage gas	1	2	0	1	4	0	0%
Total	13	63	70	56	369	4,651	

Table 72 Current capacity and renewable energy resource in York. Current" refers to facilities that are operational or have planning consent

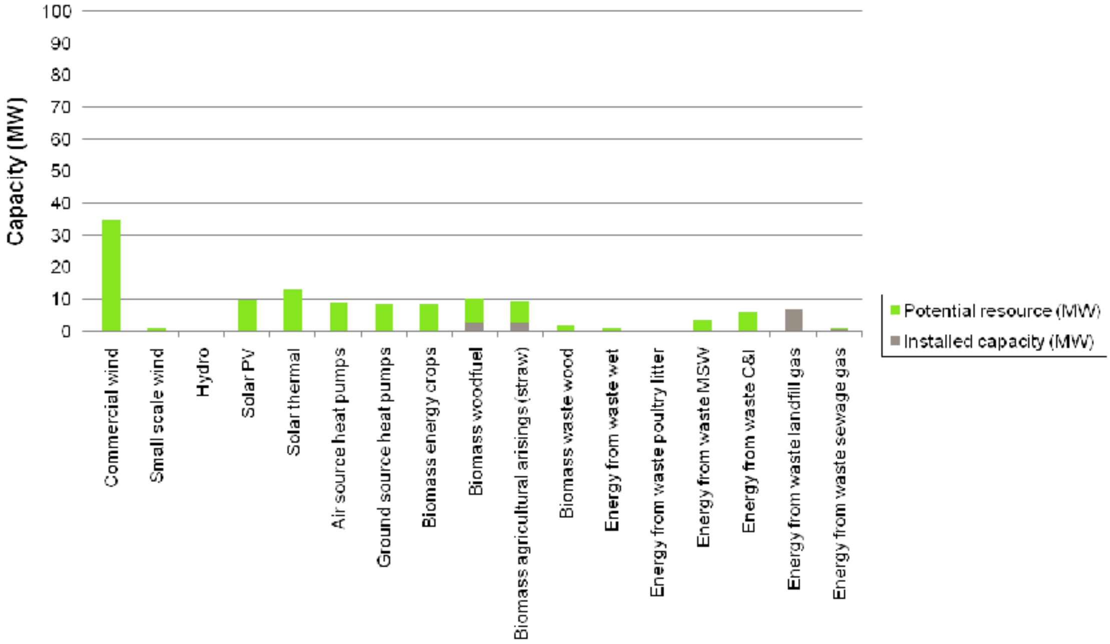


Figure 100 Current capacity and renewable energy resource in York. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

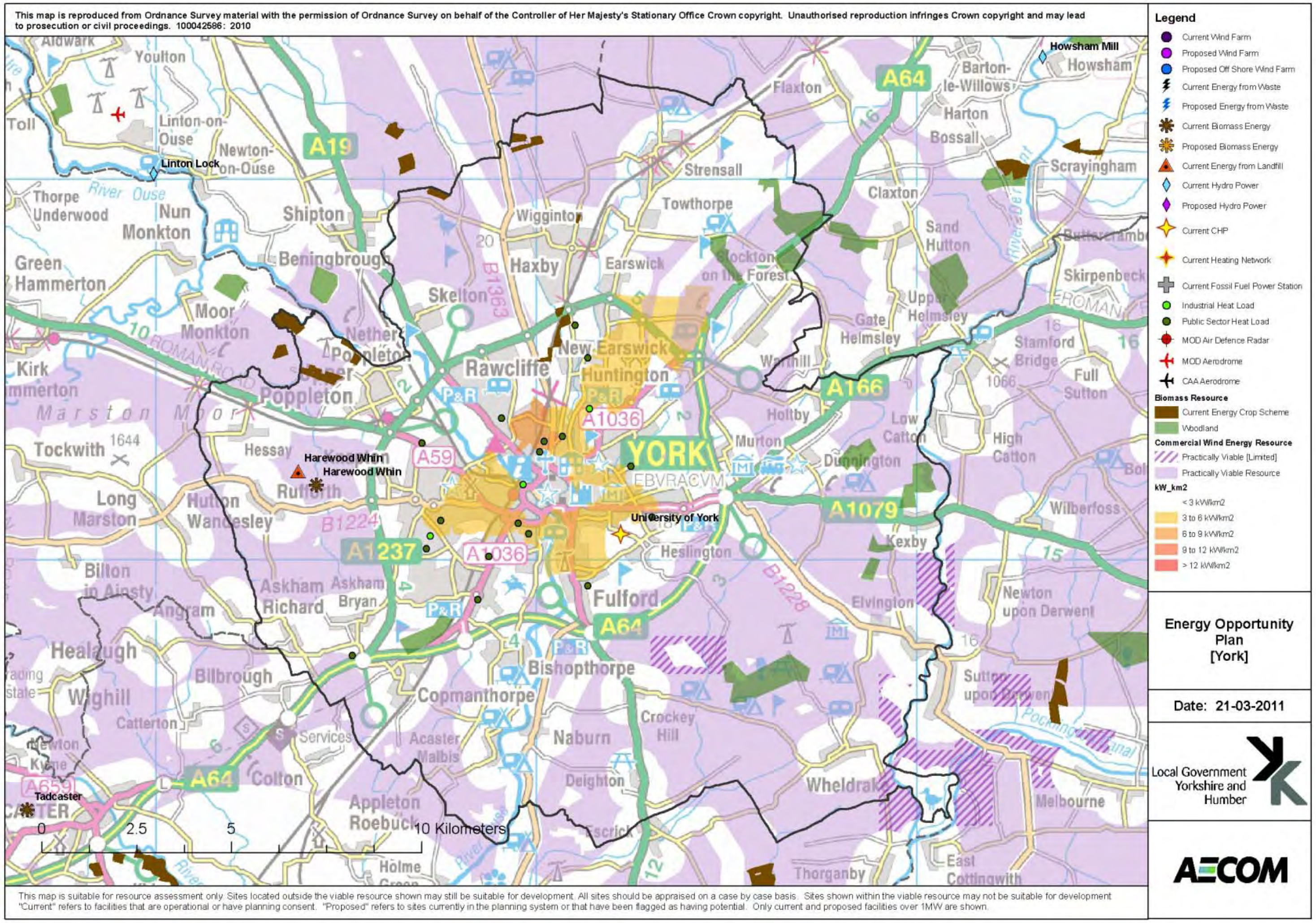


Figure 101 Energy opportunities plan for York. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed 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.

Appendix C Stakeholder engagement

This chapter describes the barriers and opportunities to the development of low carbon and renewable energy in the region, obtained from meetings with stakeholders.

C.1 Meeting with CO2 sense, 17 September 2010

Stakeholders can overcome barriers to biomass and anaerobic digestion schemes by:

- Working to develop food waste collection schemes for C&I organic waste – CO2 sense has currently developed four such schemes
- Look at providing transfer facilities for this waste
- LAs can help create a market for AD by how they collect and procure solutions for their municipal organic waste. i.e. need to separate food waste from green waste, and provide long term fuel supply contracts to AD operators.

C.2 Meeting with Microgeneration Partnership, 28 September 2010

Strategic actions to improve delivery are as follows.

- Local authorities need to be more informed. Do not like being sold to but need to build relationships with local suppliers.
- A lot of bureaucracy at the moment involved with being members of REA, HETAS, BPEC, Solar Energy, etc. Process needs to be streamlined.
- Too much bureaucracy in particular with MCS accreditation. Process needs to be easier and faster. E.g. DEFRA Clean Air Act list does not recognise MCS Air Emissions test.

C.3 Meeting with CE Electric, 13 October 2010

Strategic actions for region are as follows:

- Limited potential to affect low voltage network. It is generic across our region and we need to keep it reasonably standard. However different network operators have historically chosen (and are now tied to) different standards. Moving those standards is a slow process.
- Clustering of wind farms is an issue, particularly in East Riding which is a light load area. North of Humber, thermal rating of 66kV lines is an issue.
- Generally not an issue with capacity of grid. There are a number of substations where there is spare capacity.

C.4 Meeting with Scottish and Southern Energy at Ferrybridge “C”, 13 October 2010

Strategic actions for region are as follows:

- Region is ideally located to take advantage of CCS if this technology proves viable.
- Younger people need to be encourage into industry to replace skills
- Greater investment is needed.
- More certainty is needed in terms of regulation (e.g. ROC banding significantly affected business model).

C.5 Meeting with Banks Renewables, 26 October 2010

Strategic actions for region are as follows:

- Produce study outputs by local authority (or by an area with defined boundaries such as National Park, not sub-regions). This engages LA in process and highlights renewable energy as issue that needs to be tackled.
- Is a general lack of strategic landscape expertise at the local authority level, for example, with respect to interpreting ZTVs, cumulative impact, etc. Quality of external advice is dependent on which consultant is used.
- Regional datasets that are kept up to date would be useful. This study could be a live document with its own website that industry, Renewables UK, etc could feed into.

C.6 Meeting with Environment Agency-Hydro, 26 October 2010

Strategic actions for region are as follows:

- High level feasibility studies good for demonstrating potential of hydro to local authorities. However, it is not really possible to assess feasibility at a lower level without site visits, which is expensive,
- Bureaucracy and regulations are a barrier at the moment, i.e. getting EA consents, construction licences, river consents, fish pass consents, etc. EA is trying to bring this together into a single application.

C.7 Meeting with RWE NPower, 8 November 2010

Strategic actions for the region are as follows:

- Constraints for wind energy development should be set at a strategic level.
- At a local level, guidance is needed to avoid assessment of sites using a checklist approach.

- National energy policy is not filtering down to local level. Councils should be made more aware of the need for renewable energy.

C.8 Meeting with Civil Aviation Authority (CAA), 8 November 2010

Strategic actions for the region are as follows.

- Regional solutions to radar mitigation should be encouraged. This is beginning to happen with offshore wind development.
- Developers should work together to find appropriate solutions, to share capital costs. Will all benefit as region is opened up.

C.9 Meeting with Energy Saving Trust, 9 November 2010

Strategic actions for the region are as follows:

- Supply chain for solar thermal is quite advanced, but this is not the case for solar PV or for domestic biomass.
- EST runs a renewables network for the region. Can be an issue with competition between installers.
- Are very few installers based in North Yorkshire.
- May be an issue for individuals and community groups to obtain the funding needed for expensive feasibility studies.

C.10 Meeting with Osprey consulting on behalf of Leeds Bradford International airport, 24 November 2010

Strategic actions for the region are as follows:

- Is an issue with proliferation of wind farms, planners do not have the tools to deal with cumulative impact.
- Airports often do not have time to deal with wind farm applications. Is the option for developers to use independent consultants or bodies to mediate between themselves and the airports.
- Solar is not an issue at the moment.
- Objections can also be raised against small wind turbines.

C.11 Feedback from stakeholder workshop, 17 November 2010

The following opportunities and constraints were identified from the sub-regional breakout sessions. Actions emerging from the workshop are described in Table 73.

Hull and Humber Ports sub-region

Opportunities

Renewable Heat Incentive and Feed-in Tariff

Wind in Port/Humber frontage and perimeter, 350m Hull Turbine to residents - dead bird shower?

Heat Networks

Council owned properties – solar in housing stock

Build on city wind turbine services

Solar on car parks

Education

Council Transport

Better public consultation at the front end

Significant wind potential not tapped

Solar farms rather than wind

Bridlington AAP/development

Affordable homes and public buildings

Leisure centres CHP

Strong potential for Energy from burning straw – 30MW has consent (Tesco in Goole, Tansterne, and Game Slack Farm in Wetwang)

Energy from Waste – from food or fish industry

Biomass plants – access biomass from world. Local vs Global supply

Drax biomass plant in Grimsby and Helius Biomass power plant

Offshore wind support – skills

Oil refineries potential for biofuels

Carbon capture and storage pipes in Lincs

Skills fund – community upskill

Community benefit

Microgeneration more palatable?

Constraints

Small and highly built up

No funding

Viability at code levels – onsite renewable currently at 10% only

Increasing resistance to wind. Localism – no more wind farms. Political opposition. Too much wind already. Political reject planning appeal. Landscape issue. Cumulative effect. Difference in urban/rural opinion

Yorkshire Wolds

Grid constraints

MoD radar

Issues with biomass – poor link between farmers and bailers. Landscape and food supply. Carbon footprint of imported biomass. Concern about biomass monocultures - biodiversity

Nature of conservation around Humber

Birds on estuary

Development pressure around Grimsby

Price of fuel. Around 2008/2009, Drax were paying £5-6/GJ

Public opposition to plants too – transport traffic, heavy trucks, industrial. EfW in Hull and East Riding contributing pollution

Hydro doesn't seem to be delivered

Disrupt vs entrance

General support but delivery constraints

York and North Yorkshire sub-region

Opportunities

Hydro in Yorkshire Dales (National Park)

Nidderdale AONB hydro, Harrogate

Leeming bar food cluster – AD?

Large wind potential, Hambleton

Whitby Business Park, North York Moors

District Heating Study, North York Moors

District Heating in York Northwest (35 ha)

Nestle chocolate factory near hospital, York

District heating in South side, Skipton-in-Craven

Good grid connection

5,000kW hydro, Richmondshire

Some potential for Efstraw

Energy crops can be used as feedstock for straw combustion, co-firing, dedicated biomass plant burning crops, waste wood

300,000kW potential from Building Integrated Renewables

Constraints

Access to capital?

Local opposition

Developers can't engage with members

Effect of localism bill

Uncertainty over Feed-in Tariff

Legacy of ARBRE (acronym?)

Terms of trade

Unfamiliar crop for farmers

Leeds City Region sub-region

Opportunities

Wakefield - 2 strategic sites for Anaerobic Digestion (1 subject to PFI)

Multifuel (e.g., Terrybridge, Knottingley, Castleford)

Local Enterprise Partnership?

Relationship between LA and communities

Climate change skills partnerships (£800,000)

Pellet Mill in Pollington

Cross boundary opportunities for Pollington with East Riding

Significant wind potential

Europe, green investment bank

Public sector could provide anchor load

Procurement policies

Leeds Sewage TW – incinerator?

Bradford Gasification

PV on terraced roofs

DECC low carbon pilots

Aire Valley EfW

Food waste collection pilot

Capabilities on project:
Building Engineering - Sustainability

Landowners enterprise

Ferrybridge installed dedicated biomass burner. Ferrybridge planning a plant that will burn SRF

Collection of grass clippings

Strategic need for digesters

Using transport policy

Behavioural change

Revenue from microgeneration

Constraints

Risk due to uncertain national policy

Communication – CCS network

Partnerships dependent on RDA

Lack of resource

Managing transition

Skills for planners & members (e.g., infrastructure) and LAs generating energy

Cash

Travel distance for biomass

MoD radar

Local opposition

Aversion to targets – lack of drivers. Lack of understanding towards national targets

PV – loss of employment land

Airports on wind 17km buffer

Grid in certain hot spots

South Yorkshire sub-region

Opportunities

Blackburn Meadows biomass station. Meadow Hall (EON). Proposed biomass power installation (oil/woodchip). Size unknown. No heat customers. Finance an issue.

Significant wind potential

Existing Veolia EfW with DH. DH network could be extended. There is ongoing study looking into this – linked to a study around Sheffield becoming an ESCo. Also numerous existing CHP in Sheffield – some studies have looked at connection into wider network. Constraints are viability studies and finance.

Sterecycle – waste autoclaved. Thought to be only a waste transfer handling station. Where does the processed waste go? Is this a potential EfW site? Project team should review Joint Waste DPD

Dearne Valley EcoVision – 2 sites identified for future EfW, Cross boundary strategic development initiative. The Dearne Valley EcoVision is a potential catalyst project – flagship. Only got 1 bidder. All sorts of PFI contracting complications

Thorpe Marsh Coal Gasification (any potential for renewables component?). Hatfield Carbon Capture and storage scheme (no renewable link?). Scheme was intended to link to cross channel gas pipe line. Apparently this scheme now shelved? UK Coal proposed power station for Algreave/Waverline. Is there potential for co-firing?

Look into ROC Power – put in a number of planning applications for 1 – 2MW biomass power (CHP) (Vegetable Oil)

Hickleton Mine Gas scheme. Stakeholders wanted to know if could count towards renewables targets – they were arguing no different to mining Landfill gas?!

Civic biomass district heating proposal including Town Hall, Library, Offices, Westgate Plaza 1 and 2.

C5 sites have been identified in City – each with capacity for 2 – 3 wind turbines.

Thorne and Hadfield SSSI – understand a wind turbine has recently been consented

Great Hardon Community Wind Farm – 2MW. Origin Energy.

Local opposition was suggested as the biggest problem in the region – community projects have best potential to get buy-in and change perceptions.

Need to consult with British Waterways as well as EA. Thought to be reasonable potential from weirs (low head). British Waterways have a stake in a small Hydro company. They have a delivery/phasing plan. Could tap into this.

CO2 sense thought there was a study which identifies 4 – 5 low head potential hydro sites in/around Sheffield. Consult EA/BW

Sheffield Renewables are looking at a Hydro scheme (Dam/Weir) on the border of Sheff/Rotherham/Doncaster.

Could talk to Peaks National Parks (Bakewell) re potential for high head hydro

No collection of food waste. Green waste is collected. Waste goes to Incinerator (Veolia). 'Sheffield needs to feed its incinerator'

There is a cluster of food companies around Clay Wheels Lane. Perfect site for Anaerobic Digestion?

What about 'Prem Doors' (just off M1) – lots of wood waste.

Two woodland management groups managing pockets/clusters of woodland. These are: White Rose Forest and South York Forest Partnership. Good awareness raising.

A facility burning hazardous waste wood – is there any potential for clean up.

AD plant (PDM)

Speak to Yorkshire Water – sewage sludge – incinerator (Blackburn Meadows)

Constraints

C5 wind sites scrapped by new Lib Dem leadership. Focus on other types of renewables as part of manifesto pledge.

Buffer zones around SPA where designation is for birds. The Night Jar is the key protected species – should allow 300m buffer.

CAA asked if vertical obstruction been picked up (for aircraft take off and land) – is this assumed with DECC constraints? Has route radar been considered? NATS dataset? There are 23 of these radars nationwide – only a finite number of areas that are allowed to be blanked out (i.e. wind sites get blanked out).

Hull and Humber Ports sub-region	York and North Yorkshire sub-region	Leeds City sub-region	South Yorkshire sub-region
Viability of renewables in new development	LAs facilitate community involvement	Apply pressure to LAs (e.g., projects in partnership with LA)	Find Sheffield EfW/DH project brief. Find out how the Sheffield scheme was set up/financed. Are there lessons that can be learnt for other areas? Feasibility study for Doncaster? Thought to be less commercial buildings in Doncaster. Undertake feasibility study for power station/DH in Doncaster
Local policies and strategic sites studies	Funding for feasibility study	Adopt targets in partnership with LA	Viability study of Barnsley biomass district heating proposal (which includes Town Hall, Library, Westgate Plaza 1 and 2)
Educate communities, authorities, and members about appropriate technologies	Training for officers and members on technologies and statutory consultees	Capital and asset pathfinder – output should have low carbon focus	Determine if there is potential for co-firing at proposed Algreave/Waverline power station in Rotherham
Skills development to help communities deliver schemes	Sharing expertise between LAs	Use eco-settlements as exemplars	Viability of renewables in new development
Hull District Heating Viability Study	Engage with private woodland owners	T A Climate change skills fund	Educate communities, and authorities about appropriate technologies and set up skills development programs
Demonstration schemes/tours	Renewable energy expert/advice	Communication to elect members (publicly visible projects) e.g., streetlighting	
Upgrade grid issues, especially for offshore wind		Energy efficiency	
Apply pressure to LAs (e.g., projects in partnership with LA)		Transport strategy	
Adopt targets in partnership with LA			

Table 73 Sub regional actions emerging from stakeholder workshop

Capabilities on project:
Building Engineering - Sustainability

C.12 Attendance list for stakeholder workshop, 17 November 2010

No	Forename	Surname	Organisation
1	Martin	Earle	Banks Renewables
2	Stacey	Heppinstall	Barnsley Metropolitan Borough Council
3	Edward	Broadhead	Bradford Metropolitan District Council
4	Anna	Helley	Bradford Metropolitan District Council
5	Richard	Williamson	Bradford Metropolitan District Council
6	Anna	Wodall	City of York Council
7	Jo	Adlard	CO2 Sense
8	Jemma	Benson	CO2 Sense
9	Sian	Watson	Craven District Council
10	Craig	Wilson	Craven District Council
11	Stephanie	Major	East Riding of Yorkshire Council
12	Lance	Saxby	Energy Saving Trust
13	Sally	Armstrong	Environment Agency
14	Keith	Davie	Environment Agency
15	Gail	Hammond	Environment Agency
16	Tina	Penswick	Government Office Yorkshire and Humber
17	Bryony	Wilford	Hambleton District Council
18	Linda	Marfitt	Harrogate District Council
19	Philip	Reese	Hull City Council
20	Thomas	Knowland	Leeds City Council
21	Helen	Miller	Leeds City Council
22	Andy	Haigh	Leeds City Region
23	John	Clubb	Local Government Yorkshire and Humber
24	Marta	Dziudzi	Local Government Yorkshire and Humber
25	Martin	Elliot	Local Government Yorkshire and Humber
26	Ruth	Hardingham	Local Government Yorkshire and Humber
27	Mike	Barningham	Natural England

Capabilities on project:
Building Engineering - Sustainability

No	Forename	Surname	Organisation
28	Hannah	Boot	Natural England
29	Heather	Rennie	Natural England
30	James	Walsh	Natural England
31	Sarah	Housden	North York Moors National Park Authority
32	Ray	Bryant	North Yorkshire County Council
33	Rachael	Richardson	Ryedale District Council
34	Kathryn	Jukes	Savills
35	Emma	Wells	Sheffield City Council
36	Tanya	Palmowski	Sheffield City Region
37	Jenny	Poxon	Sheffield City Region
38	Neville	Ford	Wakefield Metropolitan District Council
39	Alex	Roberts	Wakefield Metropolitan District Council
40	Robert	Masheder	West Yorkshire Ecology
41	Andrew	McCullagh	Yorkshire Dales National Park Authority
42	Gordon	McArthur	Yorkshire Forward

Table 74 Attendance list for stakeholder workshop

Appendix D Funding mechanisms for low carbon and renewable energy technologies

This section identifies sources of funding that could assist with the deployment of low carbon and renewable energy technologies . It is not intended to be an exhaustive list, nor does it reach definitive conclusions about which mechanisms are most suited to the Yorkshire and Humber region. Rather it seeks to provide guidance on the opportunities that exist.

D.1 Renewable Energy 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 Obligation is guaranteed in law until 2037. The types of technology and the number of ROCs achieved per MWh are outlined in Table 75 below. The value of a ROC fluctuates as it is traded on the open market. The average value of a ROC in November 2010 was £48.12.[73]

Technology	ROCs/MWh
Hydro	1
Onshore wind	1
Offshore wind	1.5
Wave	2
Tidal Stream	2
Tidal Barrage	2
Tidal Lagoon	2
Solar PV	2
Geothermal	2
Geopressure	1
Landfill Gas	0.25
Sewage Gas	0.5
Energy from Waste with CHP	1
Gasification/Pyrolysis	2
Anaerobic Digestion	2
Co-firing of Biomass	0.5
Co-firing of Energy crops	1
Co-firing of Biomass with CHP	1
Co-firing of Energy crop with CHP	1.5
Dedicated Biomass	1.5
Dedicated energy crops	2
Dedicated Biomass with CHP	2
Dedicated Energy Crops with CHP	2

Table 75 Value of ROCs for a range of renewable energy technologies (Source: Renewable Obligation Certificate (ROC) Banding (DECC websites http://chp.defra.gov.uk/cms/roc-banding/, accessed August 2009)

D.2 Feed-in-tariffs

A feed-in tariff is a policy mechanism designed to encourage the adoption of renewable energy sources. These came into legislation in April 2010 for installations not exceeding 5 MW. The feed-in-tariffs consist of two elements of payment made to generators:

The first element is a generation tariff that differs by technology type and scale, and will be paid for every kilowatt hour (kWh) of electricity generated and metered by a generator. This generation tariff will be paid regardless of whether the electricity is used onsite or exported to the local electricity network.

The second element is an export tariff which will either be metered and paid as a guaranteed amount that generators are eligible for, or will, in the case of very small generation, be assumed to be a proportion of the generation in any period without the requirement of additional metering.

The following low-carbon technologies are eligible:

- Fuel cells
- PV & Solar Power
- Water (including. Waves and tides)
- Wind
- Geothermal sources

[73] Average ROC prices, e-ROC website http://www.e-roc.co.uk/trackrecord.htm, accessed November 2010

- CHP with an electrical capacity of 50 kW or less

The electricity produced by these technologies will be bought by the utilities at above market prices. These prices will decrease over time to reflect the impact of increasing installation rates on end prices charged to consumers, the goal being to enable industries to "stand alone" at the end of the tariff period.

D.3 Renewable Energy Heat Incentive

Renewable heat producers of all sizes will receive payments for generation of heat. The payments are intended to give a 12% rate of return will be 'deemed' rather than metered. 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 July 15th 2009 is eligible. The following technologies are included in the scheme.

- Air source heat pumps
- Anaerobic digestion to produce biogas for heat production
- Biomass heat generation and CHP
- Ground source heat pumps
- Liquid biofuels (but only when replacing oil-fired heating systems)
- Solar thermal heat and hot water
- Biogas injection into the grid

D.4 Allowable Solutions

While details of how allowable solutions will be administered have not yet been made available, early announcement by Government indicates a possible cap of around £3000 per tonne of annual CO_2 savings required. There will need to be a body to administer these funds, to access additional funds and prioritise how they should be invested. Whatever the eventual structure that emerges to do this, there will is a need for planning bodies to understand the potential opportunities and priorities in their area.

D.5 Salix Finance

This is a publicly funded company designed to accelerate public sector investment in energy efficiency technologies through invest to save schemes. Funded by the Carbon Trust, Salix Finance works across the public sector including Central and Local Government, NHS Trusts and Higher & Further Education institutions. It will provide £51.5 million in interest free loans, to be repaid over 4 years, to help public sector organisations take advantage of energy efficiency technology .

Salix launched its Local Authority Energy Financing (LAEF) pilot scheme in 2004. The success of this programme has allowed the pilot to be rolled out into a fully fledged Local Authorities programme. The next closing date for applications is 1st October 2009.

D.6 The Community Infrastructure Levy

The CIL is expected to commence in April 2010 and unlike Section 106 contributions can be sought 'to support the development of an area' rather than to support the specific development for which planning permission is being sought. Therefore, contributions collected through CIL from development in one part of the charging authority can be spent anywhere in that authority area.

D.7 Carbon Emission Reduction Target (CERT)

The Carbon Emissions Reduction Target (CERT) is a legal obligation on the six largest energy suppliers to achieve carbon dioxide emissions reductions from domestic buildings in Great Britain. Local authorities and Registered Social Landlord's (RSL) can utilise the funding that will be available from the energy suppliers to fund carbon reduction measures in their own housing stock and also to set up schemes to improve private sector housing in their area.

The main different types of measures that can receive funded under CERT are:

- Improvements in energy efficiency.
- Increasing the amount of electricity generated or heat produced by microgeneration.
- Promoting community heating schemes powered wholly or mainly by biomass (up to a size of three megawatts thermal).
- Reducing the consumption of supplied energy, such as behavioural measures.

D.8 Section 106 Agreements

Section 106 agreements are planning obligations in the form of funds collected by the local authority to offset the costs of the external effects of development, and to fund public goods which benefit all residents in the area.

D.9 The Community Energy Saving Programme

This is a £350million programme for delivering "whole house" refurbishments to existing dwellings through community based projects in defined geographical areas. This will be delivered through the major energy companies and aims to deliver substantial carbon reductions in dwellings by delivering a holistic set of measures including solid wall insulation, microgeneration, fuel switching and connection to a district heating scheme. Local authorities are likely to be key delivery partners for the energy companies in delivering these schemes.

The Community Sustainable Energy Programme has two grant initiatives. Both are only available to not-for-profit community based organisations in England.

D.10 Prudential borrowing and bond financing

The Local Government Act 2003 empowered Local Authorities to use unsupported prudential borrowing for capital investment. It simplified the former Capital Finance Regulations and allows councils flexibility in deciding their own levels of borrowing based upon its own assessment of affordability. The framework requires each authority to decide on the levels of borrowing based upon three main principles as to whether borrowing at particular levels is prudent, sustainable and affordable. The key issue is that prudential borrowing will need to be repaid from a revenue stream created by the proceeds of the development scheme, if there is an equity stake, or indeed from other local authority funds (e.g. other asset sales).

Currently the majority of a council's borrowing, will typically access funds via the 'Public Works Loan Board'. The Board's interest rates are determined by HM Treasury in accordance with section 5 of the National Loans Act 1968. In practice, rates are set by Debt Management Office on HM Treasury's behalf in accordance with agreed procedures and methodologies. Councils can usually easily and quickly access borrowing at less than 5%.

The most likely issue for local authorities will be whether or not to utilise Prudential Borrowing, which can be arranged at highly competitive rates, but remains 'on-balance sheet' or more expensive bond financing which is off-balance sheet and does not have recourse to the local authority in the event of default.

D.11 Best Value

Local authorities have the right to apply conditions to sales of their own land, whereby a lower than market value sale price is agreed with the developer in return for a commitment to meet higher specified sustainability standards. Rules governing this are contained within the Treasury Green Book which governs disposal of assets and in within the Best Value - General Disposal Consent 2003 'for less than best consideration' without consent. It is our understanding that undervalues currently have a cap of £2 million without requiring consent from Secretary of State.

D.12 Local Asset-Backed Vehicles

LABVs are special purpose vehicles owned 50/50 by the public and private sector partners with the specific purpose of carrying out comprehensive, area-based regeneration and/or renewal of operational assets. In essence, the public sector invests property assets into the vehicles which are matched in case by the private sector partner.

The partnership may then use these assets as collateral to raise debt financing to develop and regenerate the portfolio. Assets will revert back to the public sector if the partnership does not progress in accordance with pre-agreed timescales through the use of options.

Control is shared 50/ 50 and the partnership typically runs for a period of ten years. The purpose and long term vision of the vehicle is enshrined in the legal documents which protect the wide economic and social aims of the public sector along with pre-agreed business plans based on the public sector's requirements.

The first generation of LABVs were largely predicated on a transfer of assets from the public sector to a 50/50 owned partnership vehicle in which a private sector developer/investor partner invested the equivalent equity usually in cash. The benefits were in some instances compelling.

This transfer of assets suited the public sector given yields and prices had never been stronger. There is now a need for a second generation of LABVs that deliver many of the recognised benefits of LABVs as set out above but protect the public sector from selling 'the family silver' at the bottom of the market.

The answer may lie in LABV Mark 2 – a new model that is emerging based on the use of property options that will act as incentives. A better acronym would be LIBVs (Local Incentive Backed Vehicle) in which the public sector offers options on a package of development and investment sites in close 'place-making' proximity. The private sector partner is procured, a relationship built, initial low cost 'soft' regeneration is commenced such as; understanding the context, local consultation, masterplanning, site specific planning consents etc. Thereafter, as and when the market returns, the sites and delivery process will be ready to respond, options will be exercised, ownership transferred and a price paid that reflects the market at the time.

D.13 Green Renewable Energy Fund

An example of this is operated by EDF. Customers on the Green Tariff pay a small premium on their electricity bills which is matched by EDF and used to help support renewable energy projects across the UK.

This money is placed in the Green Fund and used to award grants to community, non-profit, charitable and educational organisations across the UK.

The Green Fund awards grants to organisations who apply for funds to help cover the cost of renewable energy technology that can be used to produce green energy from the sun, wind, water, wood and other renewable sources.

Funding will be provided to cover the costs associated with the installation of small-scale renewable energy technology and a proportion of the funding requested may be used for educational purposes (up to 20%). Funding may also be requested for feasibility studies into the installation of small-scale renewable energy technology.

There is no minimum value for grants, with a maximum of £5,000 for feasibility studies, and £30,000 for installations. All kinds of small-scale renewable technologies are considered. The closing dates for the applications usually fall on the 28th February and the 31st August.

D.14 Intelligent Energy Europe

The objective of the Intelligent Energy - Europe Programme aims to contribute to secure, sustainable and competitively priced energy for Europe. It covers action in the following fields:

- Energy efficiency and rational use of resources (SAVE)
- New and renewable energy resources (ALTENER)
- Energy in transport (STEER) to promote energy efficiency and the use of new and renewable energies sources in transport

The amount granted will be: up to 75% of the total eligible costs for projects and the project duration must not exceed 3 years.

D.15 Merchant Wind Power

A scheme of this type is operated by Ecotricity who build and operate wind turbines on partner sites. Ecotricity take on all the capital costs of the project, including the turbine itself, and also conducts the feasibility, planning, installation, operation and maintenance of the wind turbines. Merchant Wind Power partners agree to purchase the electricity from the turbine and in return receive a dedicated supply of green energy at significantly reduced rates.

Partnerships for Renewables is a company that has been set up to deliver turbines on public sector land. In return for a turbine the recipient receives an annual return on its investment. Importantly, installation would be limited to local authority owned land.

D.16 Energy Saving Trust Low Carbon Communities Challenge

Local authorities can apply for up to £500,000 for energy efficiency and renewable energy measures across their locality. This could help deliver carbon-saving projects such as area-based insulation schemes or community renewables, The two year programme will provide financial and advisory support to 20 'test-bed' communities in England, Wales and Northern Ireland, support inward investment and foster community leadership. The programme is open to local authorities and community groups and the Challenge is focused on communities already taking action, or facing change in the area as a result of climate change and those looking to achieve deep cuts in carbon over the long term.

The programme will provide around £500,000 capital funding (up to 10% can be spent on project management). The timescale on the scheme is short with the capital money needing to be spent very soon. The challenge will be run in two phases with applicants able to apply for either of them. Phase 1 will be for green 'exemplar' communities that have already integrated community plans to tackle climate change and Phase 2 is for communities already taking some action or facing change in their area. All applicants are required to register interest by 12 noon on Wednesday 28th October 2009.

D.17 Biomass Grants

If grown on non-set-aside land then energy crops are eligible for £29 per hectare under the Single Farm Payment rules (set-aside payments can continue to be claimed if eligible). The Rural Development Programme for England’s Energy Crops Scheme also provides support for the establishment of SRC and miscanthus. Payments are available at 40% of actual establishment costs, and are subject to an environmental appraisal to help safeguard against energy crops being grown on land with high biodiversity, landscape or archaeological value.

Capabilities on project:
Building Engineering - Sustainability

D.18 Local Authorities Carbon Management Programme

Through the Local Authority Carbon Management Programme, the Carbon Trust provides councils with technical and change management guidance and mentoring that helps to identify practical carbon and cost savings. The primary focus of the work is to reduce emissions under the control of the local authority such as buildings, vehicle fleets, street lighting and waste.

Participating organisations are guided through a structured process that builds a team, measures the cost and carbon baseline (carbon footprint), identifies projects and pulls together a compelling case for action to senior decision makers. Carbon Trust consultants are on hand throughout the ten months. Direct support is provided through a mixture of regional workshops, teleconferences, webinars and national events.

The programme could provide a useful mechanism for the Council to address its carbon emissions of which energy planning and delivery will be an important part.

D.19 2020 European Fund for Energy, Climate Change and Infrastructure - Marguerite Fund

The target volume of the fund is EUR 1.5 billion. The fund's investment policy is geared towards financing projects which contribute to achieving European key priorities in the transport and energy sectors. Projects related to all kinds of renewables will be examined including wind (onshore and offshore), solar, geothermal, biomass, biogas, hydro, and waste-to-energy. The fund will however not invest in pilot projects deploying experimental or non-tested technologies. Biofuels are not specifically contemplated in the investment strategy at the present stage.

D.20 JESSICA

The Joint European Support for Sustainable Investment in City Areas (JESSICA) is a policy initiative of the European Commission and European Investment Bank that aims to support Member States to exploit financial engineering mechanisms to bring forward investment in sustainable urban development in the context of cohesion policy.

Under proposed new procedures, Managing Authorities in the Member States, which in the case of the UK is the RDAs, will be allowed to use some of their Structural Fund allocations, principally those supported by ERDF, to make repayable investments in projects forming part of an 'integrated plan for sustainable urban development' to accelerate investment in urban areas. The investments may take the form of equity, loads and/ or guarantees and will be delivered to projects via Urban Development Funds (UDFs) and, if required, Holding Funds (HF). The fund will recycle monies over time and series of projects.

D.21 European Regional Development Fund

The European Regional Development Fund (ERDF) helps stimulate economic development and regeneration in the least prosperous regions of the European Union.

For 2007-13, the department for Communities and Local Government has transferred responsibility for managing and administering ERDF programmes to RDAs. All European funds need to be matched by, at the least, an equivalent sum from non-European sources.

D.22 ELENA

The European Local Energy Assistance facility, ELENA, can cover up to 90% of the costs associated with technical assistance for preparing large sustainable investment programmes. It aims to help cities and regions implement viable investment projects in the areas of energy efficiency; renewable energy sources and sustainable urban transport.

The technical assistance can be provided for development of feasibility and market studies, structuring of programmes, business plans, energy audits, preparation of tendering procedures and contractual arrangements, and programme implementation units and include any other assistance necessary for the development of Investment Programmes.

Appendix E Existing renewable energy capacity

Details of the renewable energy installations in the Yorkshire and Humber region above 1MW that are operational, have planning consent or are in the planning system are provided below.

E.1 Wind Energy

Type	Status	Name	Local authority	Capacity (MW)
Wind	Consented	Blackstone Edge Wind Farm	Barnsley	7.0
Wind	Consented	Todmorden Moor Wind Farm	Calderdale	15.0
Wind	Consented	Hampole Wind Farm	Doncaster	8.0
Wind	Consented	Tickhill Wind Farm	Doncaster	5.0
Wind	Consented	Tween Bridge Windfarm	Doncaster	66.0
Wind	Consented	Burton Pidsea Wind Farm	East Riding of Yorkshire	9.0
Wind	Consented	Goole Fields Wind Farm	East Riding of Yorkshire	32.0
Wind	Consented	Hall Farm Wind Farm	East Riding of Yorkshire	24.0
Wind	Consented	Sanction Hill Wind Farm	East Riding of Yorkshire	10.0
Wind	Consented	Sixpenny Wood Wind Farm	East Riding of Yorkshire	30.0
Wind	Consented	Sober Hill Wind Farm	East Riding of Yorkshire	15.0
Wind	Consented	Sunderland Farm Wind Farm	East Riding of Yorkshire	20.7
Wind	Consented	Tedder Hill Wind Farm	East Riding of Yorkshire	6.0
Wind	Consented	Twin Rivers Wind Farm	East Riding of Yorkshire	28.0
Wind	Consented	Withernwick Wind Farm	East Riding of Yorkshire	22.5
Wind	Consented	Bullamoor Wind Farm	Hambleton	12.0
Wind	Consented	Keadby Wind Farm	North Lincolnshire	85.0
Wind	Consented	Penny Hill Lane Wind Farm	Rotherham	19.8
Wind	Consented	Rusholme Wind Farm	Selby	24.0
Wind	Operational	Hazlehead Wind Farm	Barnsley	6.0
Wind	Operational	Royd Moor Wind Farm	Barnsley	5.9
Wind	Operational	Spicer Hill Wind Farm	Barnsley	6.9
Wind	Operational	Crook Hill Wind Farm	Calderdale	12.5
Wind	Operational	Ovenden Moor Wind Farm	Calderdale	9.2
Wind	Operational	Chelker Reservoir Wind Turbine	Craven	1.3
Wind	Operational	Red House / Gedney Marsh Wind Farm	Doncaster	12.0
Wind	Operational	Lisset Airfield Wind Farm	East Riding of Yorkshire	30.0
Wind	Operational	Loftsome Bridge STW Wind Turbines	East Riding of Yorkshire	2.6

Wind	Operational	Out Newton Wind Farm	East Riding of Yorkshire	9.0
Wind	Operational	Saltend STW Wind Turbine	East Riding of Yorkshire	1.3
Wind	Operational	Knabs Ridge Wind Farm	Harrogate	16.0
Wind	Operational	Croda Chemicals Wind Turbine	Kingston Upon Hull, City of	2.0
Wind	Operational	Bagmoor Wind Farm	North Lincolnshire	20.0
Wind	Operational	Advanced Manufacturing Research Centre Wind Turbines	Rotherham	2.6
Wind	Operational	Loscar Farm Wind Farm	Rotherham	3.9
Wind	Operational	Marr Wind Farm	Selby	12.0
Wind	Planning	Norton Wind Farm	Doncaster	4.0
Wind	Planning	Aire & Calder Wind Farm	East Riding of Yorkshire	45.0
Wind	Planning	Celcon Blocks Ltd	East Riding of Yorkshire	2.3
Wind	Planning	Spalding Common Wind Farm	East Riding of Yorkshire	16.1
Wind	Planning	Spaldington Airfield	East Riding of Yorkshire	10
Wind	Planning	Melmerby Wind Farm	Harrogate	17.5
Wind	Planning	Dearne Head Wind Farm	Kirklees	10.0
Wind	Planning	Mars Petcare Wind Turbine	Kirklees	2.0
Wind	Planning	Caverns Wind Farm	North East Lincolnshire	12.5
Wind	Planning	Saxby Wold Wind Farm	North Lincolnshire	40.5
Wind	Planning	Aske Moor Wind Farm	Richmondshire	14.8
Wind	Planning	Heslerton Wind Farm	Ryedale	32.5
Wind	Planning	Bishopwood Wind Farm	Selby	17.5
Wind	Planning	Cleek Hall Wind Farm	Selby	15.0
Wind	Planning	Wood Lane Wind Farm	Selby	32.2
Wind Off Shore	Consented	Humber Gateway Wind Farm	-	300
Wind Off Shore	Planning	Westernmost Rough Wind Farm	-	245
Wind Off Shore	Potential site	Dogger Bank Wind Farm	-	13,000
Wind Off Shore	Potential site	Hornsea Wind Farm	-	4,000

Table 76 Current and proposed commercial scale wind farms (over 1MW) in Yorkshire and Humber. “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.

E.2 Hydro Energy

Type	Status	Name	Local authority	Capacity (MW)
Hydro	Operational	Aiskew Watermill	Hambleton	0.027
Hydro	Operational	Armitage Bridge	Wakefield	0.06
Hydro	Consented	Bainbridge	Richmondshire	0.045

Hydro	Operational	Bonfield Ghyll	Ryedale	0.001
Hydro	Operational	Esholt STW	Bradford	0.18
Hydro	Operational	Ewden STW	Sheffield	0.275
Hydro	Operational	Garnett Hydro	Leeds	0.15
Hydro	Operational	Gayle Mill	Richmondshire	0.0207
Hydro	Operational	Gibson Mill	Calderdale	0.009
Hydro	Planning	Grange Farm	Harrogate	0.45
Hydro	Operational	Grassington	Craven	0.006
Hydro	Operational	Greenholme Mills	Bradford	0.392
Hydro	Planning	Halton Gill	Craven	0.33
Hydro	Operational	High Corn Mill	Craven	0.0120
Hydro	Operational	Howsham Mill	Ryedale	0.024
Hydro	Planning	Jordan Dam	Rotherham	0.1
Hydro	Planning	Kelham Island	Sheffield	0.025
Hydro	Consented	Kirkthorpe Hydro Scheme	Wakefield	0.38
Hydro	Consented	Linton Lock	Hambleton	1.0
Hydro	Operational	Lowna Mill	Ryedale	0.0026
Hydro	Operational	Loxley STW	Sheffield	0.22
Hydro	Operational	Newby Hall	Harrogate	0.083
Hydro	Planning	Ruswarp Weir	Scarborough	0.05
Hydro	Operational	Settle Bridge End Mill	Craven	0.0480
Hydro	Operational	Tanfield Mill	Hambleton	0.036
Hydro	Operational	Thurgoland Mill	Barnsley	0.00723
Hydro	Operational	Yore Mill	Barnsley	0.0023

Table 77 Current hydro installations in Yorkshire and Humber. “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.

E.3 Biomass Energy

Type	Status	Name	Local authority	Capacity (MW)
Biomass	Consented	Briar Hill Farm	Doncaster	8.0
Biomass	Consented	Game Slack Farm	East Riding of Yorkshire	12.0
Biomass (straw)	Consented	Tansterne Straw-Burning Power Station	East Riding of Yorkshire	10.0
Biomass (straw)	Consented	Tesco Distribution Centre, Goole	East Riding of Yorkshire	5.7
Biomass	Consented	Helius Energy Biomass Plant	North East Lincolnshire	65.0
Biomass	Consented	Victory Mill	Ryedale	6.0
Biomass	Consented	Blackburn Meadows Biomass Plant	Sheffield	25.0
Biomass	Consented	Harewood Whin	York	2.5
Biomass	Operational	Sandsfield Gravel	East Riding of Yorkshire	2.5

Capabilities on project:
Building Engineering - Sustainability

Biomass	Operational	South View Farm	Ryedale	2.0
Biomass	Operational	John Smiths Brewery	Selby	4.7
Biomass (straw)	Planning	Brigg Energy Resource Centre	North Lincolnshire	40.0
Biomass	Planning	Drax Heron	North Lincolnshire	290.0
Biomass	Planning	Drax Ouse	Selby	290.0
Biomass	Planning	Pollington Energy Park	Selby	56.0

Table 78 Current and proposed biomass installations (over 1MW) in Yorkshire and Humber. “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.

E.4 Energy from Waste

Type	Status	Name	Local authority	Capacity (MW)
AD	Consented	Selby Renewable Energy Park	Selby	8.0
AD	Operational	ReFood Energy from Waste	Doncaster	2.0
AD	Operational	Kirkburn	East Riding of Yorkshire	2.0
EfW	Consented	Energos	Bradford	14.9
EfW	Consented	Kirk Sandall Energy Recovery Facility	Doncaster	9.5
EfW	Consented	Saltend Energy from Waste Facility	Kingston Upon Hull, City of	20.0
EfW	Operational	Huddersfield Incinerator	Kirklees	10.0
EfW	Operational	NewLincs	North East Lincolnshire	6.0
EfW	Operational	Sheffield Energy Recovery Facility	Sheffield	20.0
EfW (poultry litter)	Operational	Glanford Power Station	North Lincolnshire	14.0
EfW	Planning	Hampole Quarry Incinerator	Doncaster	2.0
EfW	Planning	Allerton Waste Recovery Park	Harrogate	25.0
EfW	Planning	Skelton Grange Energy Recovery Facility	Leeds	21.0
EfW	Planning	Ferrybridge "C"	Wakefield	100.0
Sewage Gas	Operational	Esholt	Bradford	1.2
Sewage Gas	Operational	Hull WWTW	East Riding of Yorkshire	1.5
Sewage Gas	Operational	Mitchell Laithes	Kirklees	1.4

Table 79 Current and proposed energy from waste installations (over 1MW) in Yorkshire and Humber. “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.

The table below summarises the current proposals for how Waste Disposal Authorities in the region will deal with residual MSW.

	Local authority	Waste respon-sibility	Total MSW 2009/10 (tonnes)	Procurement status
1	Bradford	Unitary	262,000	Interim contract preferred bidder is Waddingtons-Yorwaste (cancelled). Partnership out to tender for long-term residual waste management contract – down to 2 bidders, Earth Tech/Skanska and Shanks
	Calderdale	Unitary	83,000	
2	Barnsley	Unitary	116,000	Each has separately prepared waste management strategies and a Joint Strategic Waste Development Plan Document published in 2010 for waste management until 2026. 3 procurements: Interim Treatment (Rotherham); Treatment & Disposal PFI (Barnsley); HWRC (Doncaster, awarded to WRG) Partnership to tender for long term residual waste treatment contract – down to 2 bidders, Shanks/SSE and Sita. Preferred bidder is expected to be named in April 2011.
	Doncaster	Unitary	167,000	
	Rotherham	Unitary	122,000	
3	East Riding of Yorkshire	Unitary	196,000	Partnership has a long term integrated waste management contract with WRG until 2024 but “contractual problems in recent years” means that the Councils will re-procure the contract in 2013. WRG will continue to carry out waste services for the councils until 2013. Proposed WRG EfW plant at Saltend has planning consent but its future is uncertain.[74]
	Kingston upon Hull, City of	Unitary	139,000	
4	Kirklees	Unitary	219,000	Has a 25 year integrated waste management contract with SITA which began in 1998, based around EfW. This is the existing Huddersfield energy recovery facility.
5	Leeds	Unitary	336,000	Out to tender for long-term residual waste management contract - down to 2 bidders, based around EfW; final 2 bidders are Veolia Environmental Services (proposing a 190,000 tonnes/year incinerator on site of former wholesale market in Cross Green) and the Aire Valley Environmental consortium (proposing a 230,000 tonne incinerator on site of Knostrop waste water treatment, Cross Green) Decision due in February 2011
6	North East Lincolnshire	Unitary	84,000	Have a long term integrated waste management contract until 2024 with Tiru, based around EfW. This is the existing Newlincs energy recovery facility in Grimsby. Preferred approach is to build a second CHP facility on the same site. Biffa Singleton based on gasification, WRG on MBT.
7	North Lincolnshire	Unitary	98,000	Partnership out to tender for long term residual waste management contract –

[74] Saltend energy-from-waste facility will not go ahead, MRW website, accessed January 2011 http://www.mrw.co.uk/news/saltend-energy-from-waste-facility-will-not-go-ahead/8610103.article

				down to 2 bidders,
8	Sheffield	Unitary	226,000	Have long term integrated contract with Veolia Environmental, based around EfW including district heating. This is the existing Sheffield energy recovery facility.
9	Wakefield	Unitary	174,000	Out to tender for long-term integrated waste management contract, with preferred bidder appointed as Babcock/ VT Group in 2007, based around MBT, autoclaves. However Babcock are understood be reconsidering their position on the procurement process.
10	York	Unitary	106,000	Long-term 25 year residual MSW contract awarded to AmeyCespa in December 2010. Technologies include AD and EfW incineration at Allerton Waste Recovery Centre in Harrogate, expected to be operational from 2014 if planning consent is received.
	North Yorkshire	Disposal	355,000	

Table 80 MSW procurement status in Yorkshire and Humber (Source: State of the nation briefing: waste and resource management, ICE)

E.5 Energy generation from landfill

Type	Status	Name	Local authority	Capacity (MW)
Landfill	Consented	Parkwood Power Plant	Sheffield	8.0
Landfill	Operational	Manywells Quarry- A	Bradford	1.0
Landfill	Operational	ATLAS POWER	Calderdale	1.1
Landfill	Operational	Skibeden Landfill Site	Craven	1.1
Landfill	Operational	BOOTHAM LANE	Doncaster	1.3
Landfill	Operational	Bootham Lane, Phase II A, C	Doncaster	1.4
Landfill	Operational	Levitt Hagg Generation - A,C	Doncaster	1.1
Landfill	Operational	Scabba Wood Generation - A	Doncaster	2.8
Landfill	Operational	Skelbrooke 2 - A	Doncaster	2.1
Landfill	Operational	Carnaby Generator	East Riding of Yorkshire	1.4
Landfill	Operational	Gallymoor	East Riding of Yorkshire	1.4
Landfill	Operational	ALLERTON PARK	Harrogate	1.0
Landfill	Operational	Honley Wood - A	Kirklees	1.0
Landfill	Operational	HOWDEN CLOUGH ROAD	Kirklees	1.9
Landfill	Operational	Soothills Landfill	Kirklees	1.0
Landfill	Operational	Gamblethorpe Landfill	Leeds	1.1
Landfill	Operational	PECKFIELD QUARRY	Leeds	4.1
Landfill	Operational	Skelton Grange - A, C	Leeds	3.1
Landfill	Operational	IMMINGHAM LANDFILL	North East Lincolnshire	1.0
Landfill	Operational	New Crosby Warren	North Lincolnshire	1.4
Landfill	Operational	PG2 BOLAM POWER GENERATION	North Lincolnshire	1.0
Landfill	Operational	Winterton	North Lincolnshire	3.0
Landfill	Operational	Meadow Hall Power	Rotherham	1.1
Landfill	Operational	Roxby Gas to Energy - A, C, D	Scarborough	8.5

Landfill	Operational	SEAMER CARR	Scarborough	1.5
Landfill	Operational	BARNSDALE BAR LANDFILL	Selby	1.4
Landfill	Operational	Parkwood Power Plant - D	Sheffield	2.5
Landfill	Operational	Darrington - North	Wakefield	4.0
Landfill	Operational	Long Lane Landfill Site	Wakefield	2.5
Landfill	Operational	Welbeck Power	Wakefield	8.0
Landfill	Operational	Harewood Whin	York	6.6

Table 81 Current and proposed landfill sites (over 1MW) in Yorkshire and Humber. “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.

E.6 District heating networks

Local authority	Type of system	Description	postcode
Barnsley	Boiler house	Sheffield Road Flats	S70 4NW
Barnsley	Boiler house	500 kW scheme for the council depot, Smithies Lane Depot	S71 1NL
Barnsley	Boiler house	Westgate Plaza One	S70 2DR
Barnsley	Boiler house	Town Hall	S70 2TA
Barnsley	Boiler house	Digital Media Centre	S70 2JW
Bradford	-	No information received	
Calderdale	-	None	
Craven	-	No information received	
Doncaster	Boiler house	Doncaster College	DN1 2RF
Doncaster	Boiler house	Balby BridgeMilton Court, St James Court & Stirling Day Centre	DN1 3QG
Doncaster	Boiler house	Trafalgar House	DN6 8BS
Doncaster	Boiler house	Sheep Dip Lane	DN7 4AU
Doncaster	Boiler house	Adwick Town Hall	DN6 7DR
Doncaster	Boiler house	Marlborough House	DN6 0LN
Doncaster	Boiler house	Circuit House	DN6 7TE
Doncaster	Boiler house	Victoria Court	DN5 0HA
Doncaster	Boiler house	Woodlands Market Square	DN6 7SS
Doncaster	Boiler house	Ennerdale	DN2 8QR
Doncaster	Boiler house	71 Skellow Road	DN6 8HP
East Riding	-	None	
Hambleton	Boiler house	No information received	

Harrogate	Community	Town Centre	HG1 2WH
Kingston Upon Hull, City of	Boiler house	Boothferry Flats Boilerhouse	DN14 6BB
Kingston Upon Hull, City of	Boiler house	Melville St Flats Boilerhouse	HU1 2QJ
Kirklees	-	No information received	-
Leeds	Community	Leeds General Infirmary	LS1 3EX
Leeds	Community	University of Leeds	LS2 9JT
North East Lincolnshire	-	No information received	-
North Lincolnshire	-	No information received	-
Richmondshire	-	No information received	-
Rotherham	Boiler house	Arbour Drive Boiler House	S66 9DU
Rotherham	Boiler house	Ascension Close Boiler House (Model Village)	S66 7HQ
Rotherham	Boiler house	Beeversleigh	S65 2AD
Rotherham	Boiler house	Conery Close Boiler House (Vale Road)	S65 4ES
Rotherham	Boiler house	Elizabeth Parkin Boiler House	S65 4LF
Rotherham	Boiler house	Florence Avenue Boiler House (Mansfield Road)	S26 4RL
Rotherham	Boiler house	Greasbrough - District Heating	S61 4RB
Rotherham	Boiler house	Hurley Croft Boiler House	S63 6BN
Rotherham	Boiler house	Langdon Walk Boiler House	S61 3QF
Rotherham	Boiler house	Manor Lodge Boiler House	S2 1UH
Rotherham	Boiler house	Mark Grove Boiler House	S66 2UZ
Rotherham	Boiler house	Mason Avenue Boiler House	S62 6DB
Rotherham	Boiler house	St Anns - Boiler House	S65 1DA
Rotherham	Boiler house	Swinton Fitzwilliam Estate Boiler House	S64 8HF
Rotherham	Boiler house	The Grange Boiler House	-
Rotherham	Boiler house	Tickhill Road Boiler House (Glencairne Court)	S66 7NQ
Rotherham	Boiler house	Vine Close Boiler House	S60 1JN
Rotherham	Boiler house	Woodland Drive Boiler House (Narrow Lane)	S25 4JT
Ryedale	-	None	-
Scarborough	-	No information received	-
Selby	-	No information received	-

Sheffield	Community	Sheffield District Heating Network	S1 2BG
Wakefield	Boiler house	St Swithins Court, Ferry Lane in Stanley	WF3 4QA
York	-	None	-

Table 82 District heating networks in Yorkshire and Humber