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Building Engineering - Sustainability

Local Government Yorkshire and Humber

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Low carbon and renewable energy capacity in Yorkshire and Humber

Final report

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1	Draft issued to DECC	APA	15.02.11	SW	15.02.11
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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

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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).

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A.6.7 Renewable energy pathway modelling

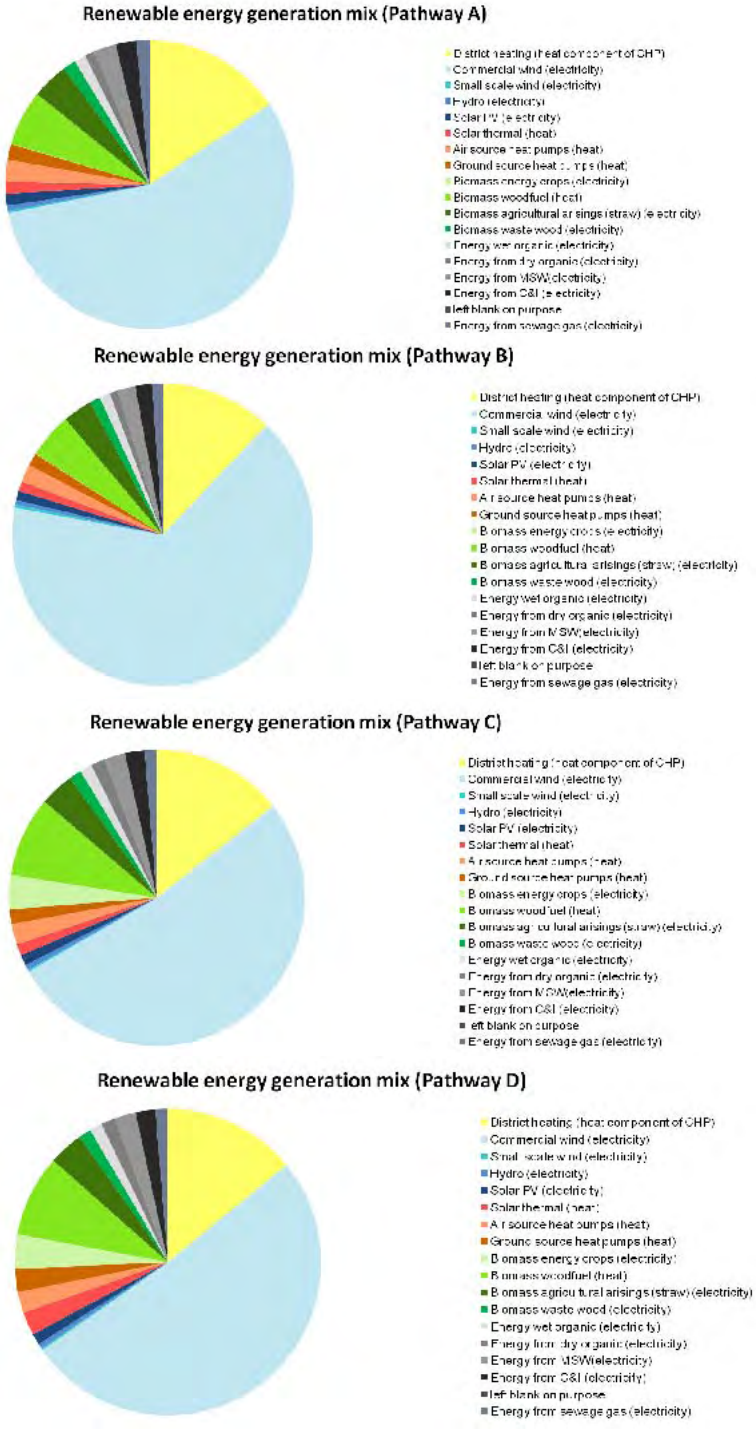

Figure 59 Breakdown of renewable energy for scenario modelling

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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

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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

Capabilities on project:
Building Engineering - Sustainability

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

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.

Capabilities on project:
Building Engineering - Sustainability

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.

Capabilities on project:
Building Engineering - Sustainability

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

Capabilities on project:
Building Engineering - Sustainability

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

Capabilities on project:
Building Engineering - Sustainability

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.

Capabilities on project:
Building Engineering - Sustainability

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

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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

Capabilities on project:
Building Engineering - Sustainability

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:

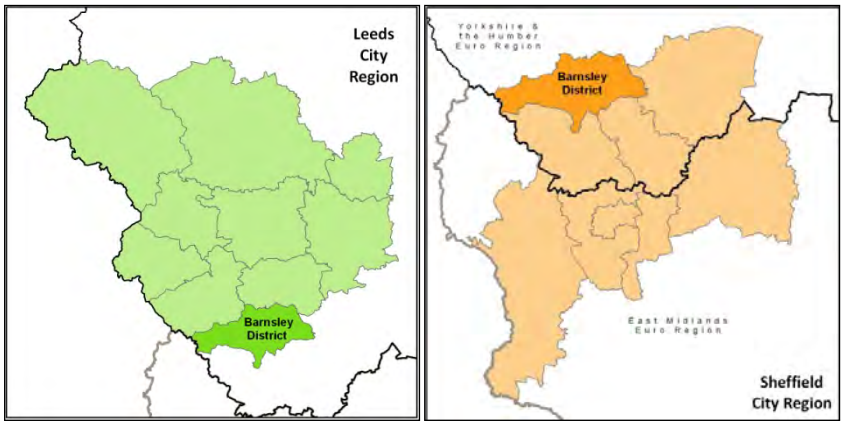
- Co-firing resource
- Offshore technologies.

Capabilities on project:
Building Engineering - Sustainability

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

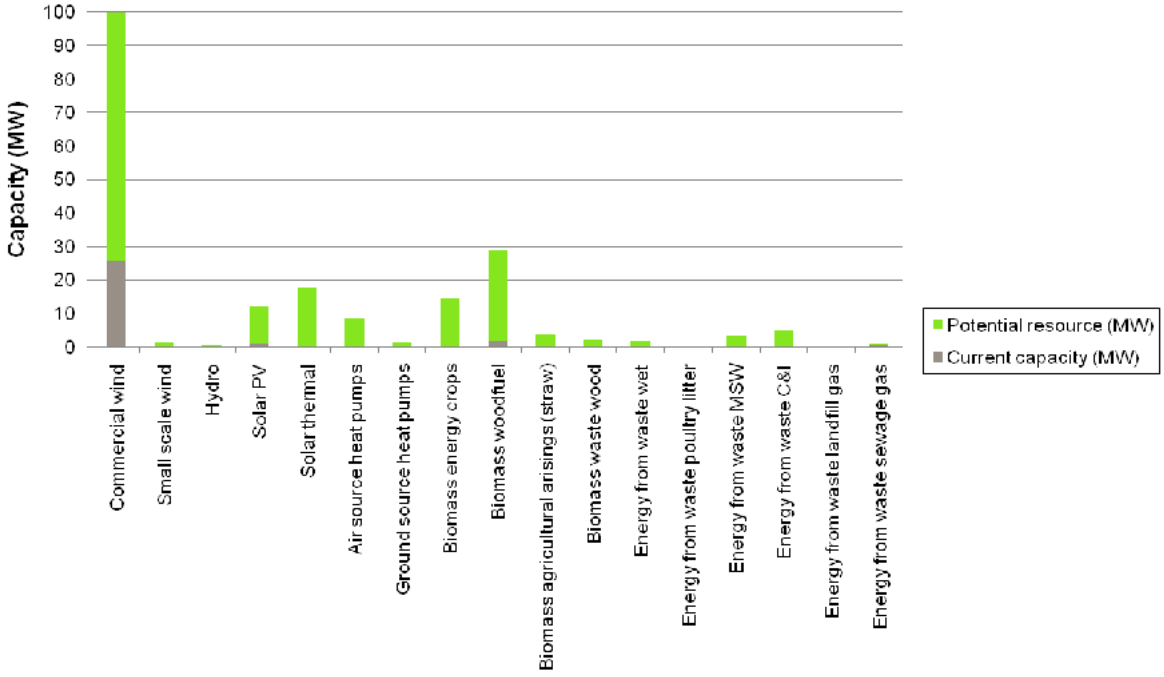


Figure 60 Current capacity and renewable energy resource in Barnsley. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

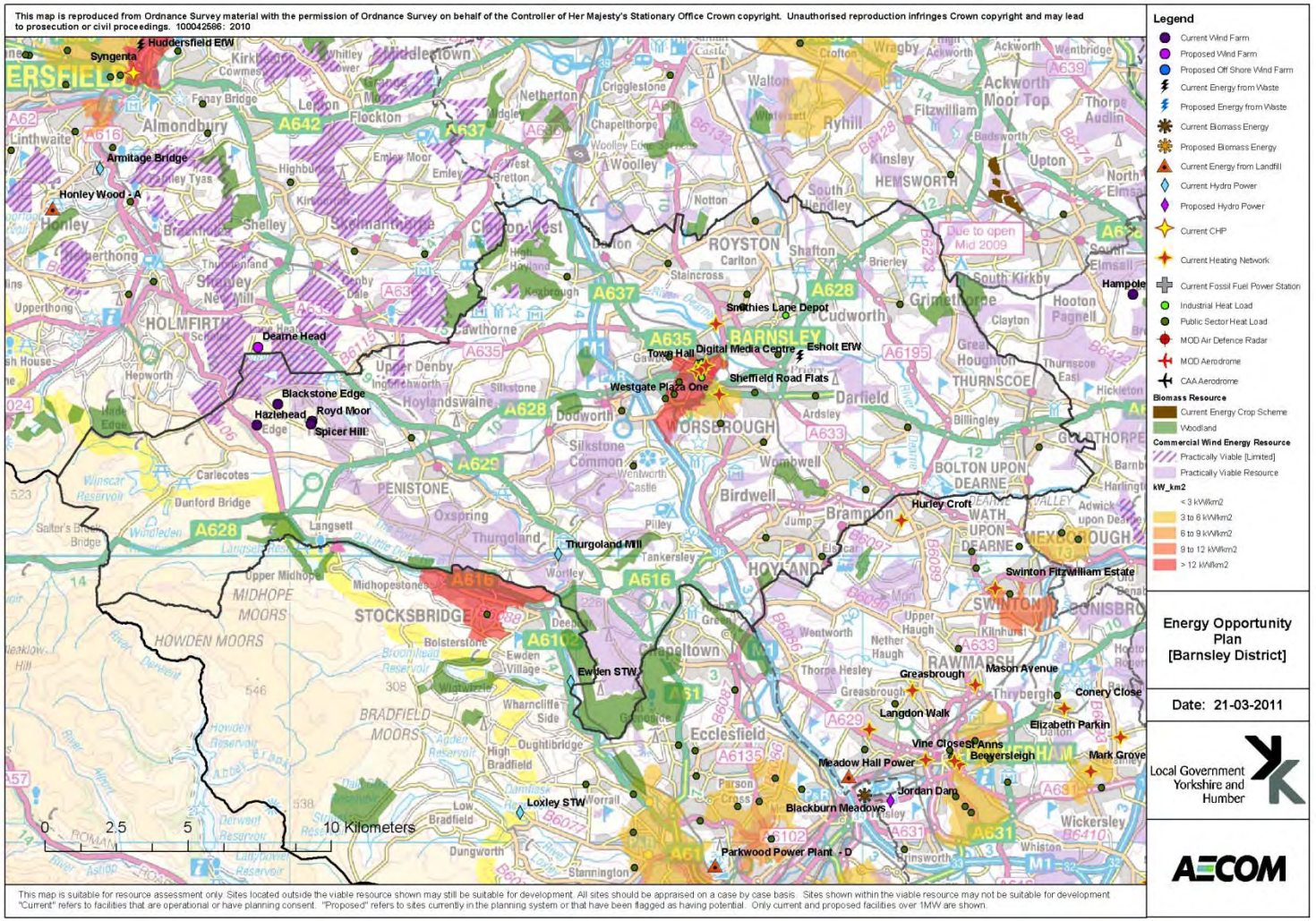


Figure 61 Energy opportunities plan for Barnsley. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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.

Capabilities on project:
Building Engineering - Sustainability

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

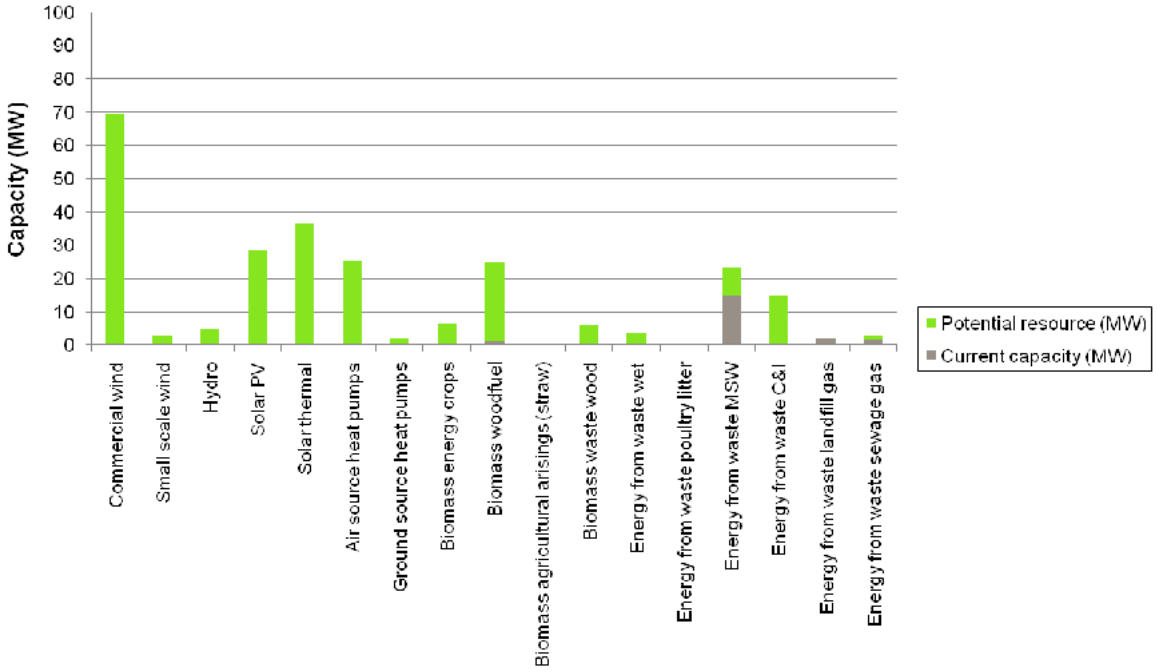


Figure 62 Current capacity and renewable energy resource in Bradford. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

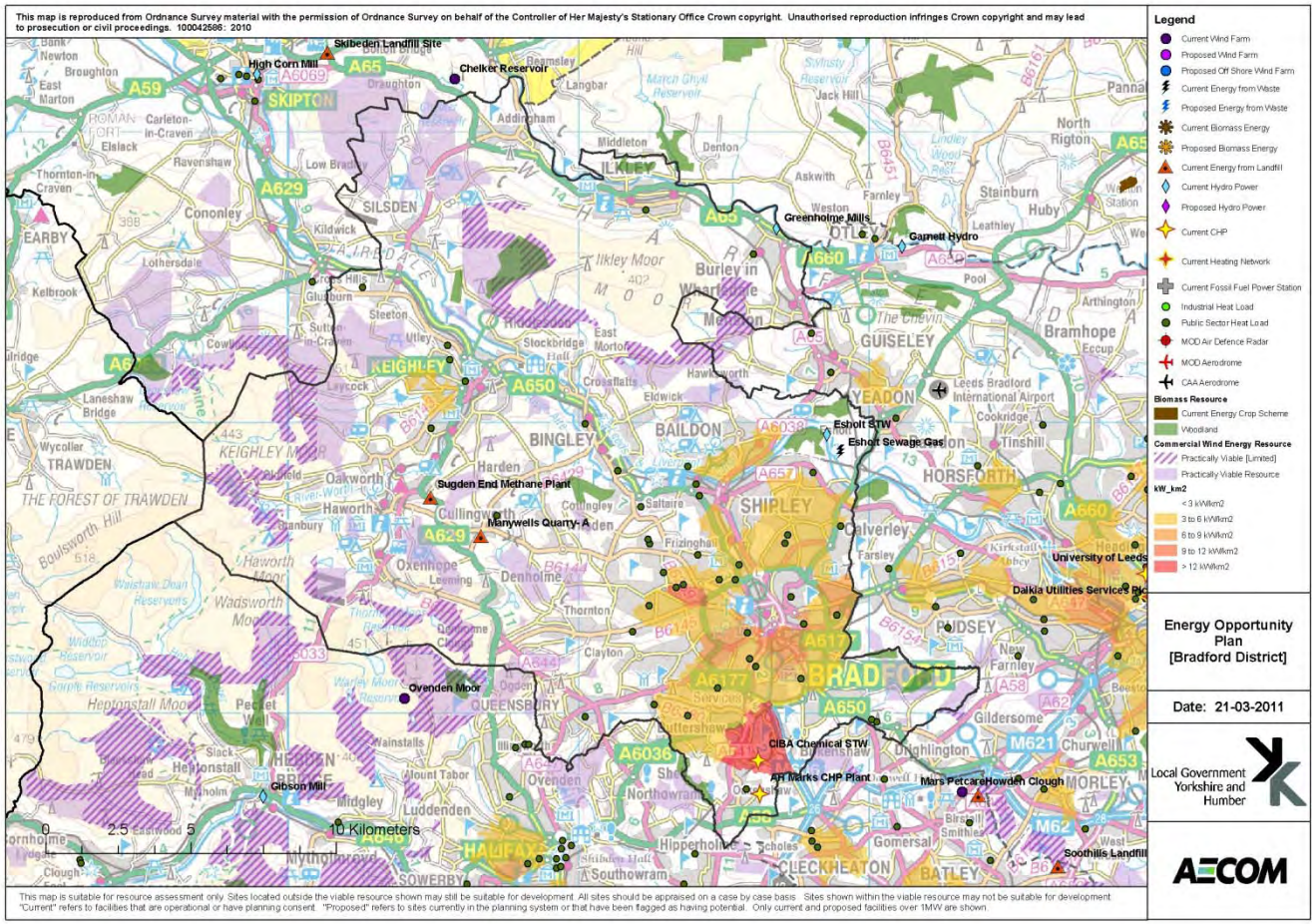


Figure 63 Energy opportunities plan for Bradford. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

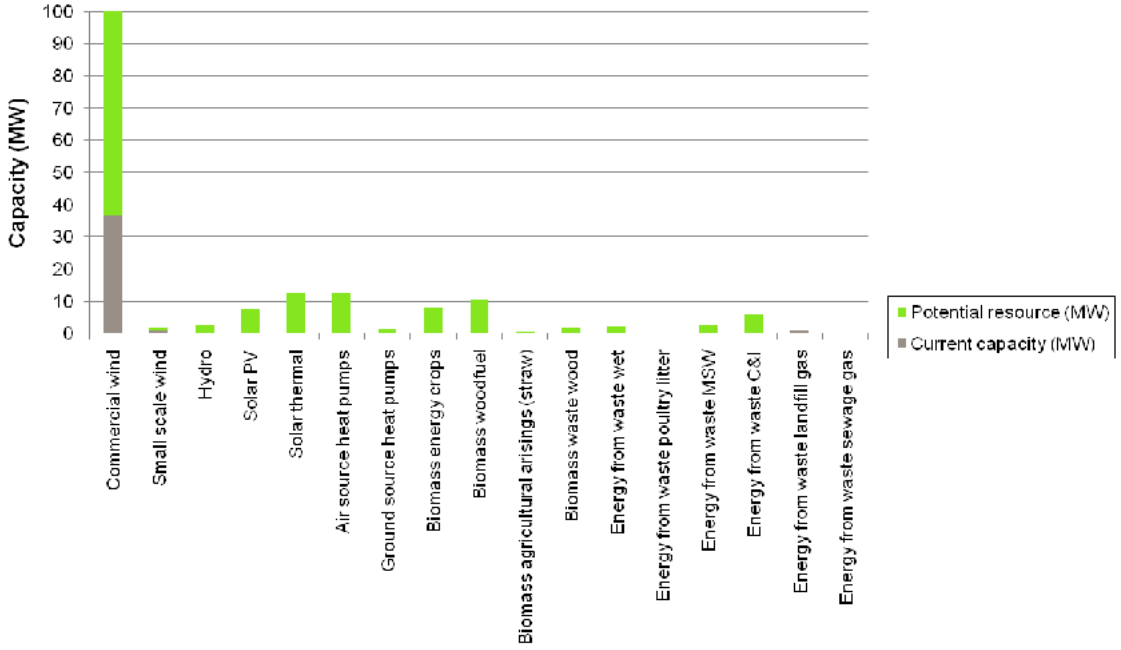


Figure 64 Current capacity and renewable energy resource in Calderdale. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

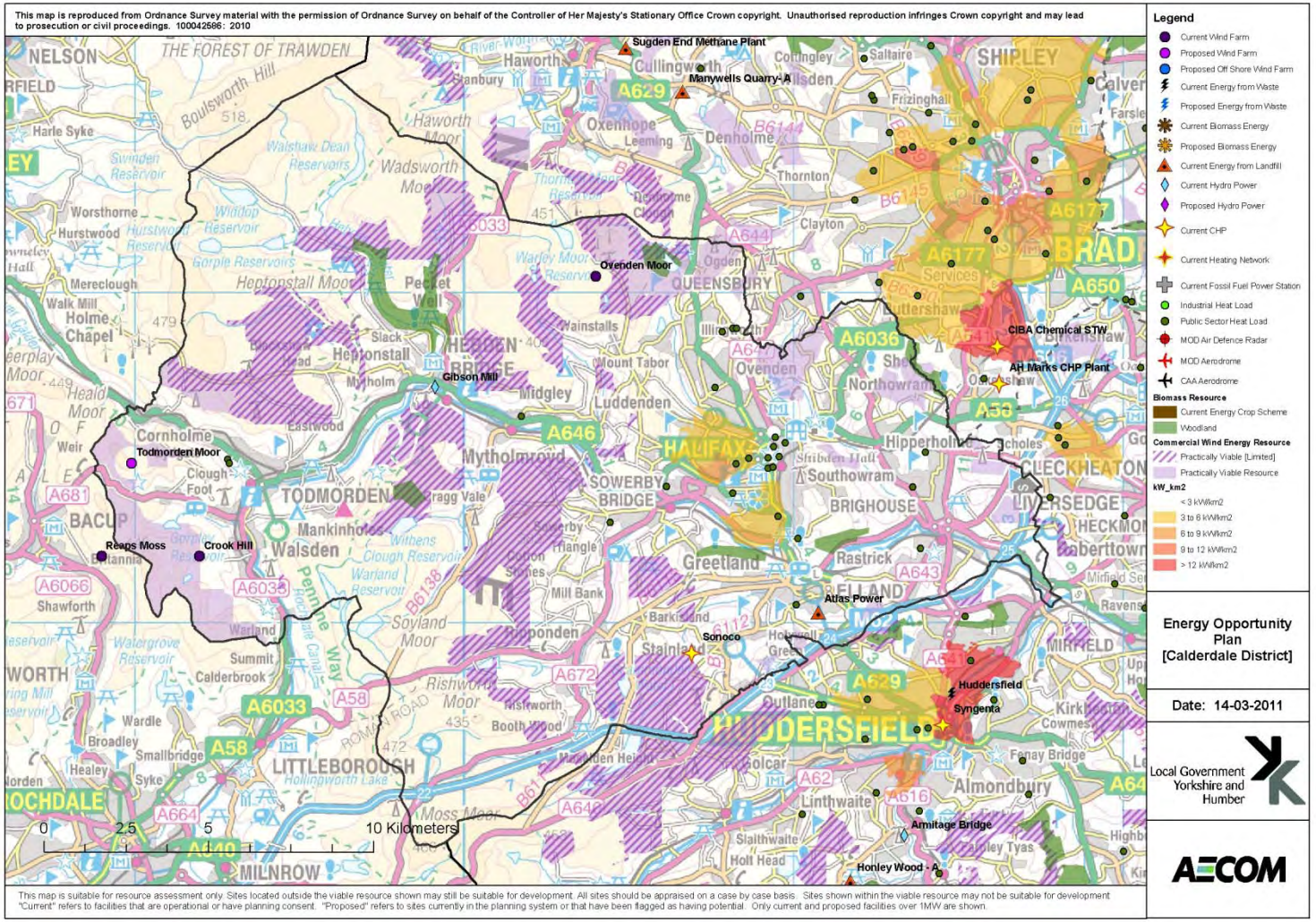
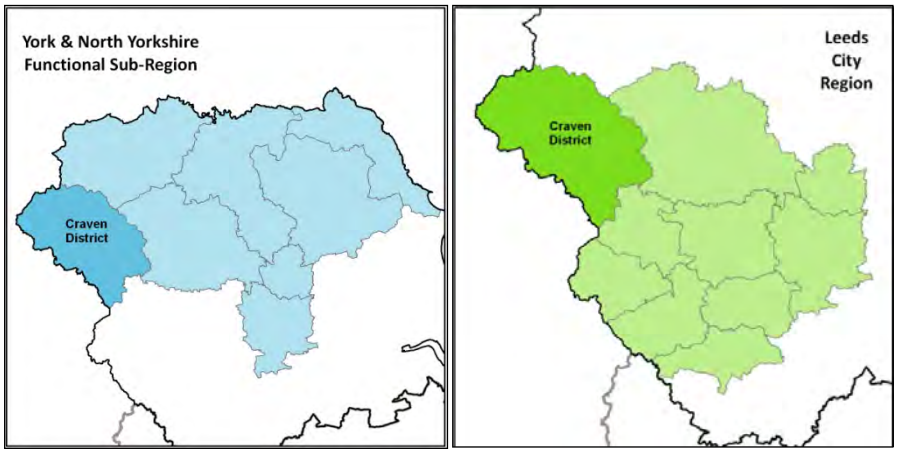


Figure 65 Energy opportunities plan for Calderdale. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

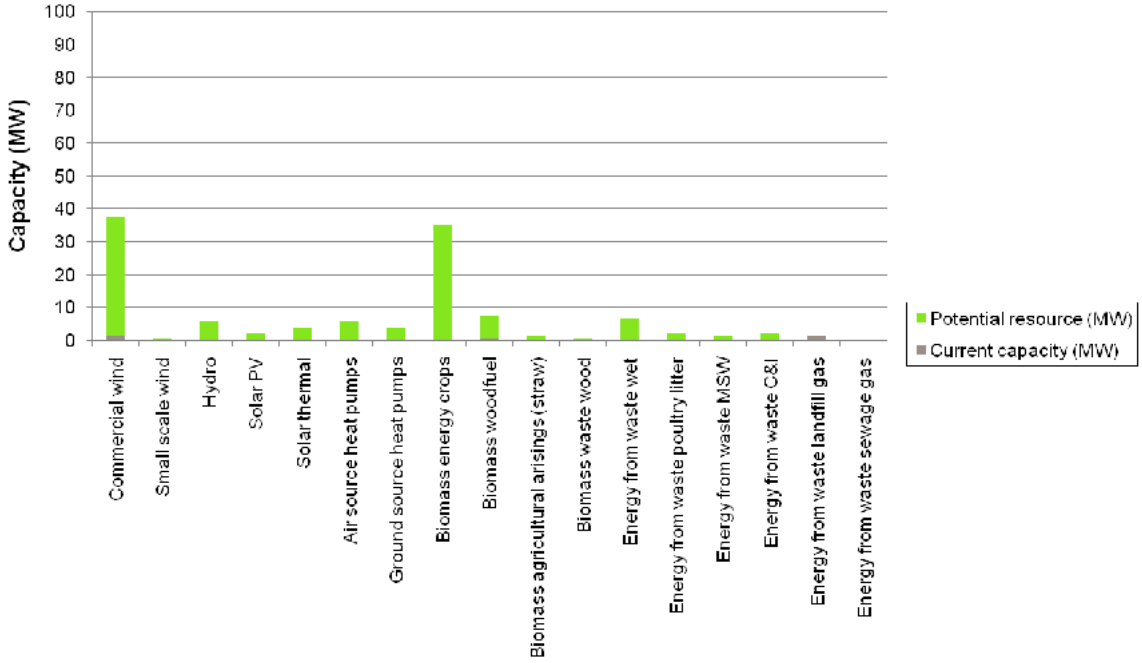


Figure 66 Current capacity and renewable energy resource in Craven. Current" refers to facilities that are operational or have planning consent.

Capabilities on project:
Building Engineering - Sustainability

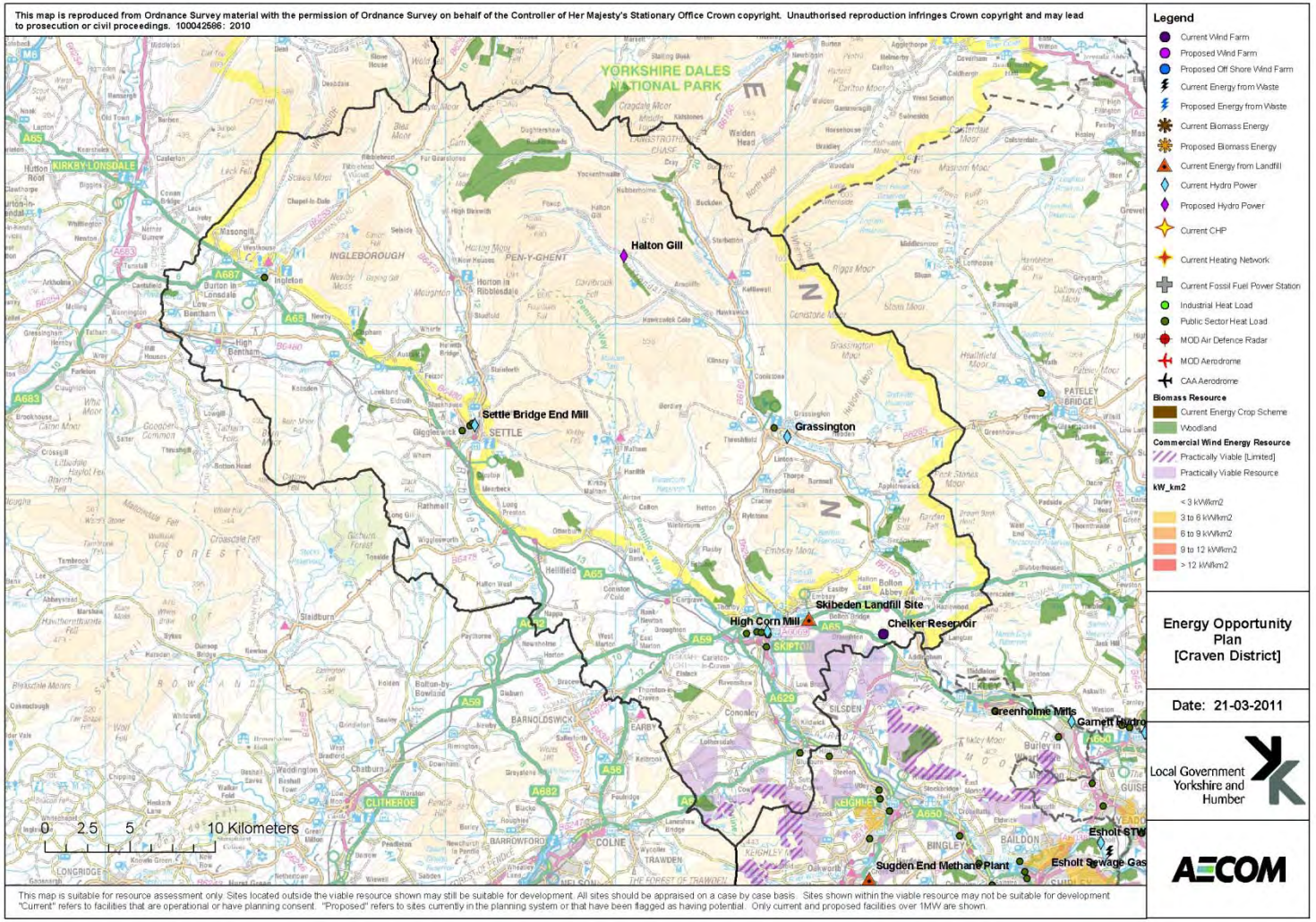


Figure 67 Energy opportunities plan for Craven. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

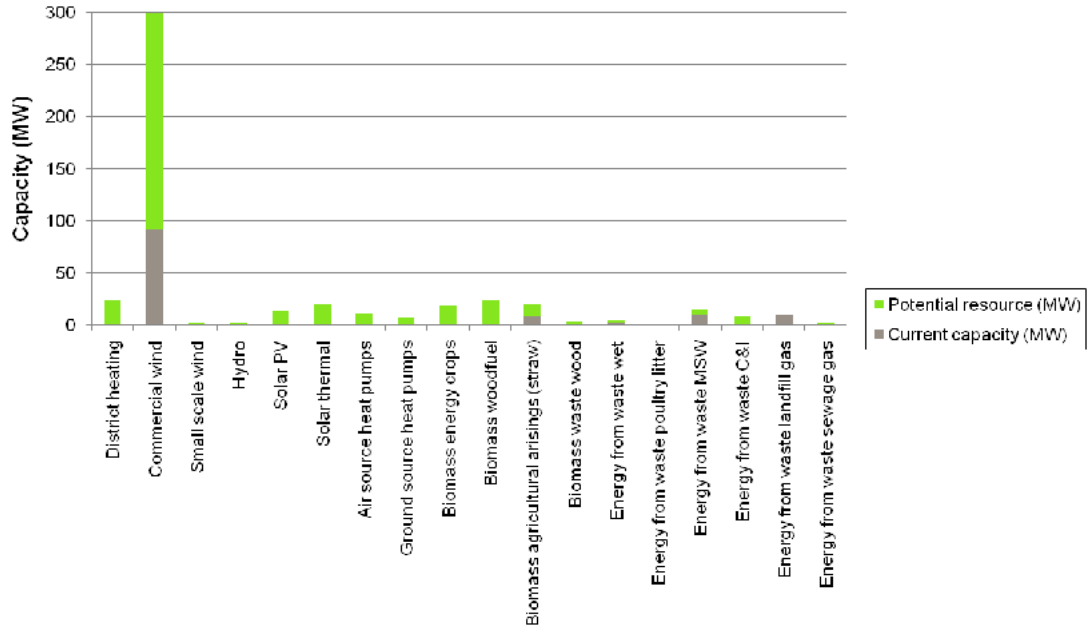


Figure 68 Current capacity and renewable energy resource in Doncaster. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

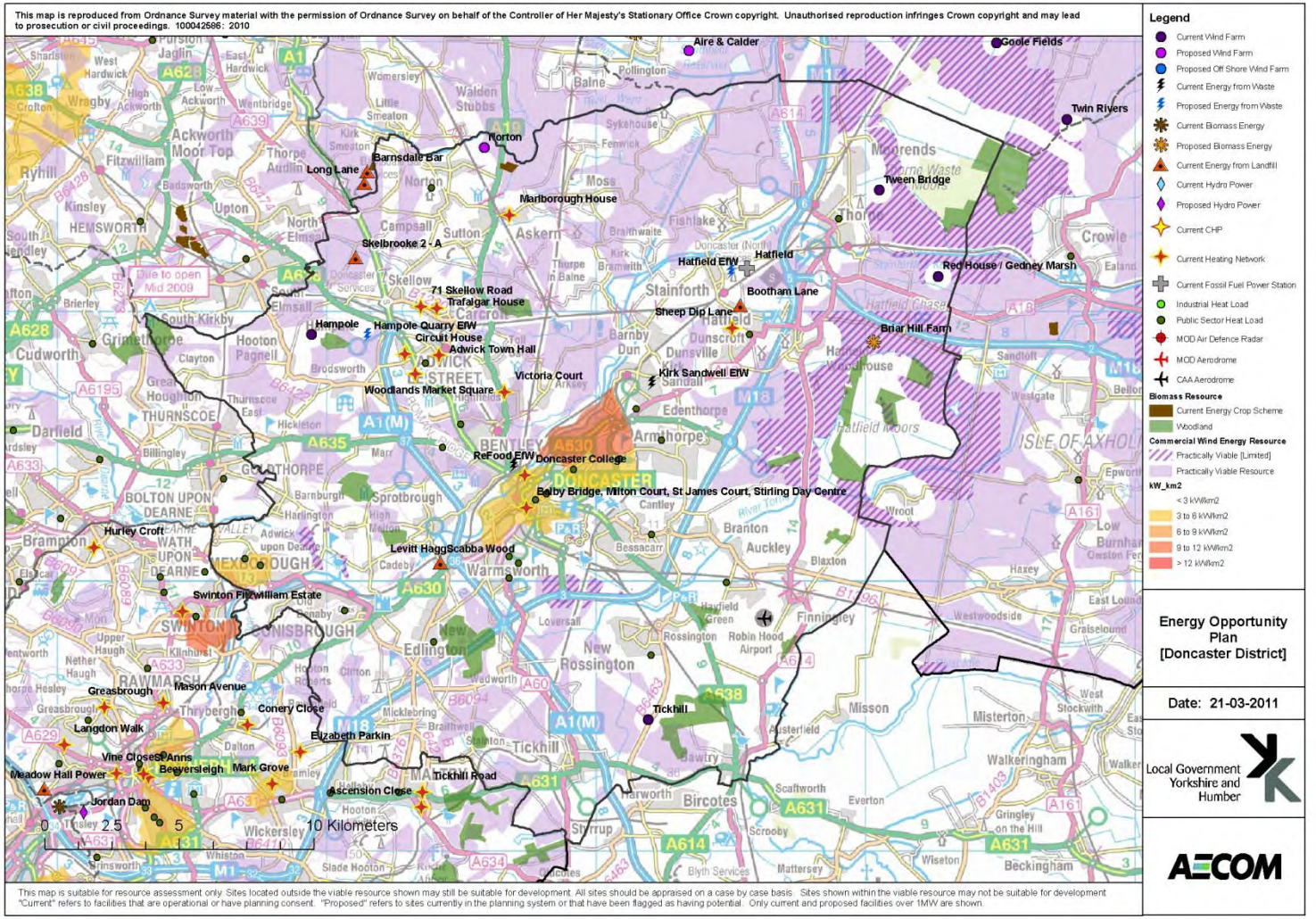


Figure 69 Energy opportunities plan for Doncaster. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

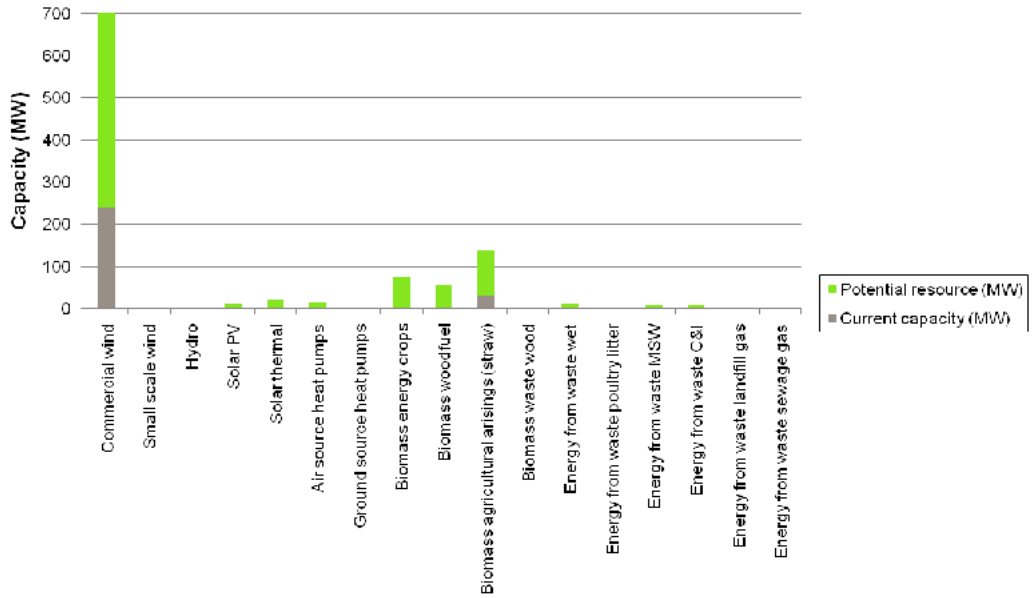


Figure 70 Current capacity and renewable energy resource in East Riding. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

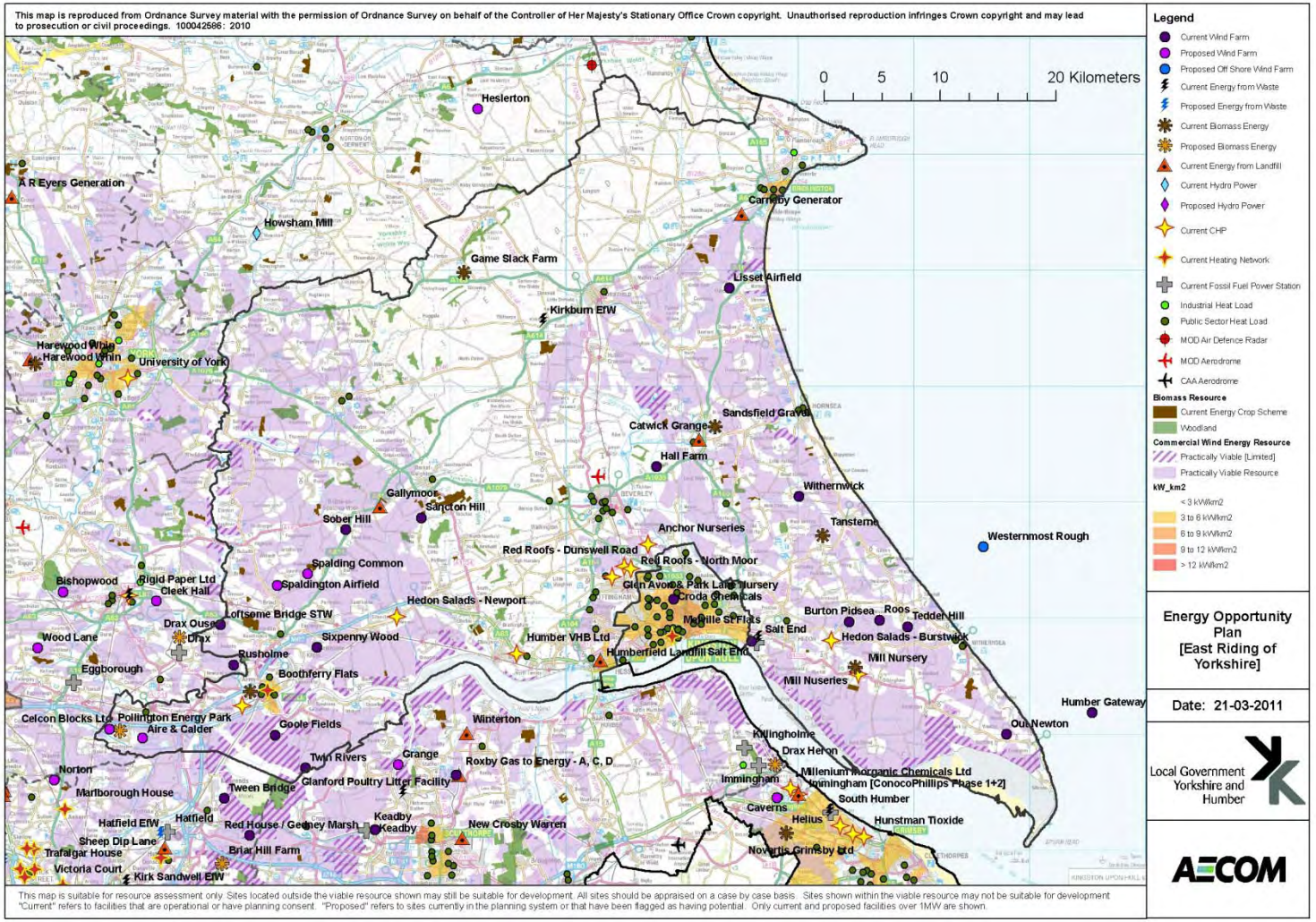


Figure 71 Energy opportunities plan for East Riding of Yorkshire. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only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

Capabilities on project:
Building Engineering - Sustainability

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

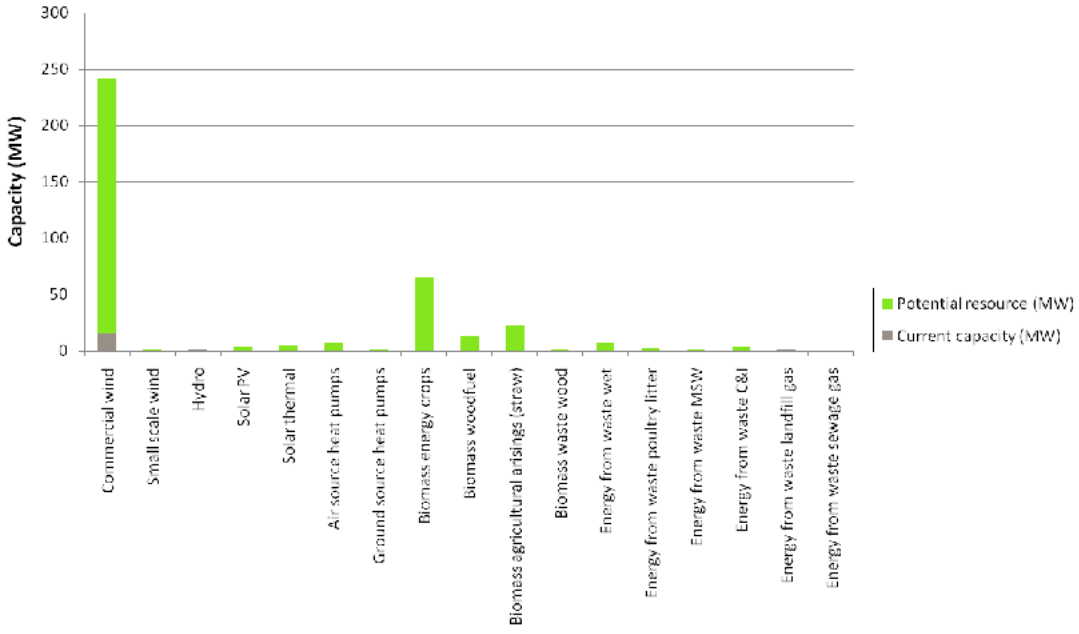


Figure 72 Current capacity and renewable energy resource in Hambleton. Current" refers to facilities that are operational or have planning consent.

Capabilities on project:
Building Engineering - Sustainability

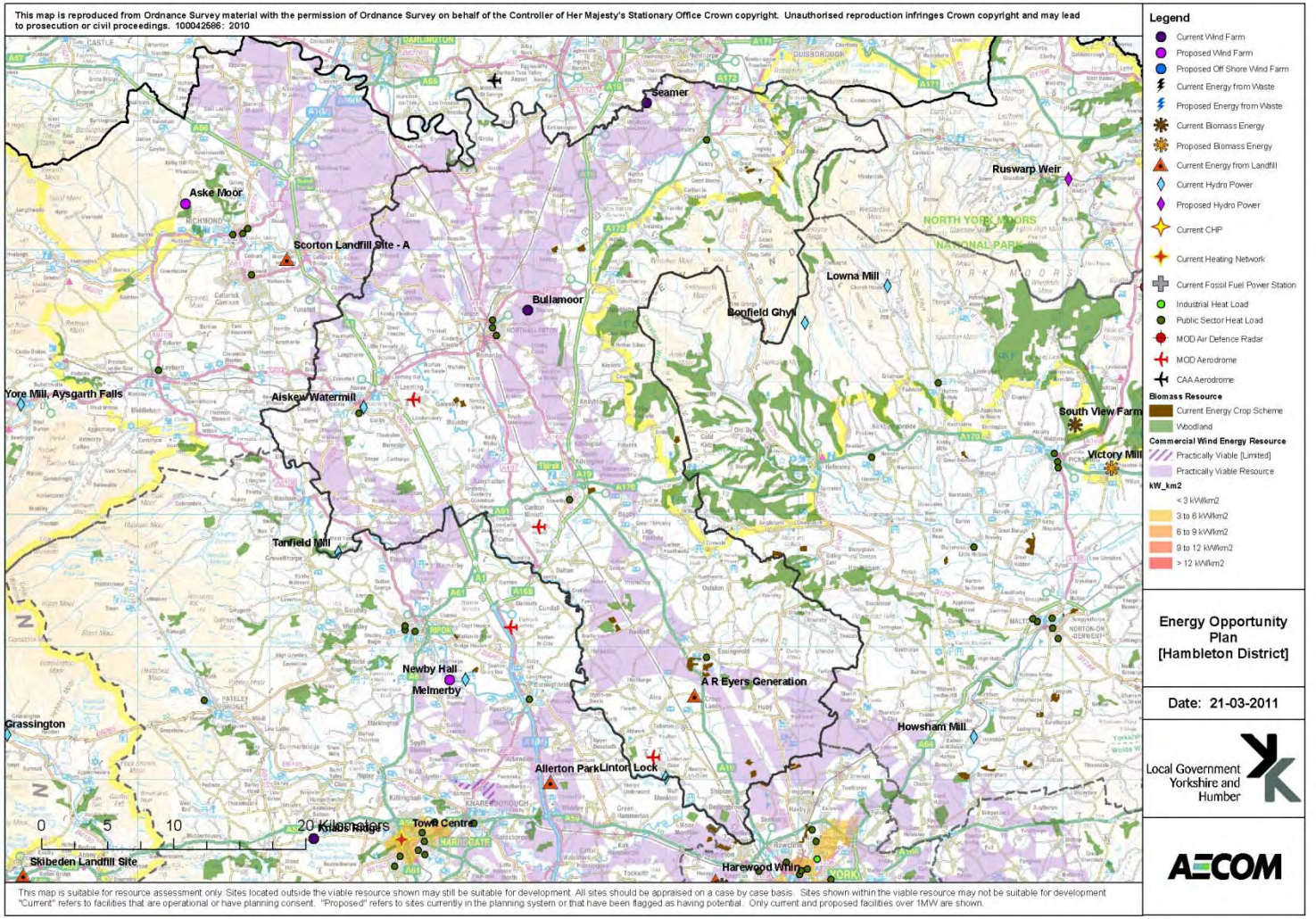


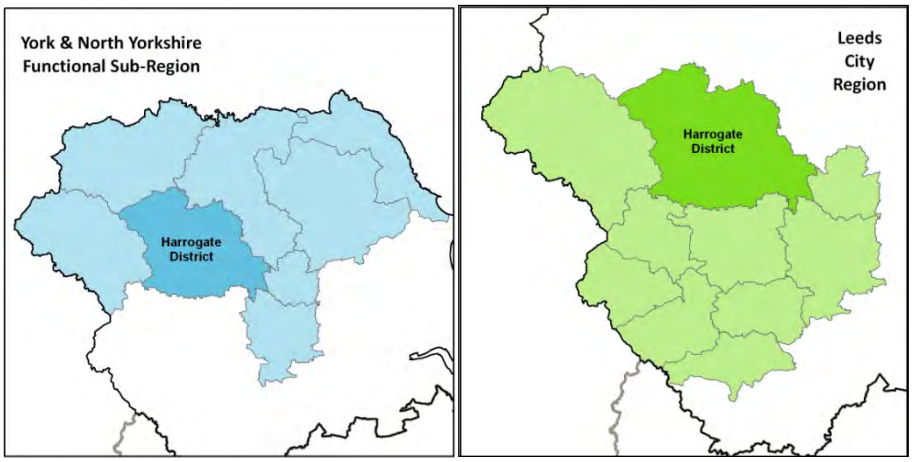
Figure 73 Energy opportunities plan for Hambleton. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

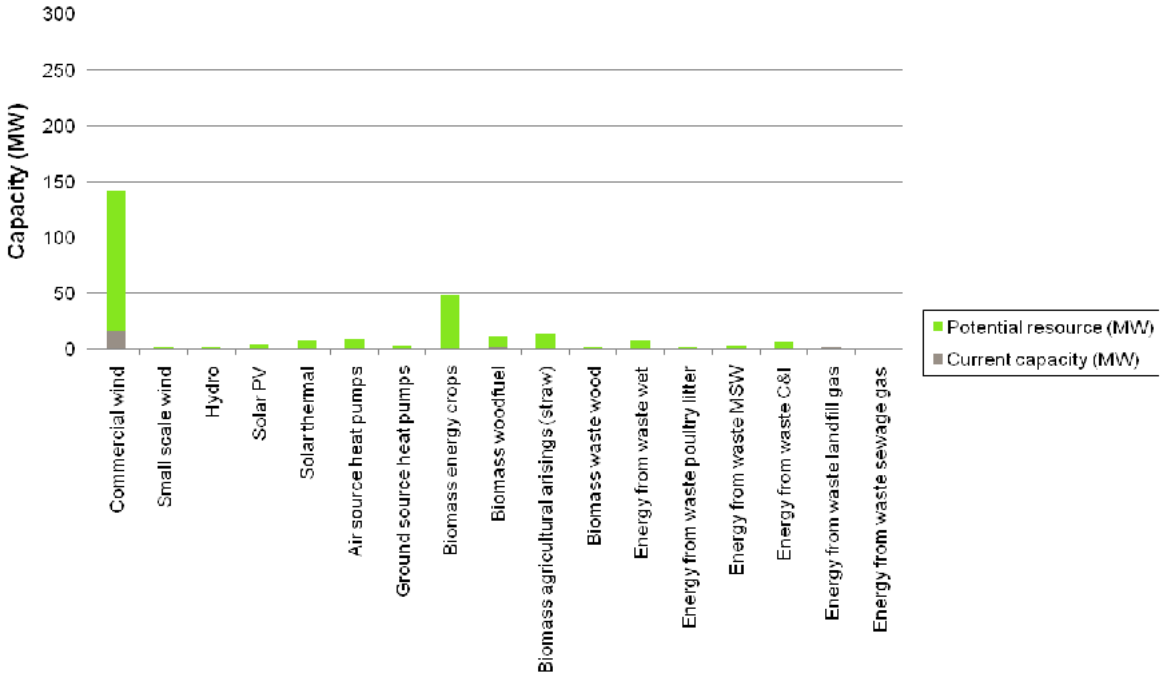


Figure 74 Current capacity and renewable energy resource in Harrogate. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

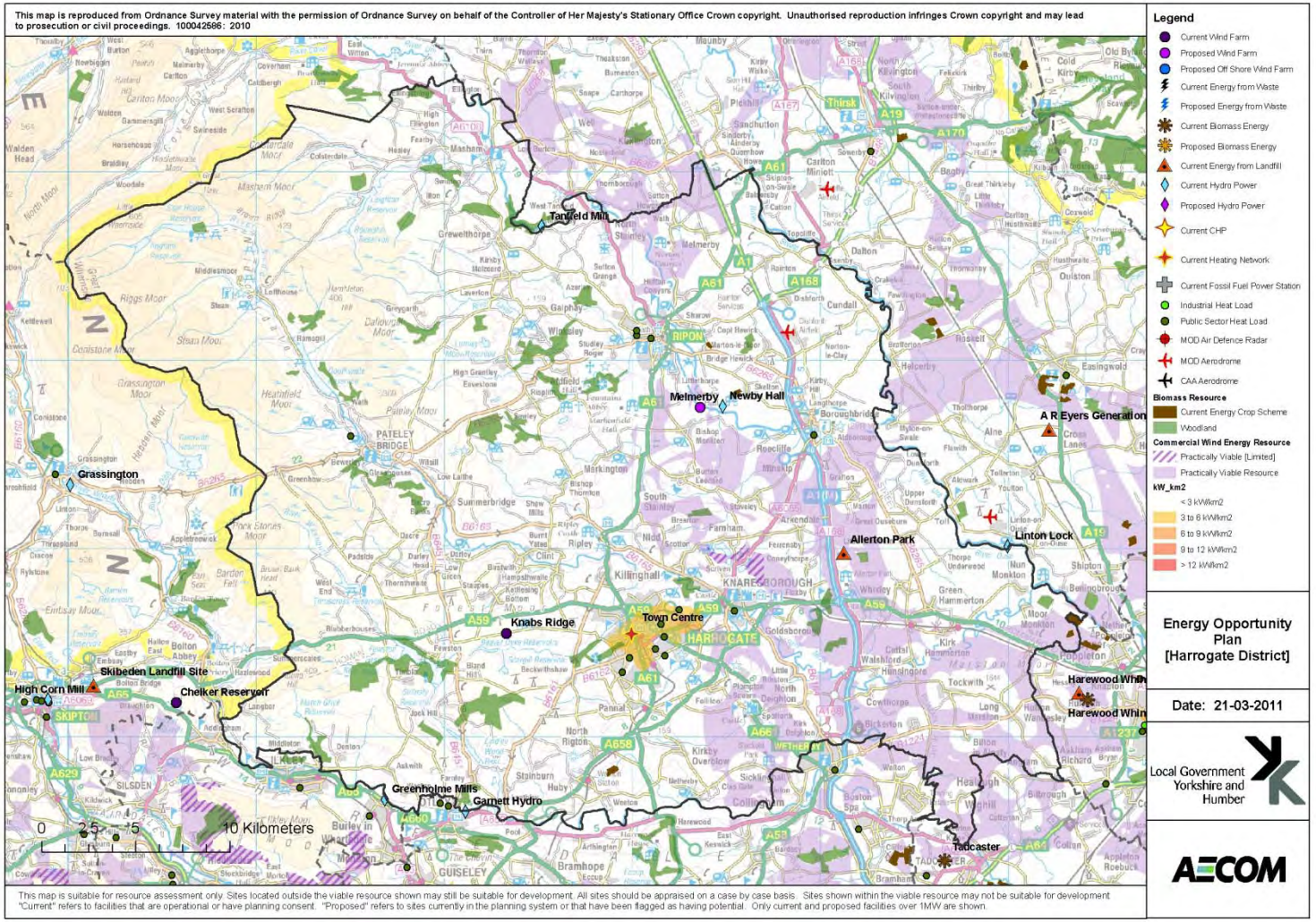


Figure 75 Energy opportunities plan for Harrogate. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

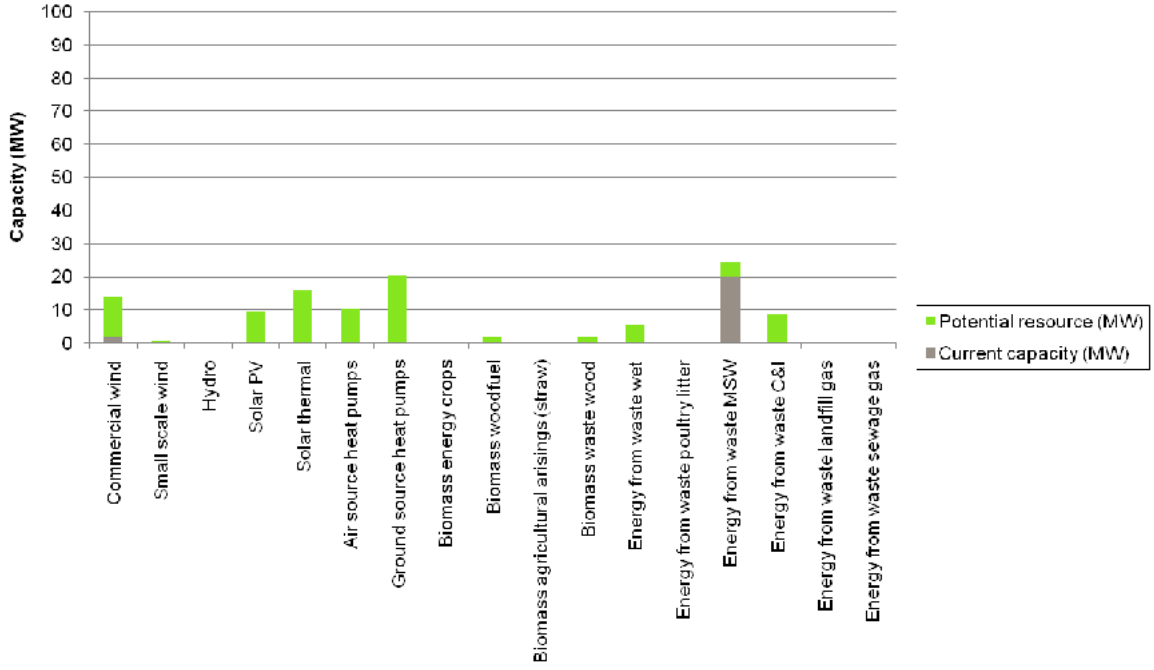


Figure 76 Current capacity and renewable energy resource in Hull. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

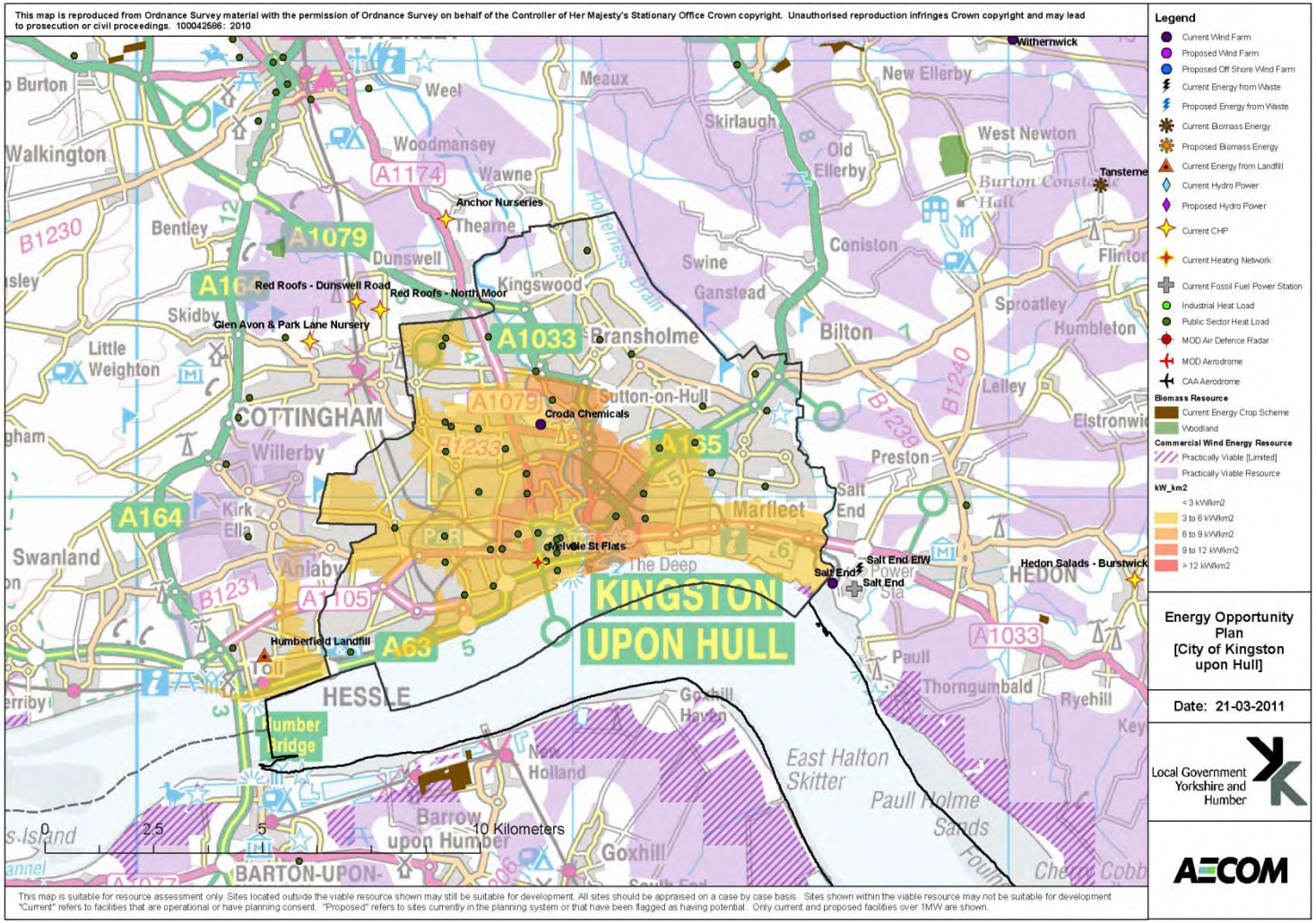


Figure 77 Energy opportunities plan for City of Kingston Upon Hull. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only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

Capabilities on project:
Building Engineering - Sustainability

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

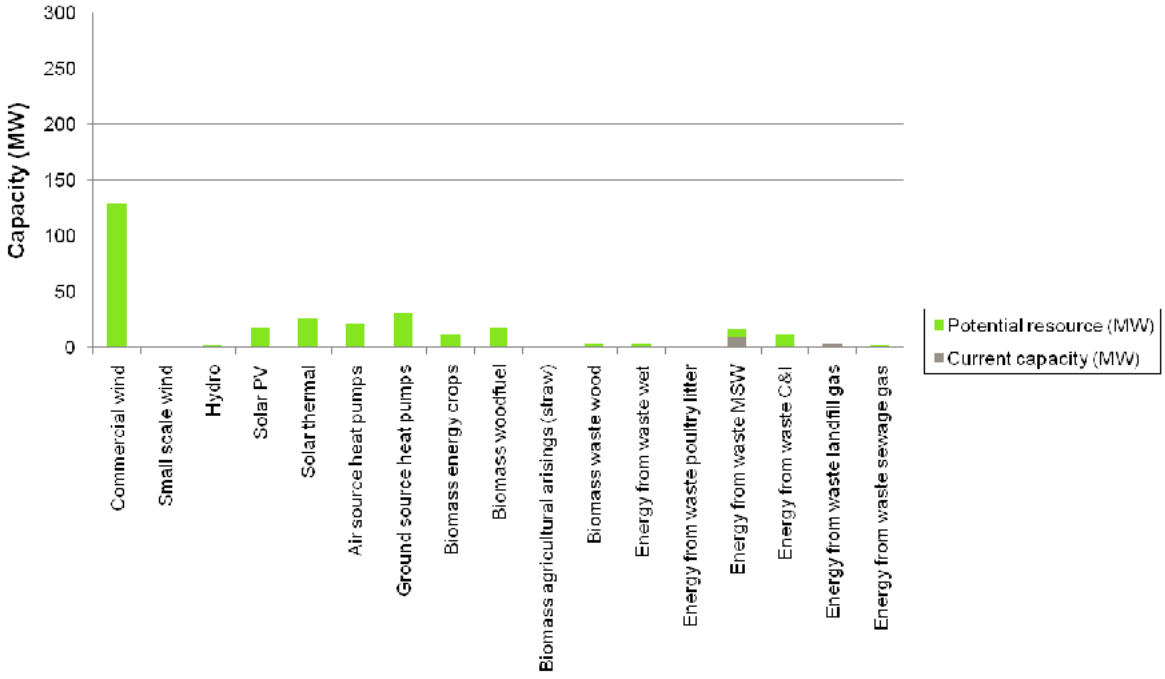


Figure 78 Current capacity and renewable energy resource in Kirklees. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

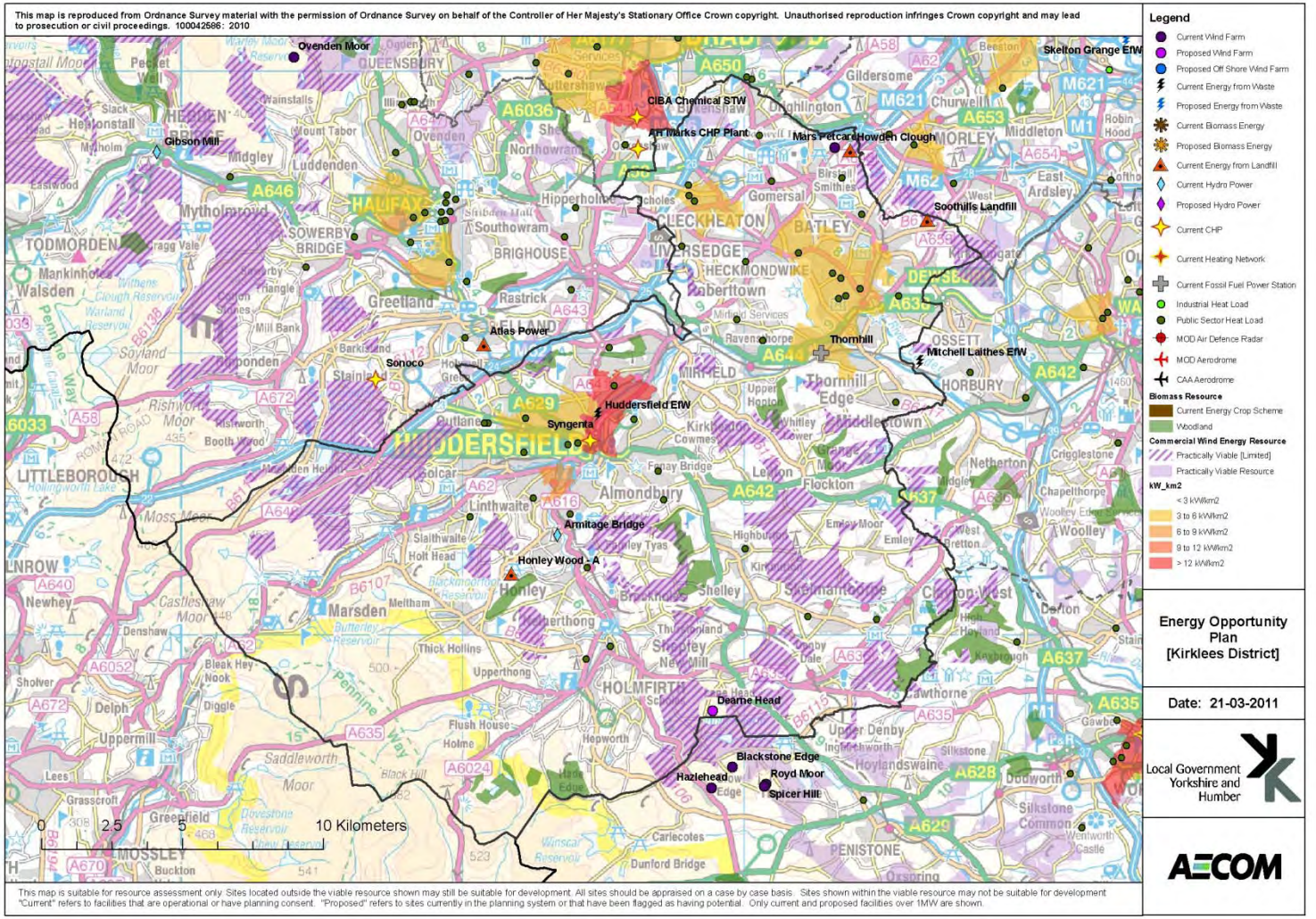


Figure 79 Energy opportunities plan for Kirklees. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

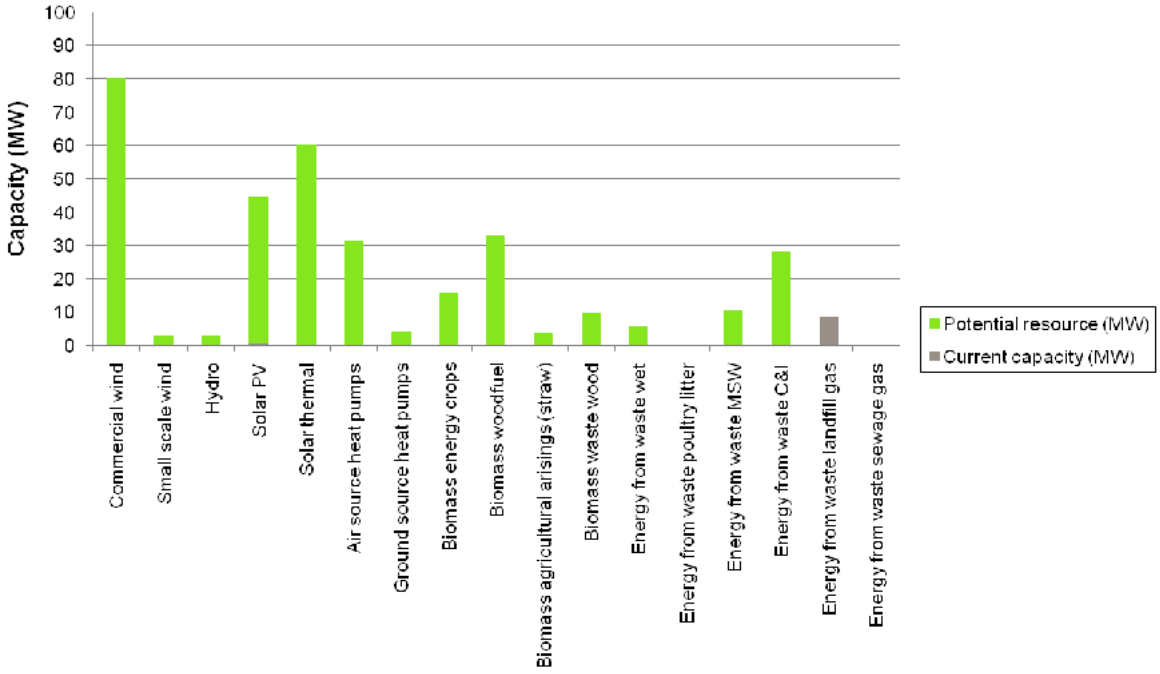


Figure 80 Current capacity and renewable energy resource in Leeds. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

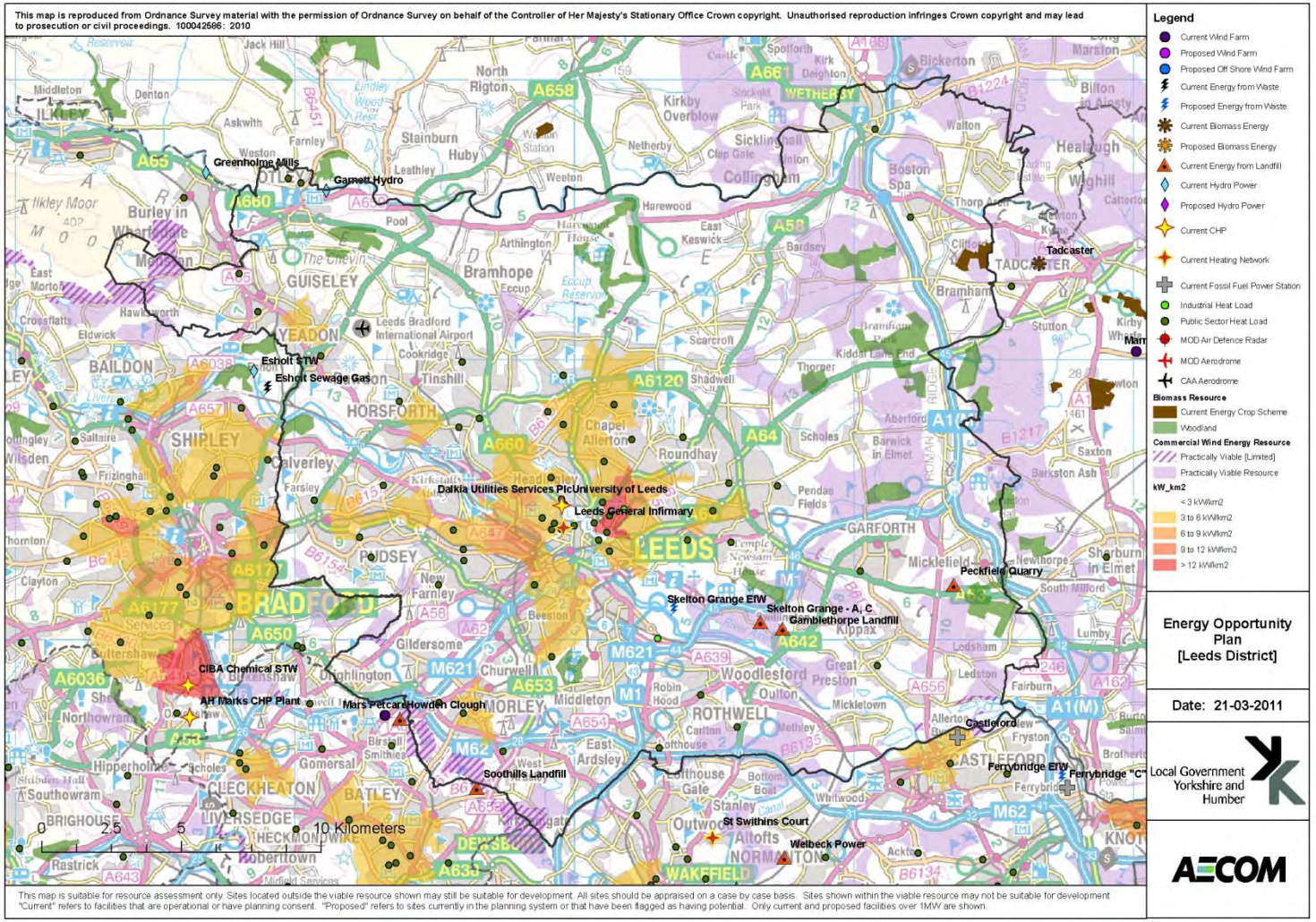


Figure 81 Energy opportunities plan for Leeds. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

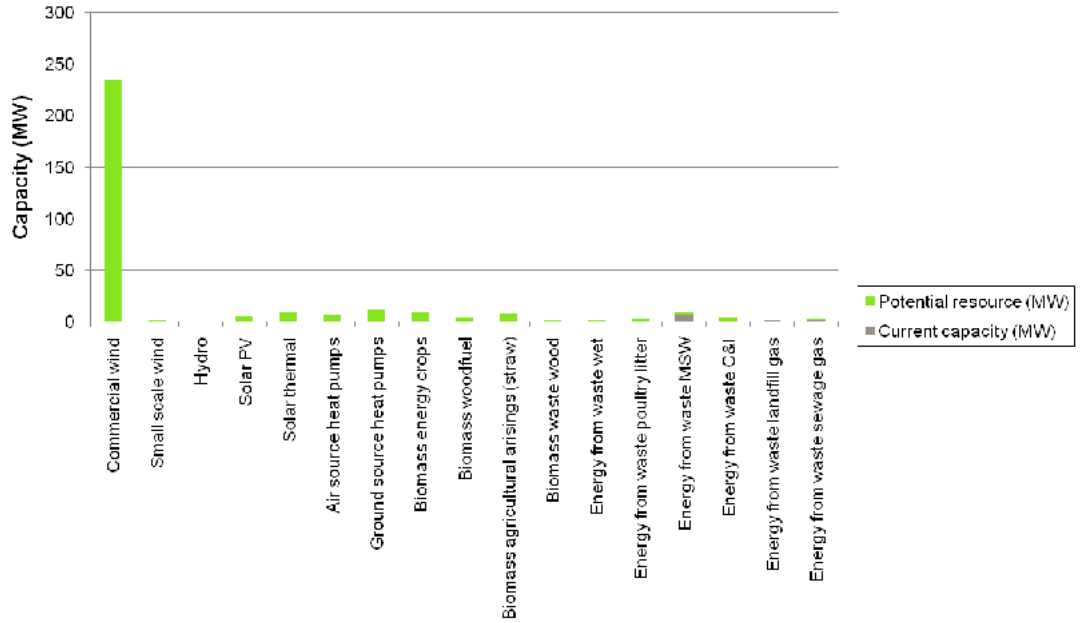


Figure 82 Current capacity and renewable energy resource in North East Lincolnshire. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

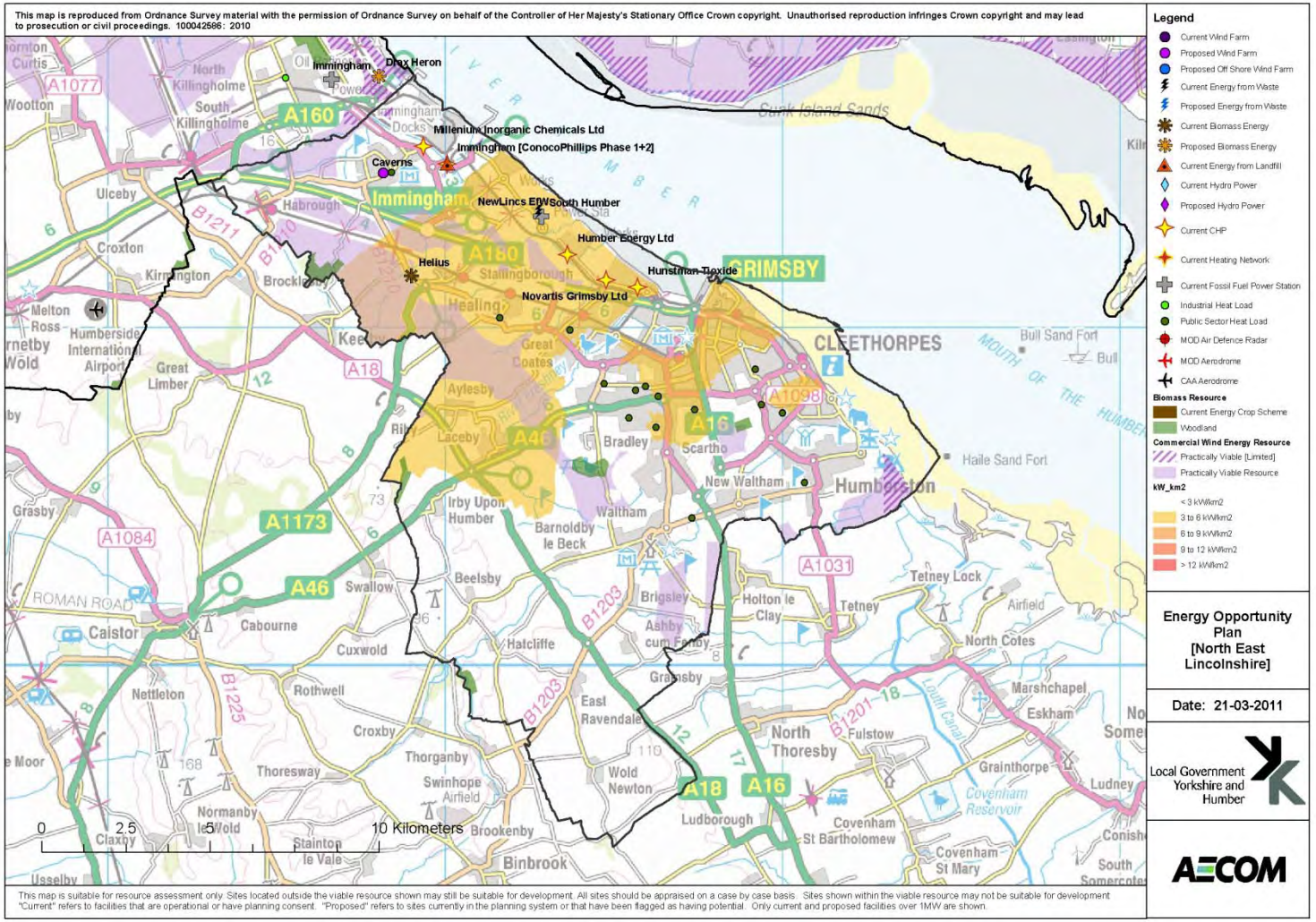


Figure 83 Energy opportunities plan for North East Lincolnshire. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only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

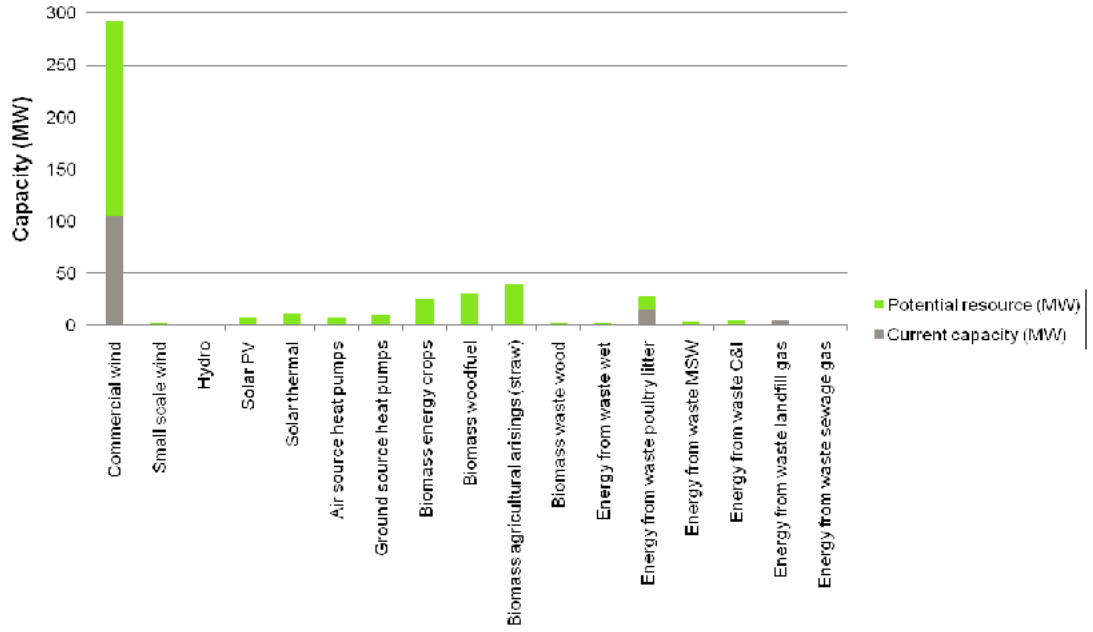


Figure 84 Current capacity and renewable energy resource in North Lincolnshire. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

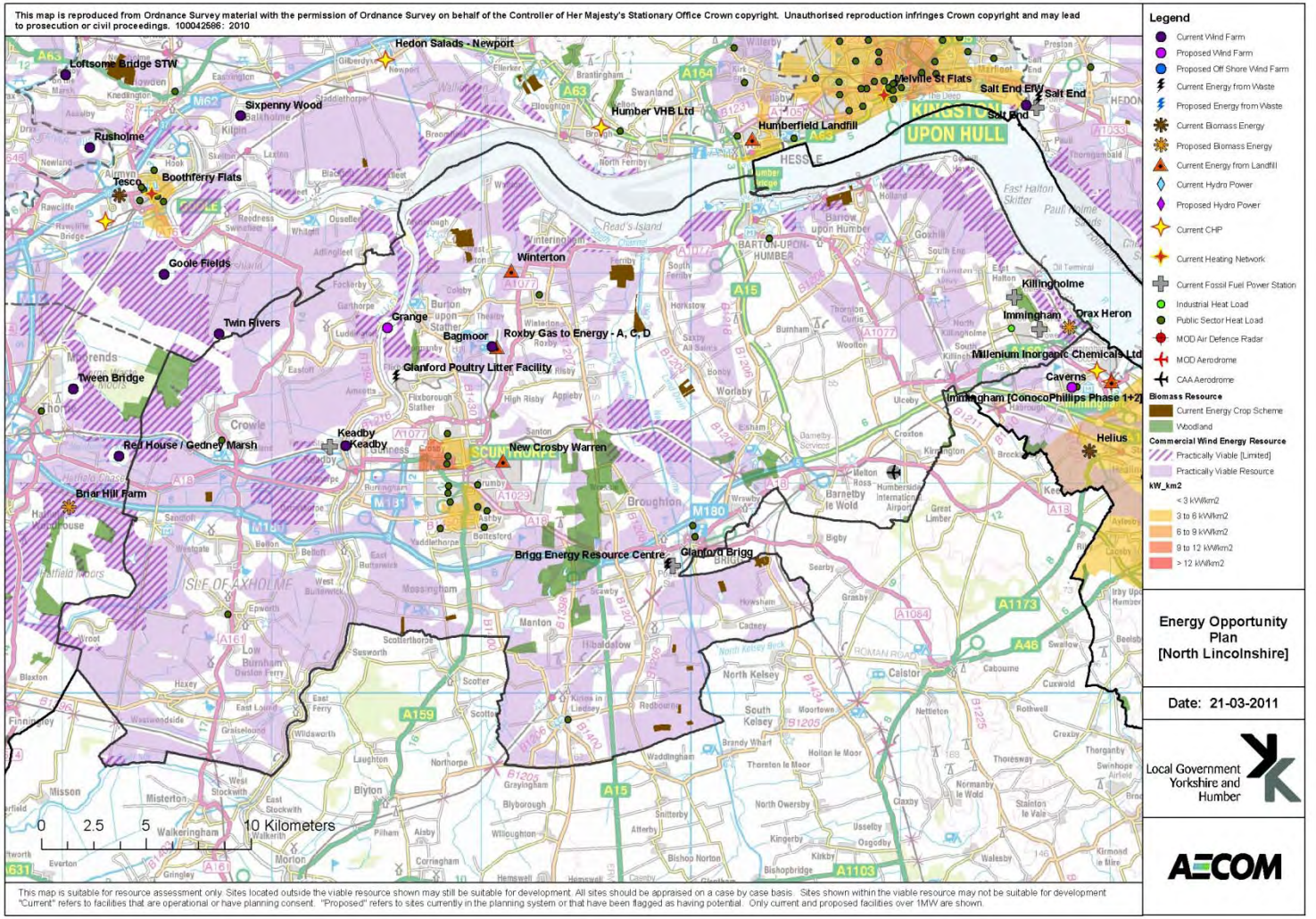


Figure 85 Energy opportunities plan for North Lincolnshire. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current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

Capabilities on project:
Building Engineering - Sustainability

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

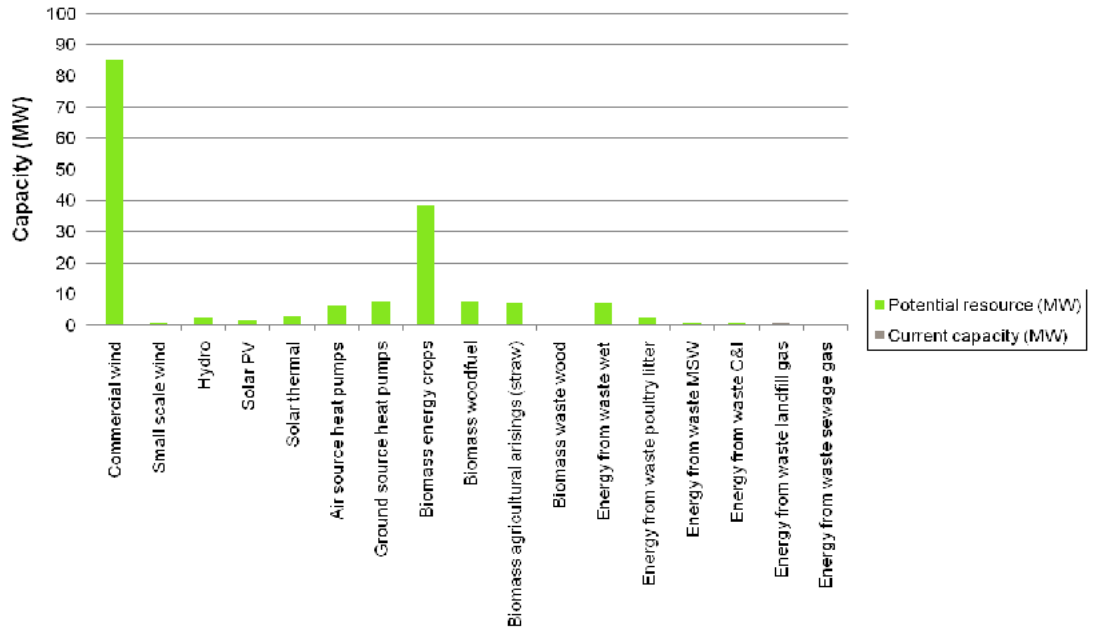


Figure 86 Current capacity and renewable energy resource in Richmondshire. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

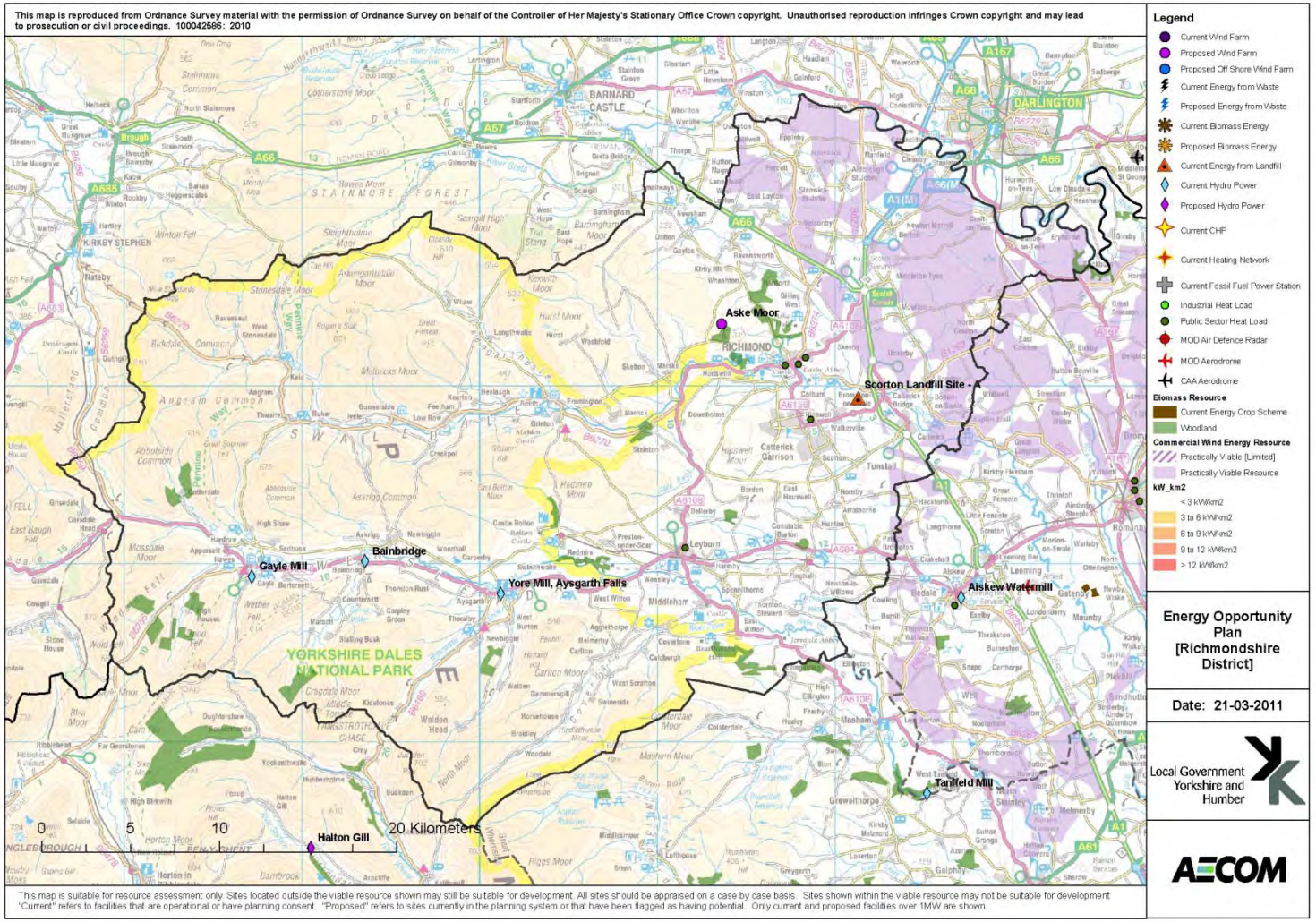


Figure 87 Energy opportunities plan for Richmondshire. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and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

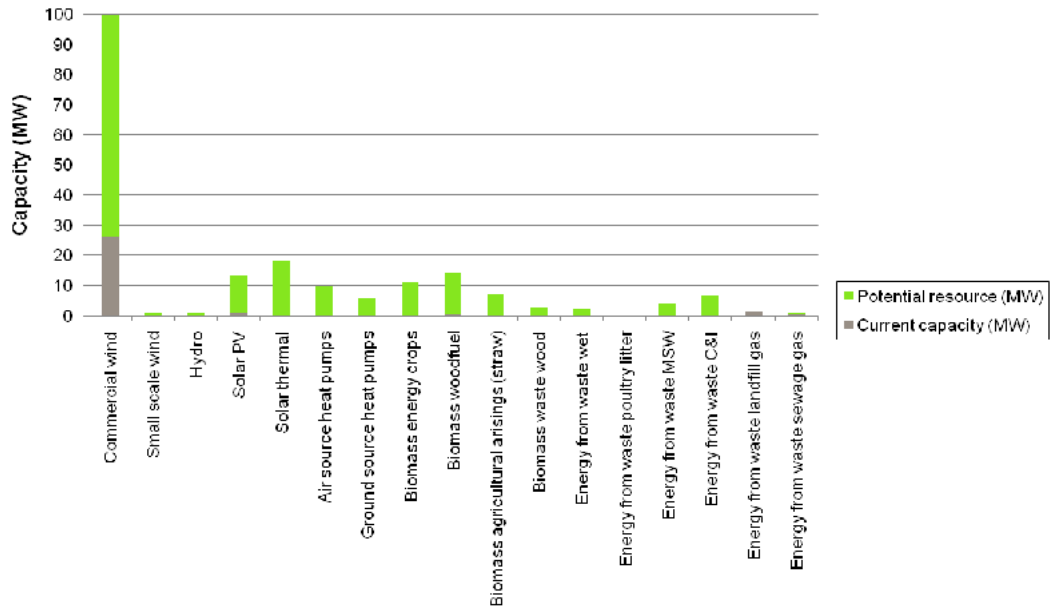


Figure 88 Current capacity and renewable energy resource in Rotherham. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

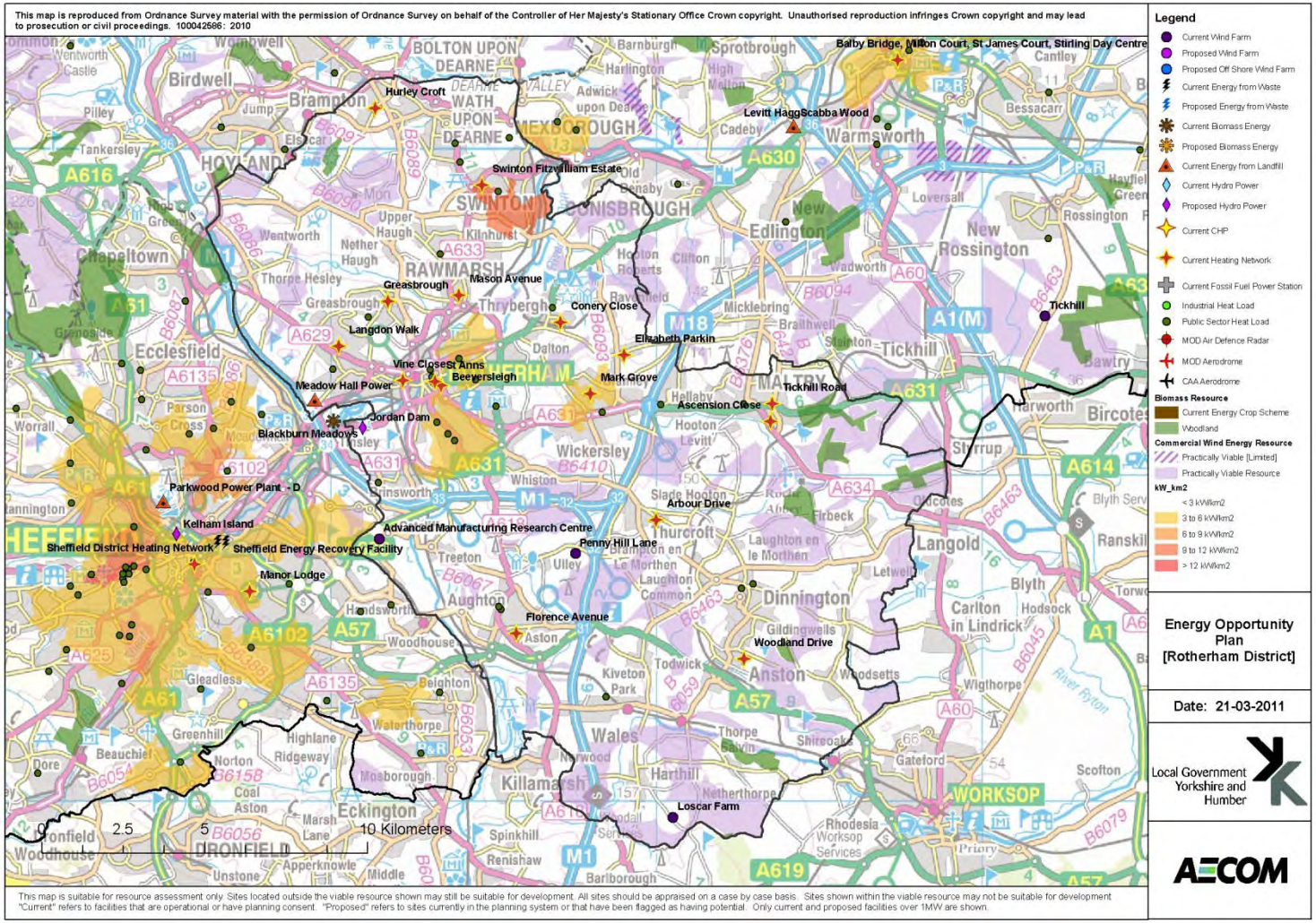


Figure 89 Energy opportunities plan for Rotherham. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

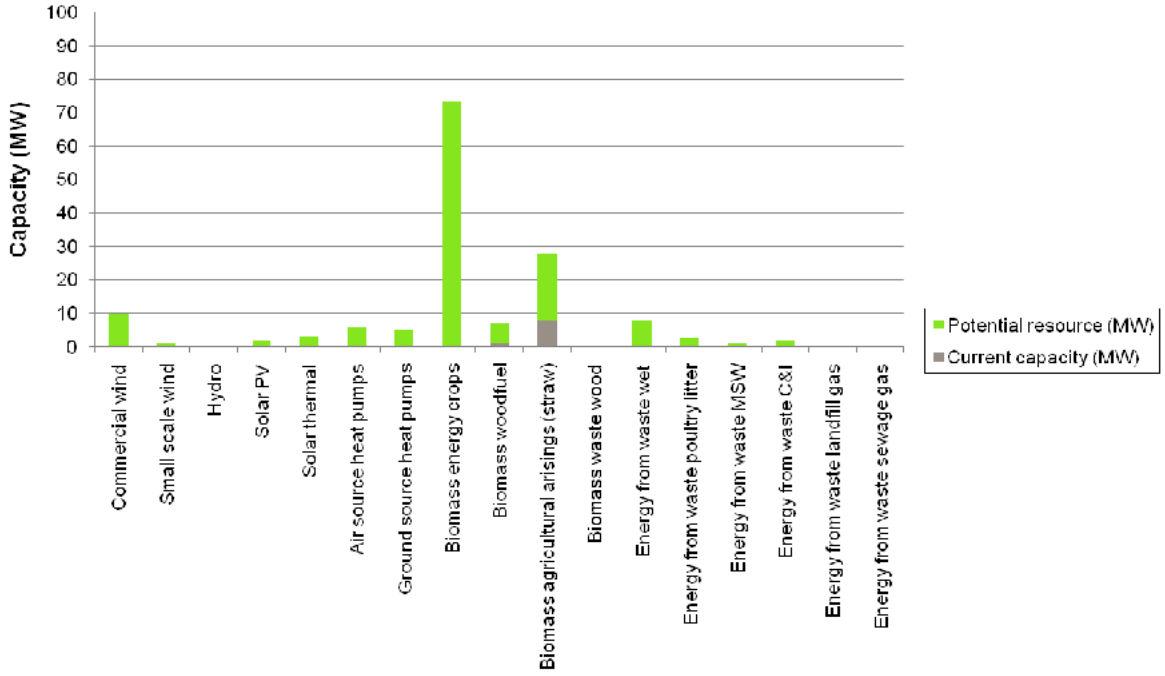


Figure 90 Current capacity and renewable energy resource in Ryedale. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

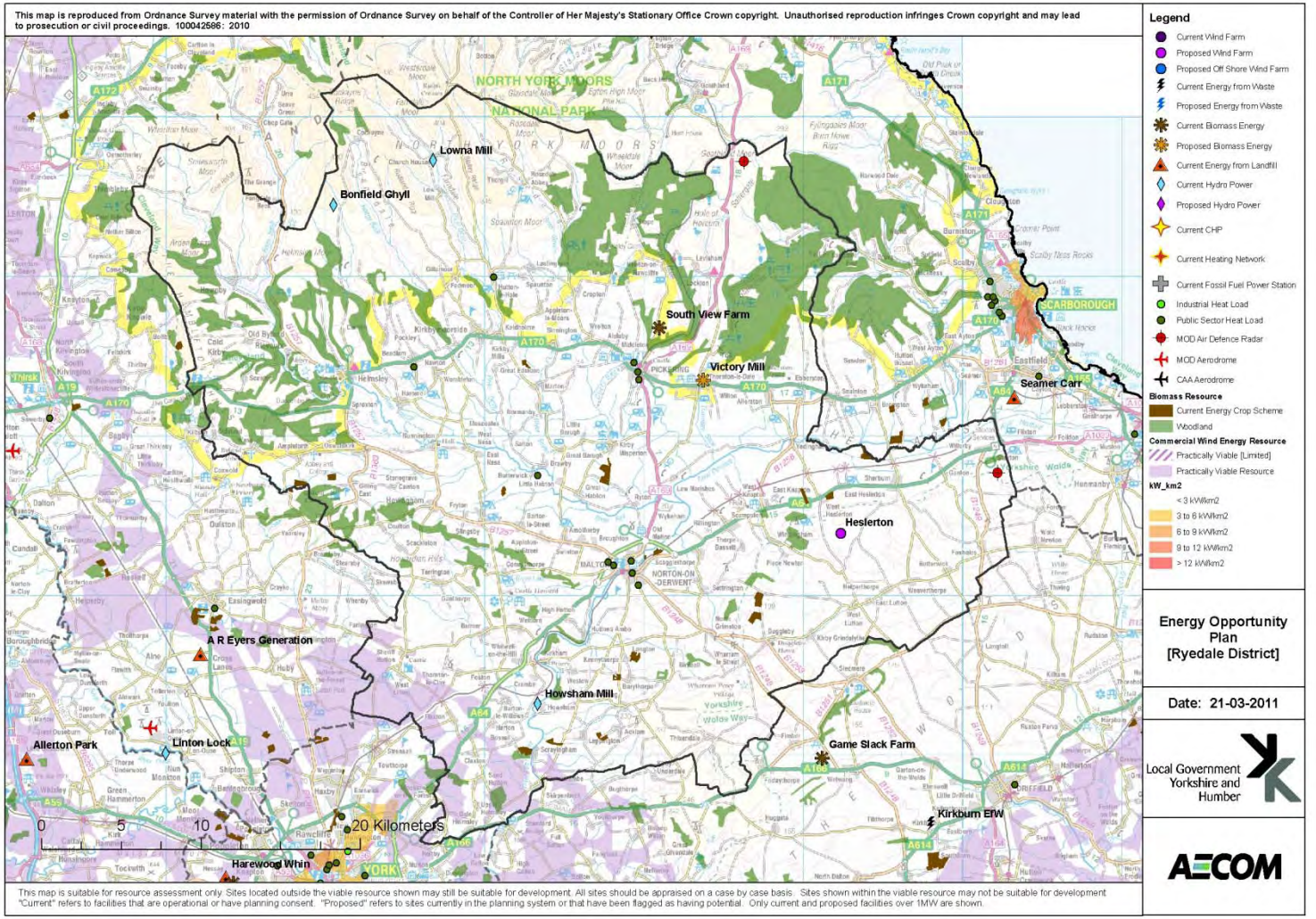


Figure 91 Energy opportunities plan for Ryedale. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

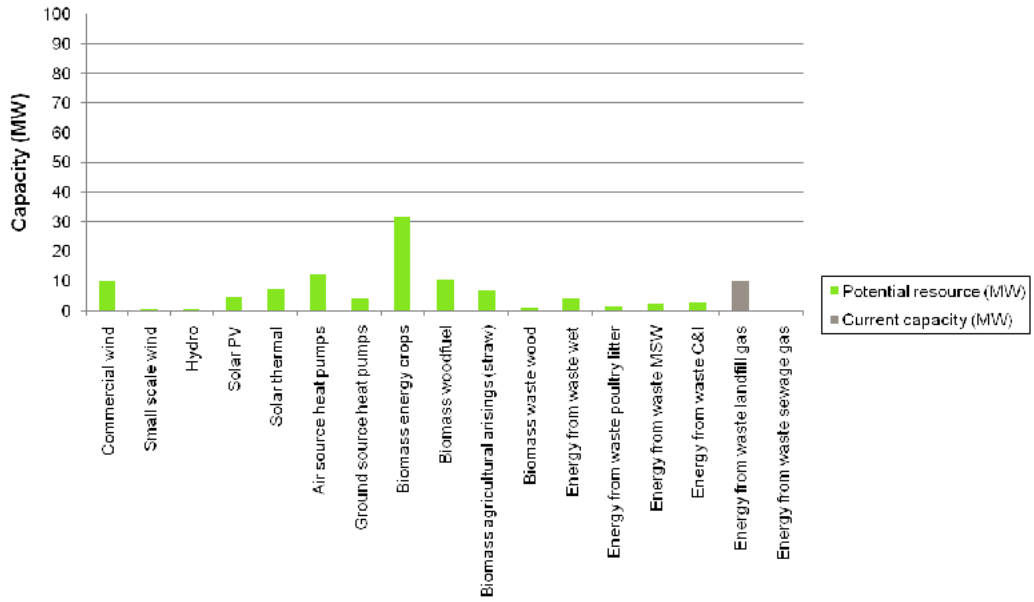


Figure 92 Current capacity and renewable energy resource in Scarborough. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

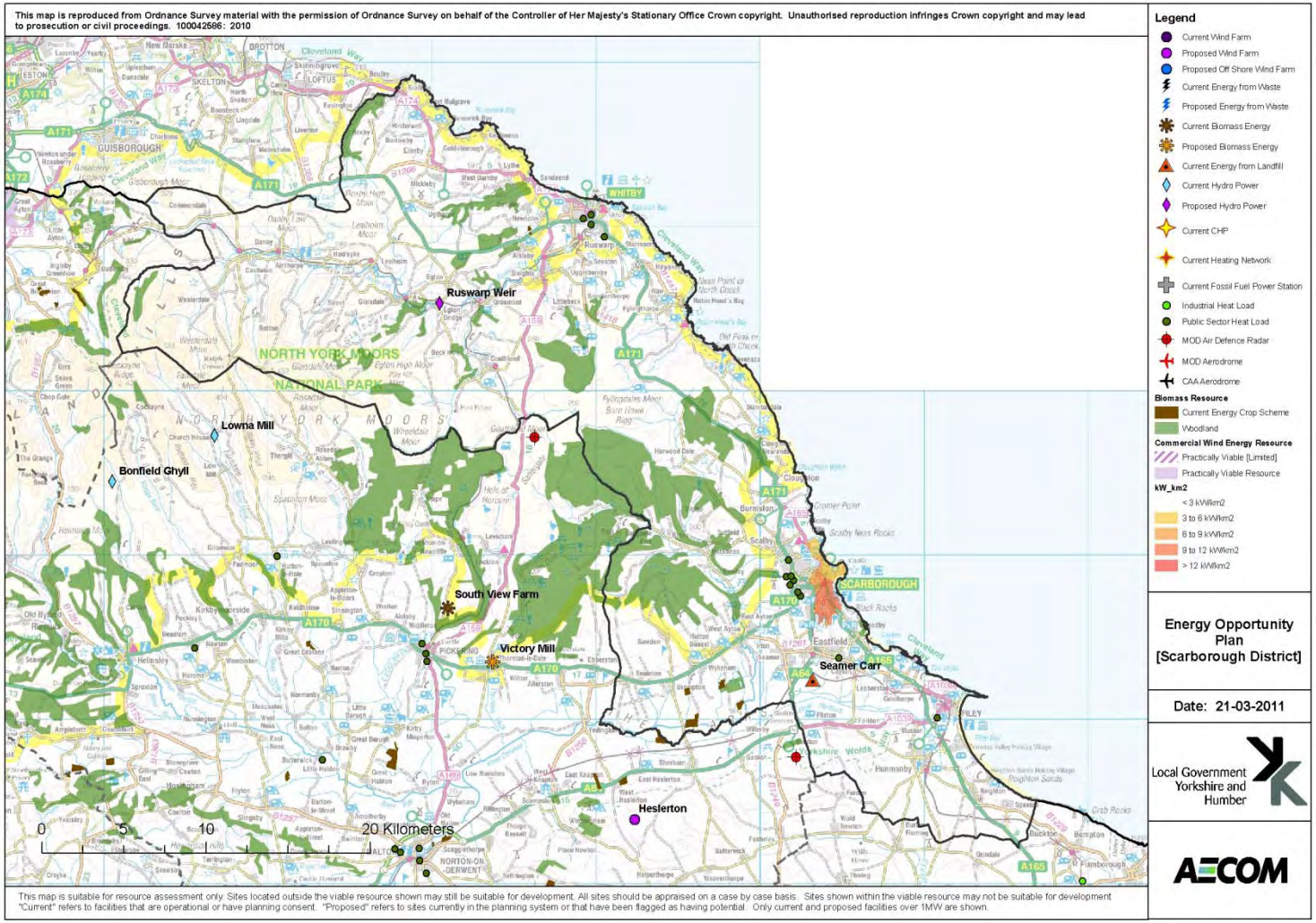


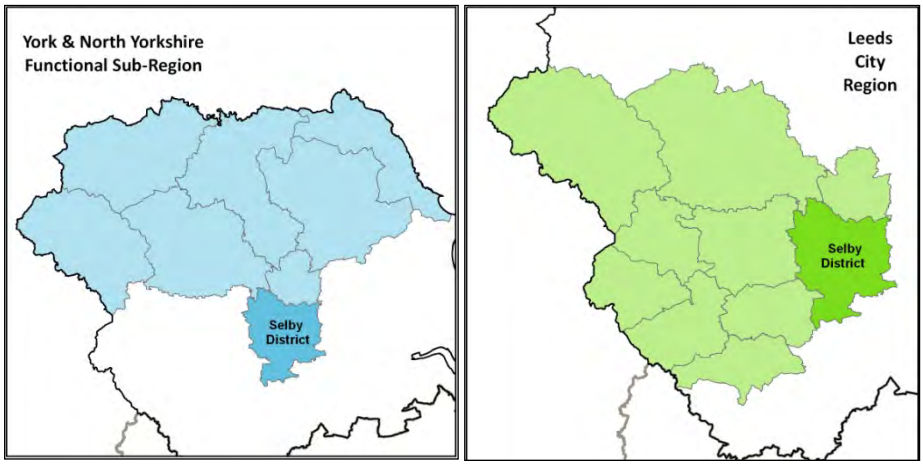
Figure 93 Energy opportunities plan for Scarborough. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and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

Capabilities on project:
Building Engineering - Sustainability

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

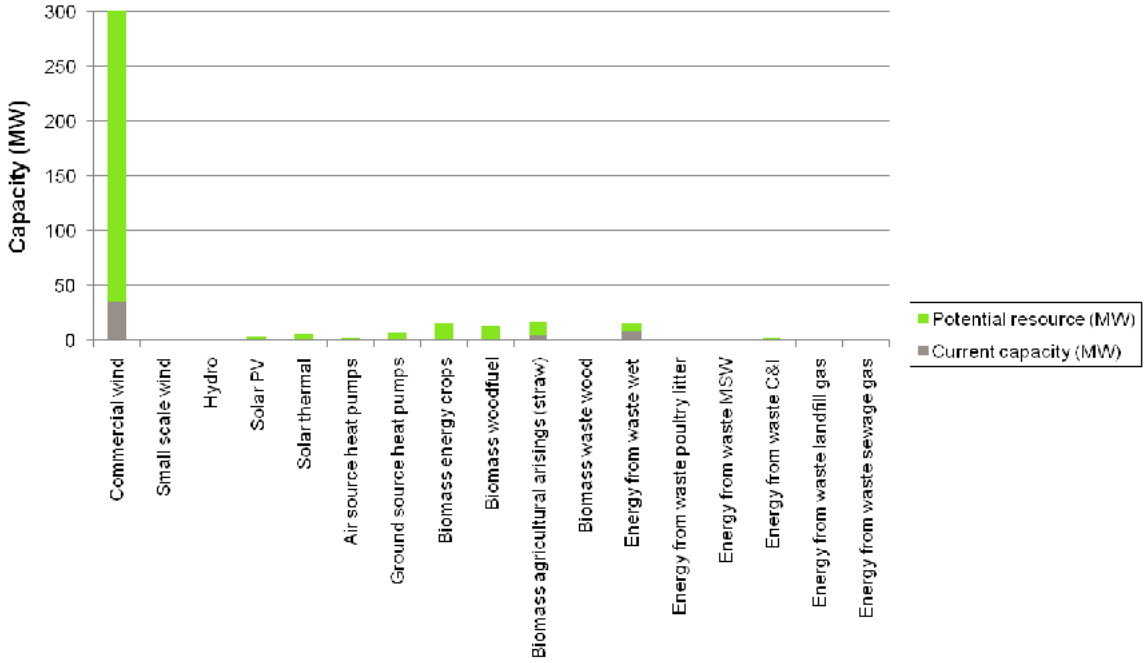


Figure 94 Current capacity and renewable energy resource in Selby. Current" refers to facilities that are operational or have planning consent.

Capabilities on project:
Building Engineering - Sustainability

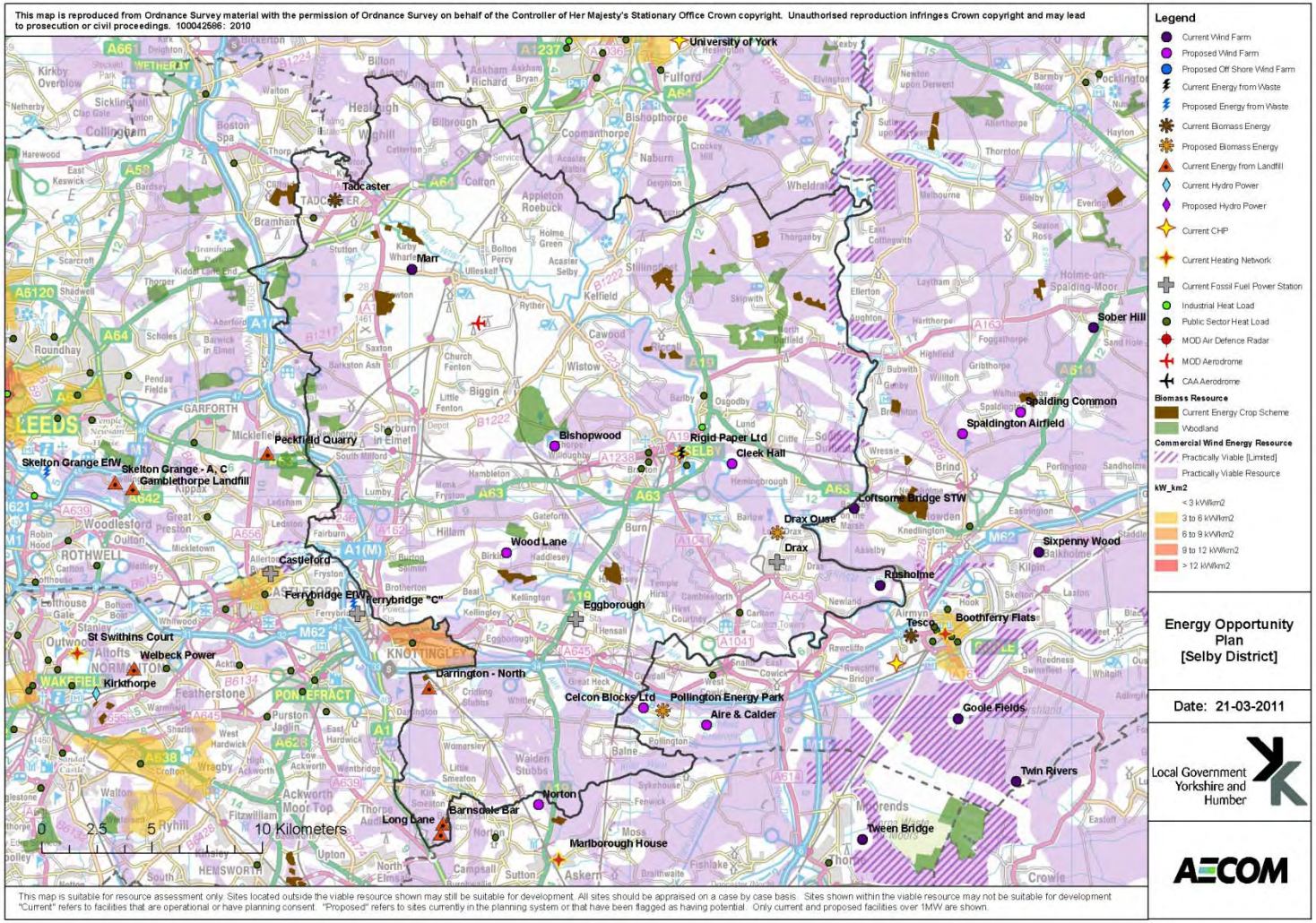


Figure 95 Energy opportunities plan for Selby. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

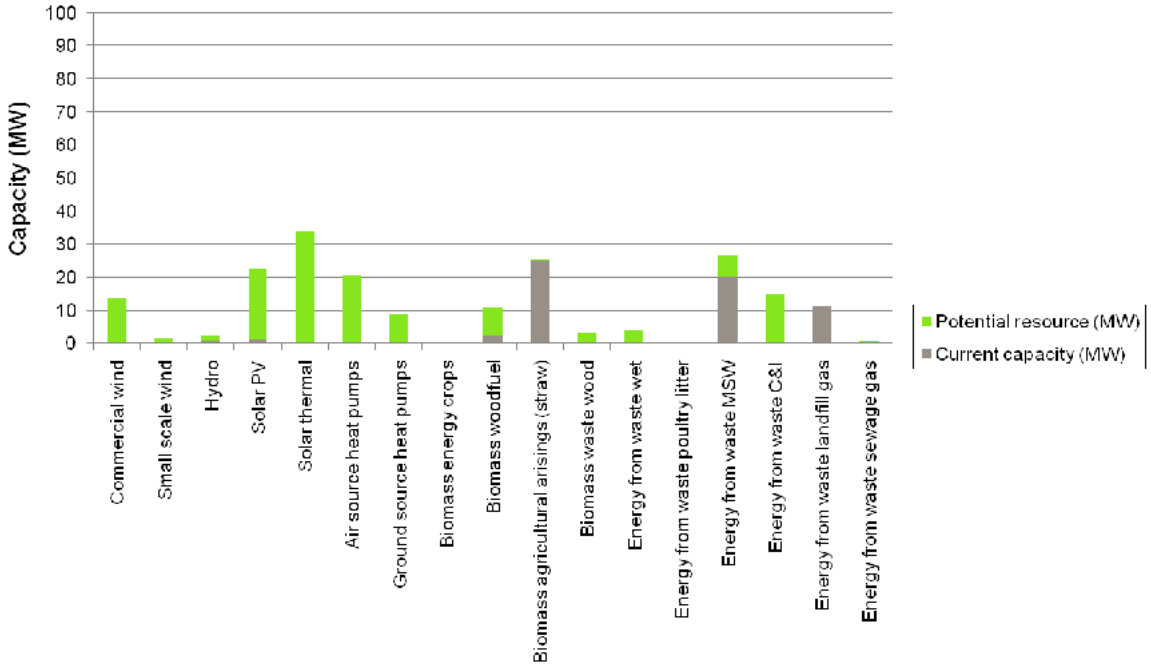


Figure 96 Current capacity and renewable energy resource in Sheffield. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

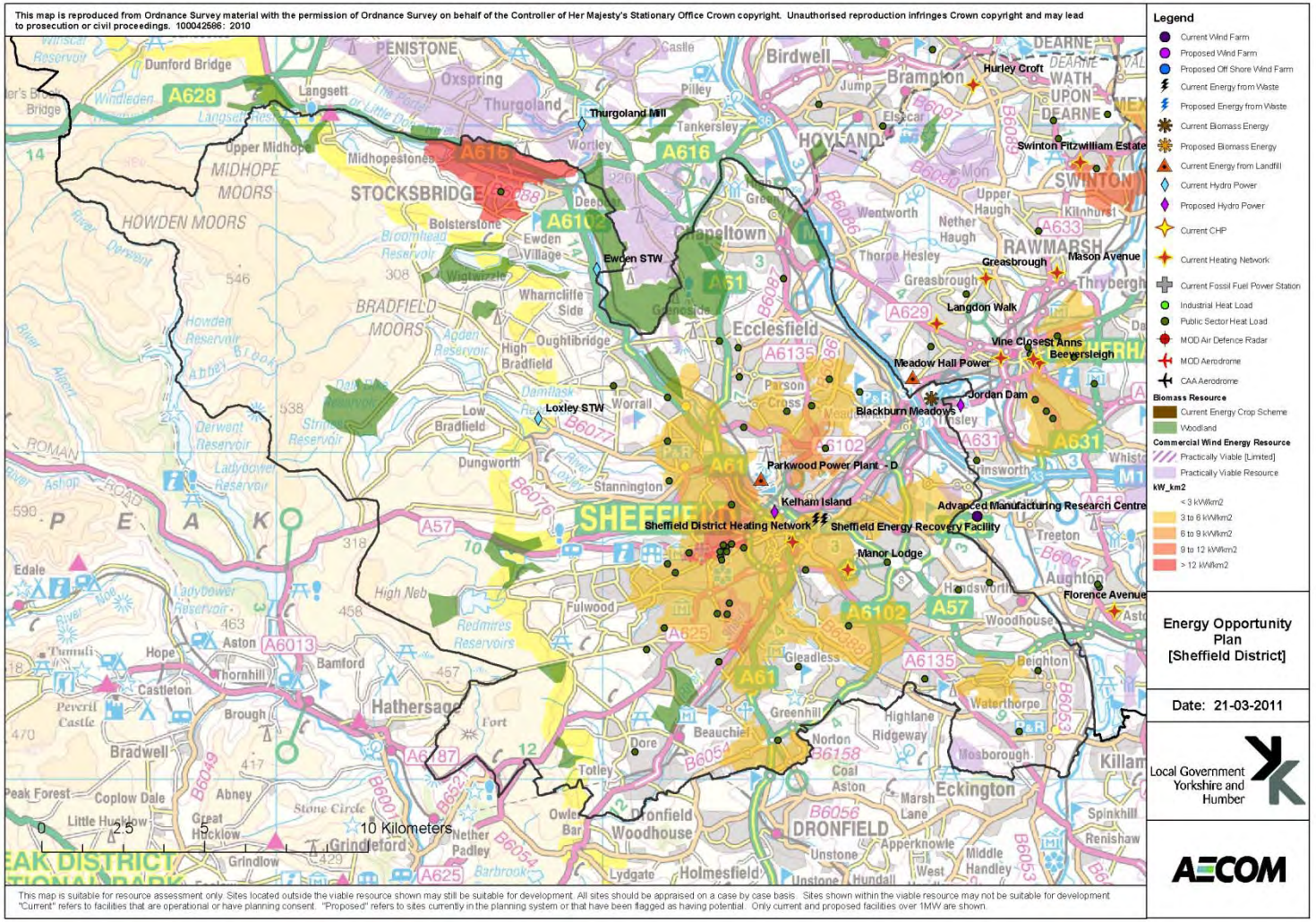


Figure 97 Energy opportunities plan for Sheffield. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

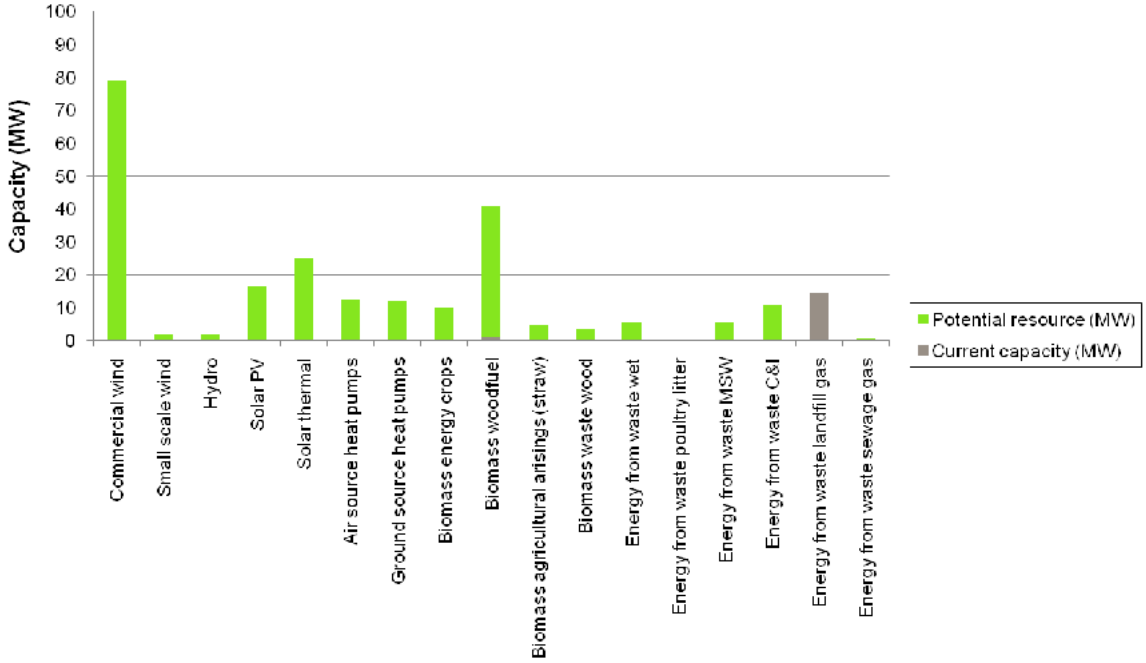


Figure 98 Current capacity and renewable energy resource in Wakefield. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

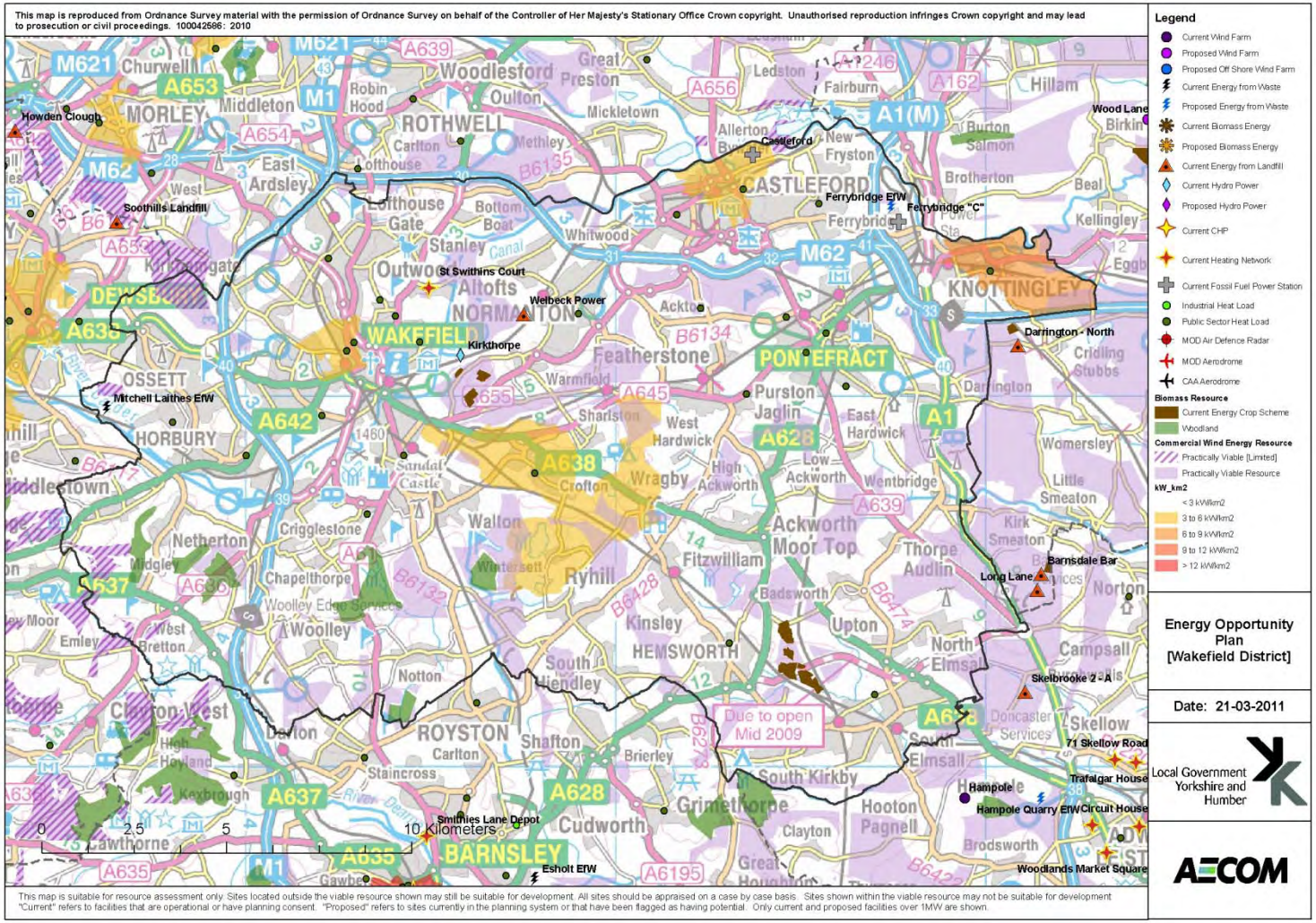


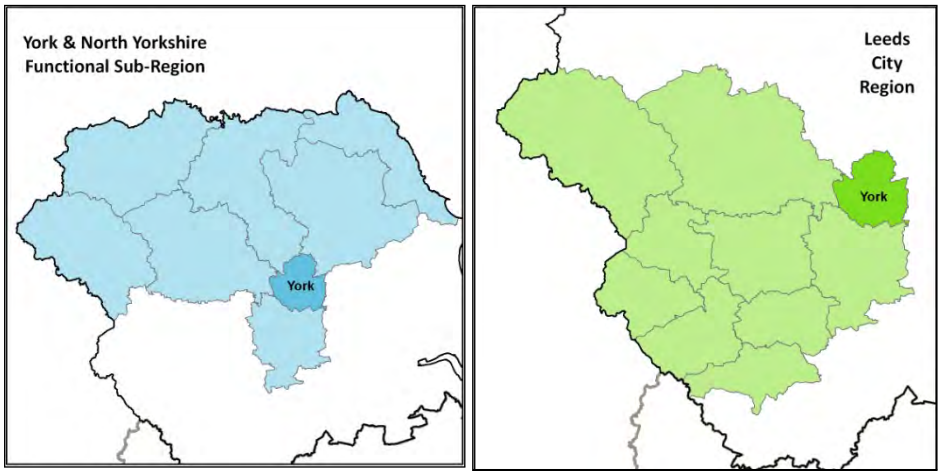
Figure 99 Energy opportunities plan for Wakefield. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

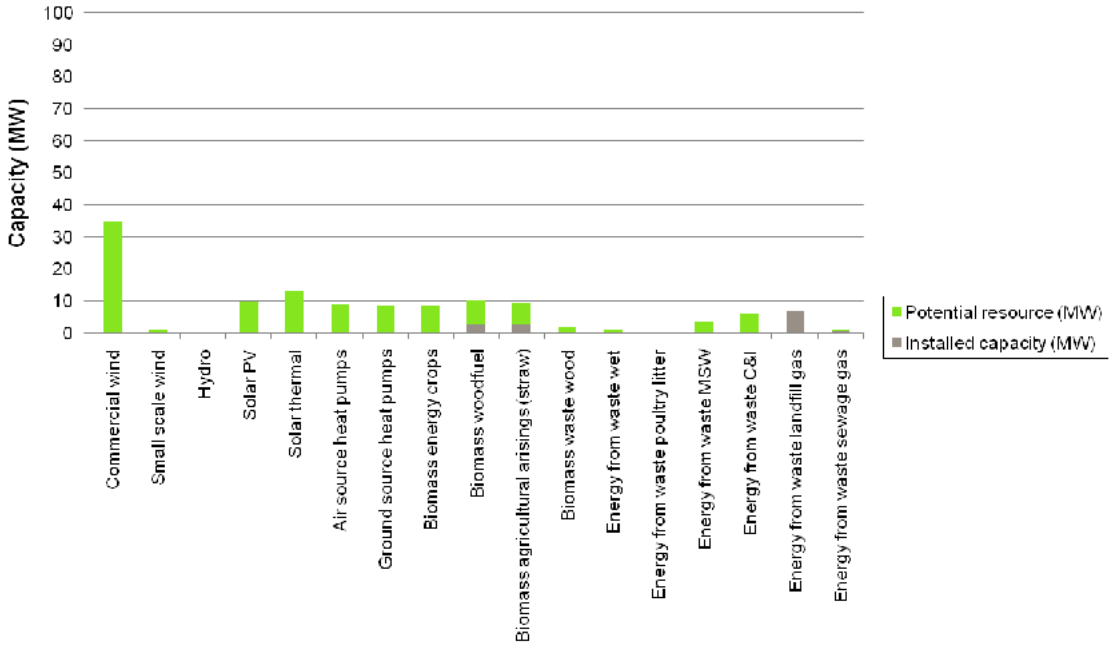


Figure 100 Current capacity and renewable energy resource in York. Current" refers to facilities that are operational or have planning consent

Capabilities on project:
Building Engineering - Sustainability

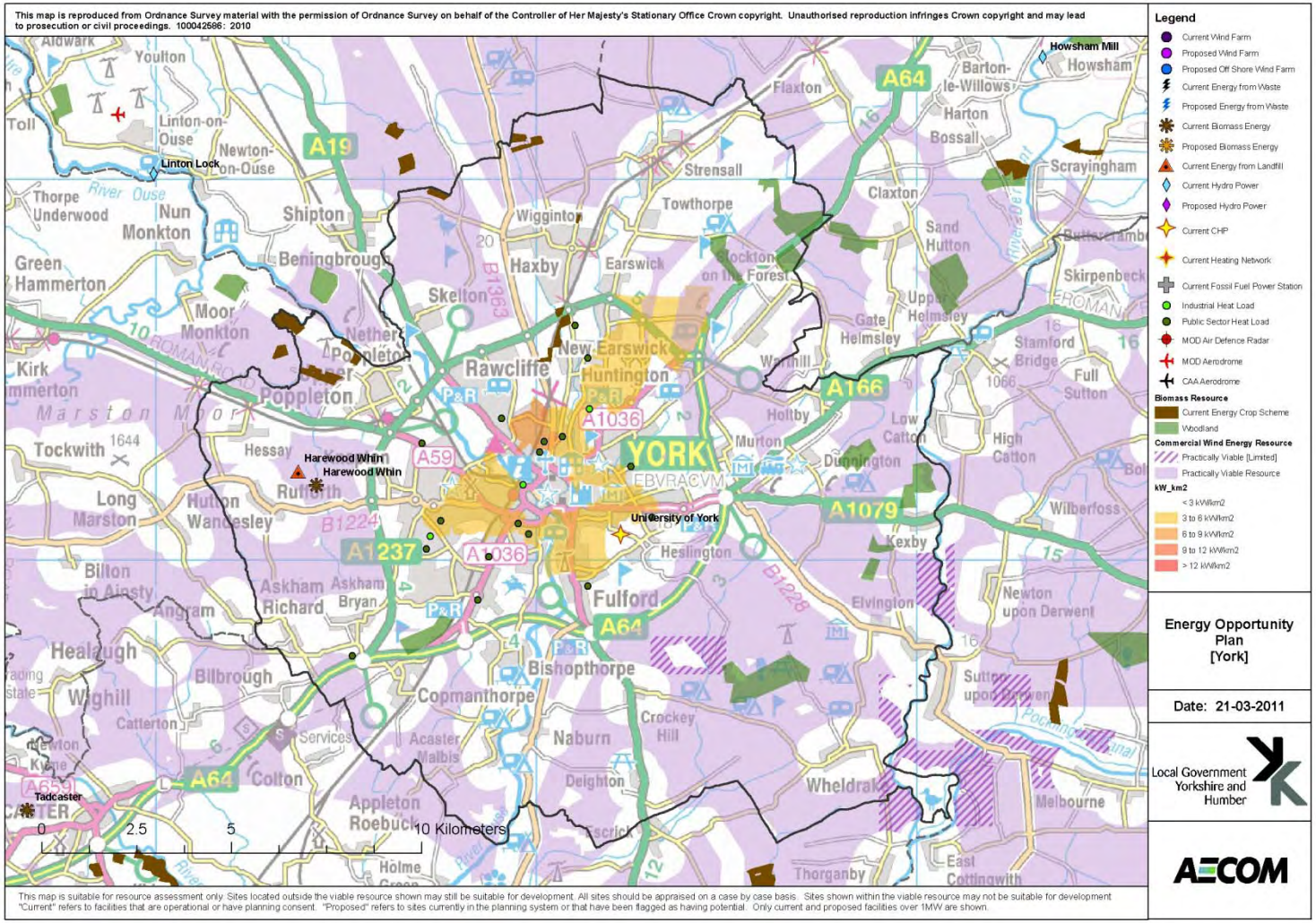


Figure 101 Energy opportunities plan for York. “Current” refers to facilities that are operational or have planning consent. “Proposed” refers to facilities currently in the planning system or sites that have been flagged as having potential. For all technologies except hydro, only current and proposed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

Capabilities on project:
Building Engineering - Sustainability

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

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.

Capabilities on project:
Building Engineering - Sustainability

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).

Capabilities on project:
Building Engineering - Sustainability

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

Capabilities on project:
Building Engineering - Sustainability

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.

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

Capabilities on project:
Building Engineering - Sustainability

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

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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).
	Calderdale	Unitary	83,000	Partnership out to tender for long-term residual waste management contract – down to 2 bidders, Earth Tech/Skanska and Shanks
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 Grimbsy. 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

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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	

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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	-

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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