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# Cheshire West & Chester Low Carbon and Renewable Energy Study

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# Contents

# Executive Summary

**Overview**

This study provides a technical assessment for Cheshire West and Chester Council of the baseline energy demand and potential renewable energy resource for Cheshire West and Chester, and options for addressing carbon emissions associated with buildings within the Borough, both existing and new development.

The study has been prepared in line with national guidance which states that planning authorities should have "an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies".

The key objectives set out in the project brief were to:

- Provide baseline data on current and future energy demands.
- Assess the opportunities for commercial and decentralised low carbon and renewable energy production.
- Assess the infrastructure required to deliver the use of low-carbon and renewable energy sources and information to inform the Infrastructure Delivery Plan.
- Advise on the role of planning obligations/community infrastructure levy in securing any supporting infrastructure.
- Include a heat mapping exercise for the Borough, providing data on heat users and suppliers and the potential for decentralised energy networks and provide GIS data and maps displaying the outputs from this work.
- Recommend planning policies to be included in the Core Strategy and a monitoring framework for these policies.
- Develop potential local level targets for low-carbon and renewable energy generation and local sustainable building targets for new development.

The key steps of the methodology for undertaking this renewable energy baseline and opportunities study are outlined in Figure 0-1 below.

Current energy consumption within the Borough has been assessed against the baseline year of 2009, and projections have been made from this year to 2020 and 2030. This forms the basis for evaluating the potential contribution that renewable energy can make to the Borough's energy needs.

The technical resource for the principal renewable energy technologies has been quantified and mapped, where possible. This technical potential has fed into predicted deployment scenarios for renewable energy in the Borough for 2020 and 2030. In addition, a heat mapping exercise has identified areas of district heating potential where combined heat and power systems could be deployed. These patterns of supply and demand for renewable energy have then been brought together to highlight the key opportunities for deploying renewable energy in the Borough. At the request of the Council the study has also considered Coal Bed Methane which is not defined as a renewable energy technology, but is included within this study as a potential local fuel resource that would reduce the Borough's level of reliance on imported fossil fuels, and reduce carbon emissions if used in the combined heat and power (CHP) or district heating applications.

This study has been completed in line with guidance provided by national Government, following the 'Renewable and Low-carbon Energy Capacity Methodology for the English Regions', as commissioned by the Department of Energy and Climate Change (DECC) in January 2010.

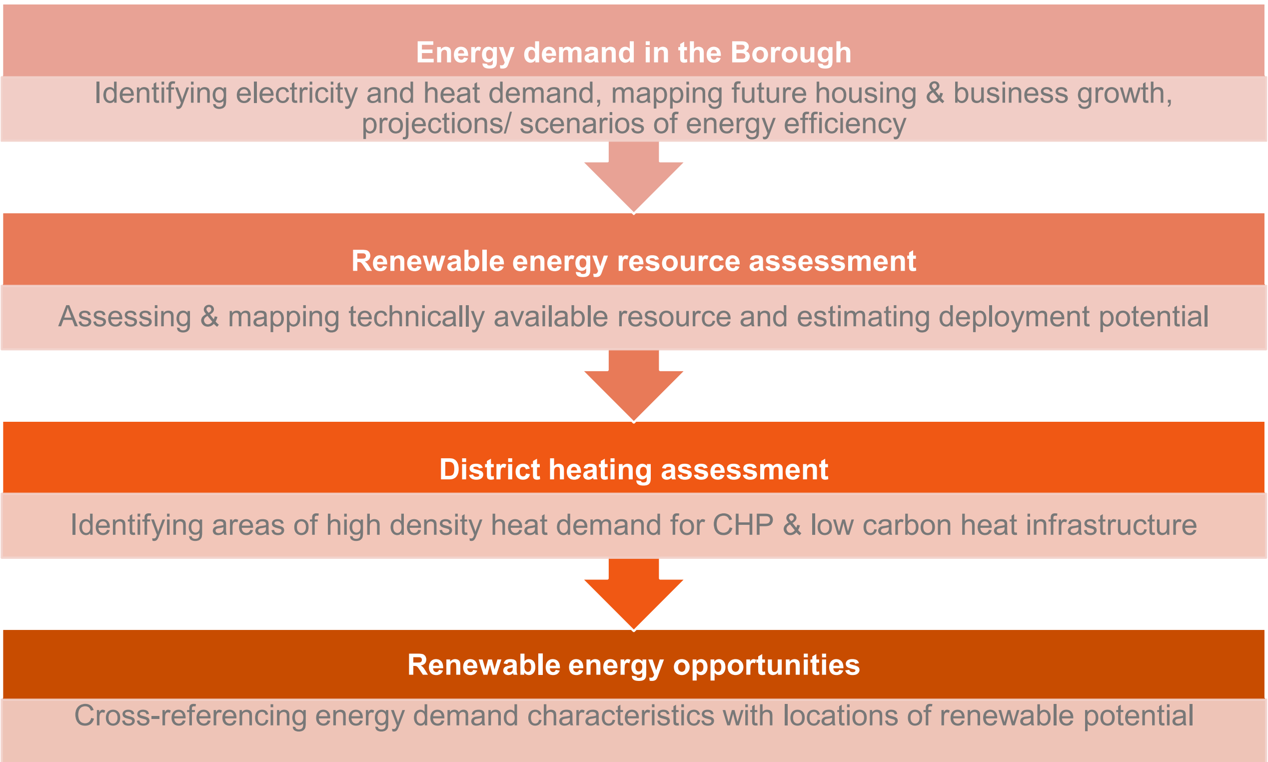


**Figure 0-1. Key steps in the assessment of renewable energy opportunities in the Borough**

Figure **0-2** shows energy consumption broken down by sector (domestic, non-domestic and transport) and by energy type. The most up to date statistics produced by DECC[1] were used to calculate annual energy consumption, resulting in a base year for this study of 2009. It should be noted that the energy consumption from the Stanlow oil refinery, which has a significant impact on the Borough-wide energy consumption, is included in these figures. With this included, energy consumption for the Borough is estimated at 67MWh per person per year which is almost 3 times greater than the national average.

[1] *2009 energy consumption statistics produced by DECC, available at:*
*http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/regional/electricity/mlsoa_2009/mlsoa_2009.aspx*
*http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/regional/road_transport/road_transport.aspx*
*http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/regional/other/other.aspx*

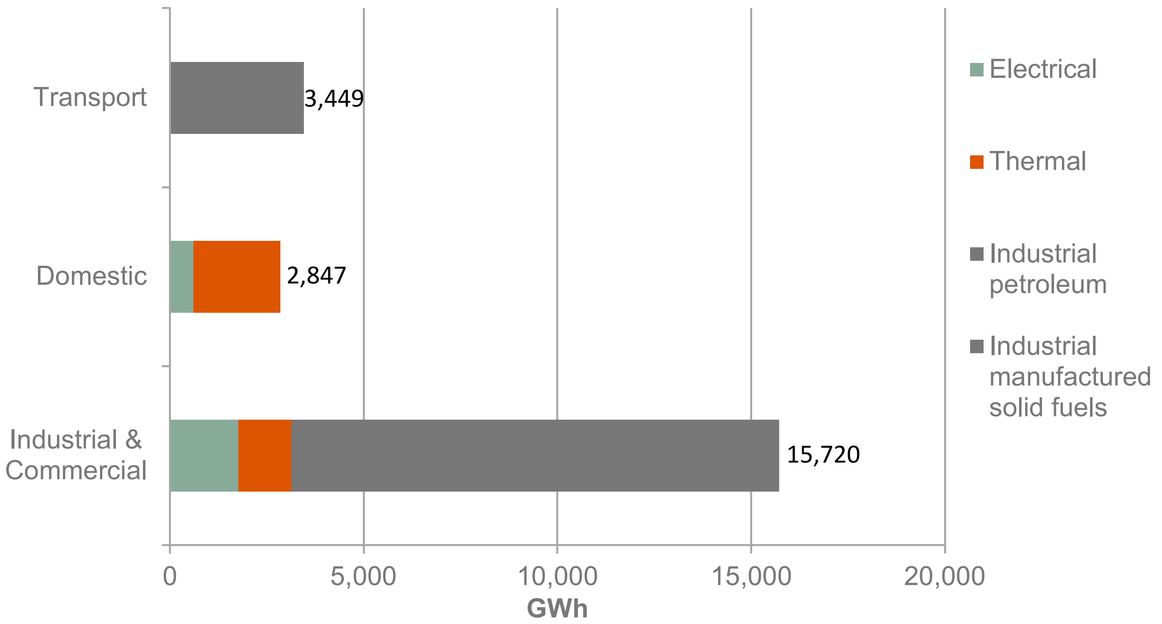


**Figure 0-2. Cheshire West & Chester energy consumption breakdown (2009)**

## Summary of Low Carbon and Renewable Energy Potential

Figure 0-2 presents a summary of the deployable potential of the renewable and low carbon energy resources in the Borough for 2020 as identified through this study. The installed capacity (in Megawatts or MW) is given for each technology along with the expected electricity and/or heat generation (in Gigawatt-hours or GWh). The anticipated carbon savings ($tCO_2$/yr) are also stated along with an estimate of how this resource will contribute to total energy consumption in the Borough by 2020.

| Technology | Installed capacity (MWe) | Installed capacity (MWth) | Electricity generation (GWh) | Heat generation (GWh) | Carbon savings ($tCO_2$) | % of the Borough s energy demand |
|---|---|---|---|---|---|---|
| **Commercial scale wind** | **23** | | **58** | **-** | **30,563** | 0.3% |
| **Biomass** | **43** | **7** | **338.1** | **21.5** | **181,056** | 1.6% |
| - Energy Crops | 0.3 | 1.1 | 2 | 3.4 | 1,729 | |
| - Managed woodland | 0.8 | 4.9 | 6.3 | 14.9 | 6,085 | |
| - Waste Wood | 1.2 | 1.0 | 9.6 | 3.2 | 5,481 | |
| - Straw | 1.8 | | 14 | - | 7,211 | |
| - WOW | 21.1 | | 166.4 | - | 87,258 | |
| - Poultry Litter | 0.2 | | 1.7 | - | 871 | |
| - MSW | 6.7 | | 53.2 | - | 27,884 | |
| - C&I W | 5.6 | | 43.8 | - | 22,988 | |
| - Landfill gas | 4.5 | | 35.7 | - | 18,728 | |
| - Sewage gas | 0.7 | | 5.4 | - | 2,821 | |
| **Hydro** | **3.5** | | **10.7** | - | **5,634** | 0.05% |
| **Solar PV** | **11.1** | | **8.4** | - | **4,399** | 0.04% |
| **Solar Thermal** | **1.9** | | - | **1.4** | **308** | 0.01% |
| **ASHPs** | **20.9** | | - | **25.2** | **- 566 *** | 0.12% |
| **GSHPs** | **19.9** | | - | **24** | **148 *** | 0.11% |
| **Micro-wind** | **4.4** | | **5.4** | - | **2,841** | 0.02% |
| **District Heating** | | | | | | |
| **In-building CHP** | **0.3** | **0.4** | **1.9** | **2.3** | **150** | 0.02% |
| **Deep geothermal** | | | | | | 0.00% |
| **Coal Bed Methane CHP** | **7** | **10** | **61.1** | **87.5** | **12,243** | 0.68% |
| **TOTAL** | **134.9** | **17.4** | **483.6** | **161.9** | **237,194** | **3.0%** |

**Table 0-1: Summary of deployable potential for renewable and low carbon energy in the Borough (2020)**

Note that Coal Bed Methane is included within Table 0-1 despite not being a renewable source of energy and not inherently being of a low carbon nature, since it is derived from coal. Only where CBM can be used to generate both electricity and recovered heat, can it be considered to make a positive carbon reduction contribution.

Table 0-1 highlights the collective biomass resource as having the greatest deployable potential in terms of energy generation. It is estimate that it could supply 1.63% of the Borough's total energy consumption by 2020. Of the individual biomass resource streams, those with the greatest potential include wet organic waste (WOW), municipal solid waste (MSW) and commercial and industrial (C&I) waste. Following biomass, Coal Bed Methane has the second greatest potential to reduce Carbon Emissions, where installations can be suitably located to make full use of the recovered heat. The importance of coordinating the suitable location of these installations is therefore recognised as being of strategic importance and is consequently acknowledged in the proposed draft policy wording, included later in the this report.

Commercial-scale wind has the third greatest potential to generate energy and could supply 0.3% of the Borough's total energy consumption by 2020. It should be noted that this resource assessment is highly sensitive to the selection of assessment parameters, as is shown when comparing the different resource conclusions drawn in this study and those from the recent North West region, which suggested a much greater resource was available.

Heat pump technologies (both air-source and ground-source) provide the next greatest potential, while other microgeneration technologies and hydro would only be expected to provide a fraction of the energy consumed within the Borough in 2020.

Collectively, renewable and low carbon energy resources could provide 3.0% of the energy consumed by 2020 (2.3% if excluding Coal Bed Methane). By way of comparison, if the consumption of Industrial Petroleum and Industrial Solid Manufactured Fuels that occurs within the Ellesmere Port area (as a proxy for the Stanlow Refinery) was excluded, the estimated resource potential (with Coal Bed Methane) could meet 6.3% of the Borough energy supply in 2020.

**Energy Opportunities Map**

Not all of the renewable and low carbon energy resources examined in this study are location specific, however, some are closely linked to a location. We have therefore mapped key technology opportunities for the Borough in the map on the following page in

Figure 0-3. The summary below identifies the approach and rationale for mapping (or excluding) technologies from this map:

1. Wind potential: The "areas of least constraint" from the wind analysis have been presented for wind development at large and medium scale. The areas identified are therefore the broad areas from which the deployable potential for wind energy was determined. (See section **Error! Reference source not found.** of this report for further details).
2. Biomass: Biomass resource cannot be mapped effectively due to the wide variety of resource streams involved in the analysis, many of which are not spatially defined. For example waste presents a major part of the biomass resource and this is dispersed across the entire building stock.
3. Hydropower: We have mapped the deployable hydropower sites identified as in this study
4. Microgeneration: Excluded. The areas of potential for the microgeneration technologies examined in this study essentially corresponds to the location individual buildings; therefore this cannot be clearly mapped at this scale. Small wind potential is focussed on buildings in more rural areas where there are fewer obstructions to cause turbulence.
5. District heating and CHP: We have presented areas of high heat demand on the energy opportunity map. "Very high" heat demand represents areas with heat demand over 5,000kW/km$^2$, i.e. areas included in the assessment of deployable potential. "High" corresponds to heat density of 3,000-5,000kW/km$^2$, or areas of technical potential.

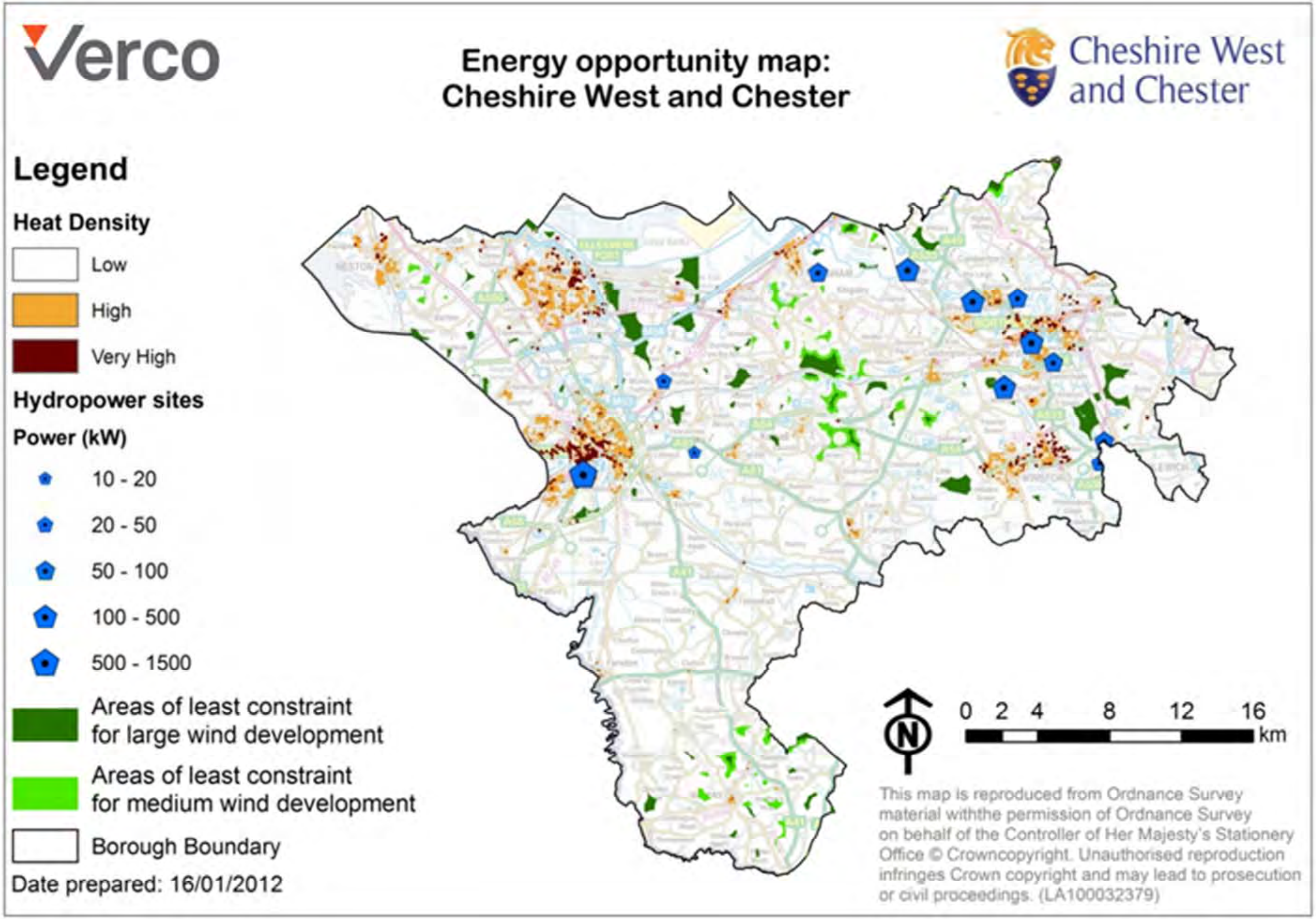


**Figure 0-3: Energy opportunity map for Cheshire West and Chester**

**Policy Recommendations**

The report provides an overview of the current and proposed future context with respect to land use planning and renewable and low carbon energy technologies. Changes being brought in through the Localism Bill and the draft National Planning Policy Framework mean that the Council has significant flexibility as to how it presents these issues within planning policy. In simple terms there are significant development opportunities for renewable and low carbon technologies within the Borough which the Council should seek to encourage through planning policy and other non-planning actions. Exactly how this is achieved needs to be considered as the principal planning documents for the borough are drawn up, with this report being used as an evidence base to support specific spatial, process and technology policy.

The Council should bear in mind the intended outcomes from its planning policy in this area, namely:

1. New and existing power supplies will be used more efficiently so as to reduce the $CO_2$ emissions associated with new developments and existing buildings
2. Renewable and low carbon energy capacity will need to increase in all areas to assist meeting national targets for a 15% share of total energy consumption from low carbon and renewable sources by 2020, with further contributions potentially required throughout the lifetime of a plan, as national targets are amended by Government
3. New development is designed / delivered so as to reduce energy demand
4. Maximise the commercial, employment, energy security and community benefits, e.g. fuel poverty, that can be delivered through deployment of these technologies

**Stand-alone energy generation**

The report provides commentary for the technologies that have been considered within the study to provide direction when developing planning policy. The most important technologies (by scale of potential) are wind energy, Coal Bed Methane (CBM), energy from waste (EfW) and biomass. The Council specifically requested that CBM be included in the study but it should be recognised that unless used in a combined heat and power or district heating application, this non-renewable resource will not reduce carbon emissions within the borough.

***Wind energy*** offers significant potential and we recommend that the council avoids constraining development which may be brought forward by the commercial sector. We suggest the council highlights the potential for medium scale wind energy, gives some direction on preferred areas of development and gives further consideration to landscape impact and cumulative landscape impact, which are poorly understood with respect to wind energy development within the borough. We also recommend that the council develop criteria-based planning policy to support objective determination and also considers encouraging and supporting community-led development of wind energy.

***Biomass*** is also a major resource which should be promoted. The opportunities for biomass exist around an array of fuel types (biodegradeable wastes, energy crops, agricultural residues and woody material from forest management) and range of project scales from commercial power stations to domestic heating. There are also significant regulatory issues associated with biomass covering not only the combustion stage of the supply chain but also the production and preparation stages. We recommend that the council's planning policy adopts a positive position to biomass generally, including the use of biodegradeable wastes, and that it highlights the opportunity of using locally derived fuels for combined heat and power, district and building-level heating, rural fuel-switching and on-farm applications. Supporting the establishment of effective supply chains will be important to facilitate the development of the resource.

Whilst ***hydro energy*** offers limited resource the council should consider highlighting the specific opportunities and encourage their development whilst minimising environmental impact.

***Coal Bed Methane*** offers that largest single resource and our planning recommendations are simply for the council to encourage its development but to specifically seek to achieve deployment where it is used in combined heat and power (CHP) and district heating applications. If delivered in typical power generation applications it presents no carbon reduction benefit for the Borough.

## Carbon reduction in the built environment

Retrofitting of existing buildings to improve energy performance offers opportunities for energy efficiency and low carbon generation technologies. Most refurbishment is permitted development, but where it is not, there is scope for the Council to establish planning policy to require extension and major refurbishments to also upgrade the energy performance of the entire building. It is recommended that the council develops specific policy around these opportunities and to also seek to develop retrofit programmes across council assets. It is recommended that the Council also considers establishing a local Carbon Fund able to utilise development receipts to support the implementation of the energy efficiency (and low carbon generation) schemes that meet local priorities.

The delivery of carbon reduction measures within urban development through the use energy efficiency, district heating and the inclusion of microgeneration is an important opportunity for the Borough. Locking in high standards for buildings that will exist for tens of decades can deliver significant long term carbon savings but also act as the catalyst for emerging markets in microgeneration technologies and district heat networks. In planning terms, at a national level, policy has seen a number of significant changes as we move towards zero carbon development standards (by 2016) and as the construction / development sector slowly emerges from recession.

National planning policy and regulation around low carbon buildings has shifted towards reducing the burden on development in the short term, but has retained the 2016 zero carbon target, albeit and with a refreshed and less demanding definition. Within the recent consultation for the 2013 version of Part L of the Building Regulations government has stated the need to establish explicit proof of the viability of delivery if Local Authorities wish to set localised carbon targets that exceed the requirements of the Building Regulations.

In essence, the conclusions within this report identify the need for the Council's planning policy to reinforce the implementation of Buildings Regulations (Part L) and then encourage development, particularly where it is significant, to go beyond this. Meeting and going beyond national energy/carbon standards should be delivered in accordance with the 'Energy Hierachy', which requires:

1. low carbon materials, then,
2. adoption of a high efficiency building envelope with passive design features, then,
3. 'on-site' low carbon energy supply, then,
4. 'off-site' energy supply, e.g. district heating, and finally,
5. offsetting measures, e.g. 'Allowable Solutions", which could be local energy efficiency or low carbon generation measures.

During the course of this study it has not been possible to conduct the detailed viability analysis required to establish the form, scale or location of development within the borough that could viably support going beyond predicted Building Regulation standards in future. We recommend that the council conducts this kind of analysis, but in the meantime planning policy should focus on placing the onus on developers to prove the carbon standard achievable on schemes, through an Energy Statement. The Planning Authority can then appraise these and also consider whether there are opportunities for the council to support higher standard and/or explore synergies, e.g. collating heat consumers to support assessments of district heating.

The study has identified a number of areas as "Areas for Potential Heat Networks" and it is recommended that policy reflects the opportunities, predominantly in the Chester and Ellesmere Port areas, and requires developers to give due consideration to developing Heat Networks, establishing a site-level network, and, removing barriers to later connection (where development is not viable). The Council could facilitate the implementation of district heating through further detailed analysis of the strategic opportunities.

**Recommendations and Next Steps**

Below is a summary of the next steps that are recommended to Cheshire West and Chester Council as a means of taking the information within this study and combining this with other forms of evidence to develop draft planning policies.

- The Council steering group should review the evidence base and policy commentary within this report to ensure that the recommendations align with the Council's intentions. The information contained within this report has been developed in consultation with the project steering group, as well as the officer-led stakeholder workshop in November 2011.
- The Council should promote the work done within this study and other related studies in supporting developers to achieve cost-effective low carbon development, making Cheshire West and Chester an attractive place for sustainable new development.
- The Council should maintain close engagement with local developers and community groups, providing training and communication sessions as necessary to prepare a local platform for low carbon development and the development of local renewable energy.
- The Council should ensure that the many different teams and Council officers involved in planning and enforcing development are aligned and engaged in promoting sustainable development for the benefit of the local community.
- The Council should continue to monitor and review the sustainable credentials of new development to ensure that standards are upheld within the Borough, to ensure that the Borough contributes to national low and zero carbon energy generation targets, in proportion to the resources available.

- Council members and officers should understand and promote the delivery of the Energy Opportunities Map to maximise the development of renewable energy and sustainable development within the Borough.
- The Council should consider promoting the formation of community-owned energy groups and support their work in developing renewable energy schemes and implementing retrofit improvements within their local communities. The Council should support such groups with guidance, in-house skills, knowledge transfer and linking to grants and funding opportunities where possible.
- The Council should maintain its awareness of upcoming schemes being developed at a national level, which will impact on the requirements and ability of local residents and developers to implement the opportunities identified in this report. Such schemes include the Green Deal, Energy Company Obligation (ECO) and updates to national building Regulation standards and related schemes such as the Community Infrastructure Levy (CIL) and 'Allowable Solutions'.
- In order to present leadership through example, the Council should consider developing those energy efficiency and renewable energy / low carbon opportunities that arise within and in the proximity of assets within its estate, either directly or via third party developer. Key opportunities included energy efficiency and renewable energy retrofit programmes within council owned buildings, developing decentralised generation on council owned land, and, co-ordinating development of district heating where council can be an 'anchor heat consumer' or can facilitate the implementation of infrastructure.
- The Council should work alongside neighbouring Local Authorities to deliver energy opportunities that exist across borough boundaries, as well as sharing expertise and best practice.
- It is also recommended that a number of further study areas are investigated to refine outline proposals for potential opportunities highlighted within this study, including:
    - Exploration of the potential for district heating within those areas highlighted as having the greatest potential within the borough
    - Preparation of outline energy strategy feasibility studies for specific strategic sites
    - Exploration of the development of a local Carbon Fund that could be introduced to substitute on-site implementation of energy efficiency and low carbon generation, with implementation elsewhere in the district on a larger scale, where it can prove to be more carbon and cost-effective to do so. This fund could provide the framework for the delivery of a locally driven 'Allowable Solutions' option to enable development to achieve carbon standards under the zero carbon regime from 2016 onwards.
    - Exploration of the specific viability of establishing low carbon targets for new development going beyond national requirements established in forthcoming Building Regulations.
    - Educating and informing local community energy groups.
    - Providing training for Council members and officers.

## Glossary of Terms & Acronyms

| | |
|---|---|
| Allowable Solutions | Measures to account for the carbon emissions that are not expected to be achieved on site through Carbon Compliance measures, to meet zero carbon Building Regulations in 2016. The developer will make a payment to a "provider", who will take the responsibility and liability for delivering equivalent carbon reductions. |
| APEE | Advanced Practice Energy Efficiency standard |
| ASHP | Air Source Heat Pump |
| BER | Buildings Emissions Rate |
| BERR | (Department of) Business, Enterprise and Regulatory Reform |
| BPEE | Best Practice Energy Efficiency standard |
| BREEAM | Building Research Environmental Assessment Method |
| Building Regulations | Minimum standards for design and construction which apply to most new buildings and many alterations to existing buildings in England and Wales. http://www.communities.gov.uk/planningandbuilding/buildingregulations/ |
| Carbon Compliance | To comply with the 2016 Building Regulations, new zero carbon homes will have to meet on-site requirements for Carbon Compliance (achieved through the energy efficiency of the fabric, the performance of heating, cooling and lighting systems, and low and zero carbon technologies). |
| CCGT | Combined Cycle Gas Turbine |
| CERT | Carbon Emissions Reduction Target |
| CfSH | Code for Sustainable Homes |
| CHP | Combined Heat and Power |
| CIBSE | Chartered Institute of Building Services Engineers |

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| $CO_2$ | Carbon Dioxide (taken as *equivalent* figures to represent all greenhouse gas emissions in total). |
| Communal energy | Term used to refer to community- or district-based energy systems, typically a heat and/or cooling network. |
| COP | Coefficient of Performance |
| CIL | Community Infrastructure Levy |
| DCLG | The Department of Communities and Local Government |
| Decentralised energy | Term used to identify energy generation that is more localised than traditional highly centralised power generation plant. Decentralised energy could include energy supplied from wind farms, incinerators and smaller scale power stations. |
| DECC | Department of Energy and Climate Change |
| DER | Domestic Energy Rating |
| DHN | District heating Network |
| ECO | Energy Company Obligation |
| EPCs | Energy Performance Certificates |
| ESCO | Energy Services Company |
| EST | Energy Saving Trust |
| FIT | Feed-in Tariff. |
| GSHP | Ground Source Heat Pump |
| GW | Gigawatt. A unit of power equivalent to 1,000,000,000 watts.<br>One GW = 1000 MW |

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| GWh | Gigawatt hour. A unit of energy equivalent to one Gigawatt of power being expended for one hour.<br><br>One GWh = 1,000 MWh |
| LDF | Local Development Framework |
| LZC | Low or zero carbon technologies |
| MW | Megawatt. A unit of power equivalent to 1,000,000 watts.<br><br>One MW = 0.001 GW |
| MWh | Megawatt hour. A unit of energy equivalent to one Megawatt of power being expended for one hour.<br><br>One MWh = 0.001 GWh |
| Microgeneration | Small-scale low carbon generation technologies often applied in the domestic or commercial setting. |
| ONS | Office of National Statistics |
| Part L 2006 | A section of the 2006 Building Regulations which sets a minimum standard of energy efficiency for dwellings up to October 2010. All carbon reduction targets proposed within this document or as part of the national roadmap are quoted as a % improvement in $CO_2$ above this standard. |
| PV | Photovoltaic |
| RSL | Registered Social Landlord |
| Regulated energy | Includes those forms of energy use covered in Building Regulations. This includes all fixed consumption inherent in the building, e.g. fixed lighting, space heating, water heating. |
| RHI | Renewable Heat Incentive. |
| ROC | Renewable Obligation Certificate |

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| SAP | Standard Assessment Procedure |
| SHLAA | Strategic Housing Land Availability Assessment |
| TW | Terawatt. A unit of power equivalent to 1,000,000,000,000 watts. |
| TWh | Terawatt hour. A unit of energy equivalent to one Terawatt of power being expended for one hour. |
| Unregulated energy | Those energy uses not covered by Building Regulations.  This includes energy consumed by 'plug-in' appliances (e.g. standing lamps, TVs) and/or cooking. |
| VOA | Valuation Office Agency |

# 1. Introduction

## 1.1 Aims of the study

This study provides a technical baseline assessment of Cheshire West and Chester's (from herein referred to as 'the Borough') energy demand and low carbon renewable energy resource for Cheshire West and Chester Council (from herein referred to as 'the Council').

It forms part of the evidence base for the Council to obtain a key understanding of the main opportunities and constraints facing renewable (and "low carbon") energy deployment in the Borough. This evidence base will inform the preparation of the Council's Core Strategy, including the preferred options for the development strategy, objectives and planning policies for the Borough.

The study has been prepared in line with national guidance which states that planning authorities should have "an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies".

The key objectives of the study were to:

- Provide baseline data on current and future energy demands.
- Assess the opportunities for commercial and decentralised low carbon and renewable energy production.
- Assess the infrastructure required to deliver the use of low-carbon and renewable energy sources and information to inform the Infrastructure Delivery Plan.
- Advise on the role of planning obligations/community infrastructure levy in securing any supporting infrastructure.
- Include a heat mapping exercise for the Borough, providing data on heat users and suppliers and the potential for decentralised energy networks and provide GIS data and maps displaying the outputs from this work.
- Recommend planning policies to be included in the Core Strategy and a monitoring framework for these policies.
- Develop potential local level targets for low-carbon and renewable energy generation and local sustainable building targets for new development.

## 1.2 Overview of approach

The key steps of the methodology for undertaking this renewable energy baseline and opportunities study are outlined in Figure 1-1 below.

Current energy consumption within the Borough has been assessed according to the baseline year of 2009, and projections made about future levels of consumption. This forms the basis for evaluating the potential contribution that renewable energy can make to the Borough's energy needs.

The technical renewable energy resource has been quantified and mapped where appropriate. This technical potential has fed into predicted deployment scenarios for renewable energy in the Borough for 2020 and 2030. In addition, a heat mapping exercise has identified areas of district heating potential where combined heat and power systems could be deployed. These patterns of supply and demand for renewable energy have then been brought together to highlight the key opportunities for deploying renewable energy in the Borough. The scope of the report was also widened to consider alternative energy sources, namely geothermal and coal bed methane. Whilst coal bed methane is not a renewable resource, nor is it low carbon by default, any identified resource could contribute to energy security in the Borough.

This study has been completed in line with guidance provided by national Government, following the 'Renewable and Low-carbon Energy Capacity Methodology for the English Regions', as commissioned by the Department of Energy and Climate Change (DECC) in January 2010.

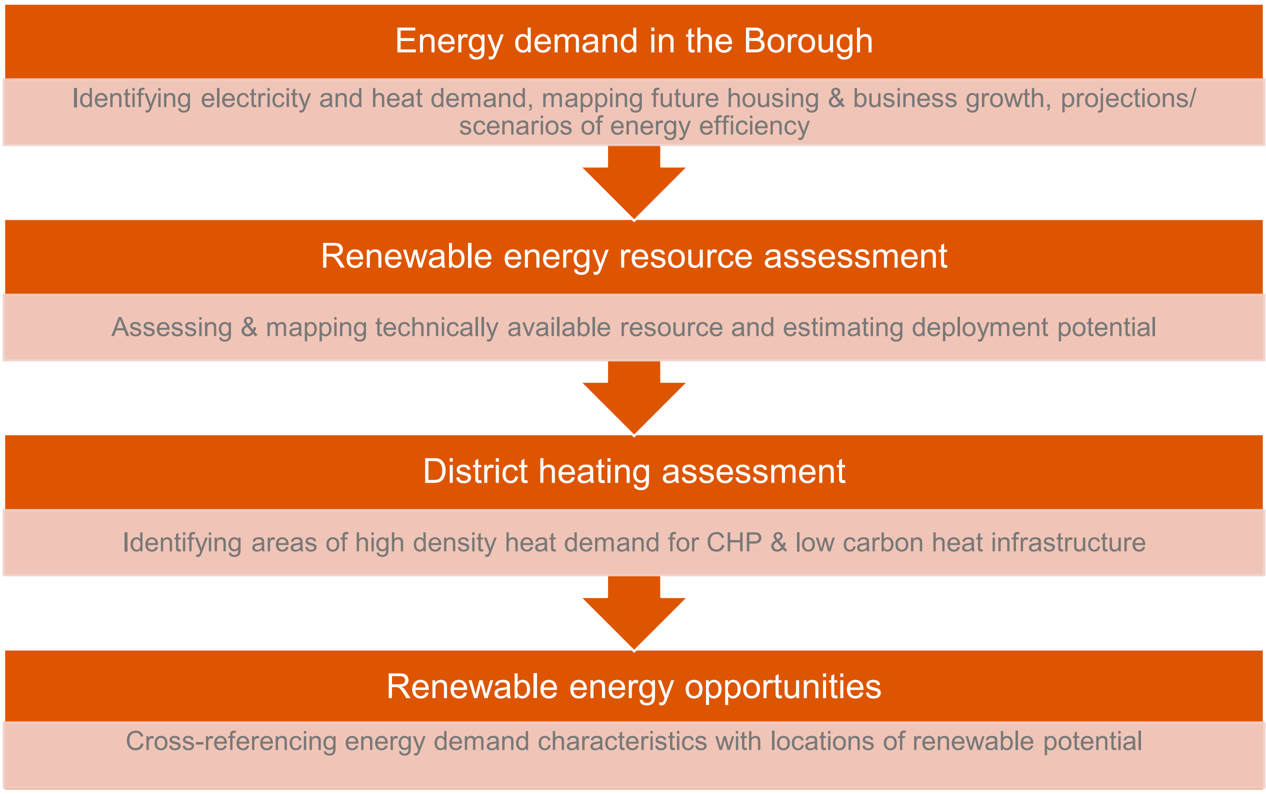



**Figure 1-1. Key steps in the assessment of renewable energy opportunities in the Borough**

## 1.3 North West Renewable and Low Carbon Energy Capacity Study

The North West Renewable and Low Carbon Energy Capacity study was completed in August 2010 and provides an assessment of the potential renewable energy and district heating resource across the whole of the North West region. The study followed the Government's recommended methodological approach prescribed by the Department of Energy and Climate Change (DECC, see section **Error! Reference source not found.**) in providing an estimate of the region's renewable energy potential. The Northwest study provides a useful overview of the renewable energy resource across the region and the relative position of the Borough.

The Northwest study provides useful data for this assessment. However, further analysis was required to build on the findings and provide an evidence base specifically for the Borough, since data within the North West Study was not at the lowest level of resolution for all technologies and resources.

# 2. Climate change and energy policy

There is a wide range of national policy which influences low carbon and renewable energy development in the UK and the Borough. A significant amount of new legislation and policy has recently been put in place.

- Climate Change Act

The Climate Change Act 2008 introduced a statutory target of reducing carbon dioxide emissions by at least 80% below 1990 levels by 2050, with an interim target of 34% by 2020. Government departments have prepared carbon budgets to indicate how greenhouse gas emissions will be reduced across the Government estate and in sectors where each takes a policy lead. The Act also created a framework for climate change adaptation. A national Climate Change Risk Assessment has also been completed.

- 4th Carbon Budget

The Climate Change Act requires Parliament to set 'carbon budgets' for 5 year periods which sets the maximum amount of emissions to be emitted in order to hit the target of 80% reduction in carbon emissions by 2050. Within this context, the Committee on Climate Change published the 4th Carbon Budget in December 2010 which sets out the required pathway for the period 2023-2027 and considers the level of emissions for ensuring long term compliance with the 2050 target. According to the report, it is recommended that the UK decreases its emissions by 50% by 2025 (below 1990 levels) within the 'Domestic Action Budget' i.e. without the support from the international carbon markets. In May 2011, the government announced its commitment to adopt the recommendations of Committee on Climate Change and the recommended target is now legally binding.

- 15% renewable energy target

In response to EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources, the UK has committed to sourcing 15% of its energy from renewable sources by 2020 – a five-fold increase on the share of about 3% in 2009, in less than a decade. This target covers all energy needs, including electricity, heat and transport.

- Renewable Energy Review, Committee on Climate Change, May 2011

In 2010, the Government asked the Committee on Climate Change to review the potential for renewable energy and provide advice on suitable future renewable energy targets, specifically the level of appropriate ambition beyond 2020. The Committee on Climate Change published its findings in May 2011 and the Renewable Energy Review provides options for renewable electricity and renewable heat targets for 2030 and beyond.

- Feed-In Tariff (FIT) and Renewable Heat Incentive(RHI)

The Feed in Tariff (FIT) came into effect on 1 April 2010 and provides generation-linked payments for a range of small scale renewable electricity technologies of <5MW: wind, hydro, anaerobic digestion, micro CHP and PV.

The Renewable Heat Incentive (RHI) is a tariff-based scheme with payments made to the generators of renewable heat per unit of heat output. It is available for all scales of installation within industrial, public and commercial sectors from autumn 2011. The scheme will be extended to the domestic sector in 2012 with an interim arrangement ('RHI Premium Payment') put in place to provide around £15m of grants for renewable heat installations, equivalent to around 25,000 homes. Unlike FIT, the RHI will be paid from general taxation rather than a pass through to consumer energy bills.

The existence of these support mechanisms is very relevant for the findings of this study as both the FIT and RHI can transform eligible renewable energy technologies into viable investment options and hence accelerate the rate of uptake of these technologies.

## 2.1 Planning and building control policy

- **Draft National Planning Policy Framework and Localism Act**

Note that at the time of writing this report, the NPPF was still at draft stage and so this commentary refers to the NPPF as a draft and not as the final issued document.

Planning policy in the UK is undergoing substantial change following national consultation on the draft National Planning Policy Framework that took place during summer 2011. The draft Framework aims to streamline the planning system with simplified planning guidance and a speeding up of planning decisions. Decentralisation of decision-making is also a key feature of these planning reforms with neighbourhood plans simultaneously being introduced through the Localism Act.

A key element of the NPPF proposals is a 'presumption in favour of sustainable development' which requires local planning decision-making to favour development if it contributes to the Government's definition of sustainable development. The draft Framework explicitly mentions renewable energy as a component of sustainable development and makes it clear that local authorities should consider identifying suitable areas for renewable and low-carbon energy. The NPPF supports the delivery of low carbon and renewable energy through the 'presumption in favour' approach.

When it comes into force in 2012 or 2013, the new National Planning Policy Framework will replace the PPS1 Supplement on Climate Change which has been a key policy document in encouraging local planning for renewable energy. However, until the new Framework comes into force the PPS1 Supplement and accompanying documents are still the Government's official planning policy documents on climate change issues.

- **Planning Policy Statement 1 (PPS1) and PPS1 Supplement: Delivering Sustainable Development**

PPS1 and the PPS1 Supplement have had a key role over the past few years in encouraging local authorities to compile accurate renewable energy evidence bases on the potential within their areas so as to inform planning policy. PPS1 expects new development to make good use of opportunities for decentralised and renewable or low-carbon energy. The supplement to Planning Policy Statement 1 'Planning and Climate Change' highlights situations where it could be appropriate for planning authorities to anticipate levels of building sustainability in advance of those set nationally. This could include where:

- There are clear opportunities for significant use of decentralised and renewable or low carbon-energy; or
- Without the requirement, for example on water efficiency, the envisaged development would be unacceptable for its proposed location.

PPS1 requires local planning authorities to develop planning policies for new developments that are based on:

*"….an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies, including microgeneration".*

- **Planning Policy Statement 22 (PPS22): Renewable Energy**

PPS22 sets out the Government's policies for renewable energy, to which planning authorities should have regard when preparing Local Development Documents and when taking planning decisions.

Local policies should reflect paragraphs 6-8 of PPS22 which states that:

- o *Planning applications for renewable energy projects should be assessed against specific criteria set out in regional spatial strategies and local development documents. Regional planning bodies and local planning authorities should ensure that such criteria-based policies are consistent with, or reinforced by, policies in plans on other issues against which renewable energy applications could be assessed.*
- o *Criteria based policies should be set out in regional spatial strategies where these can be applied across a region, or across clearly identified sub-regional areas. These criteria should then be used to identify broad areas at the regional/sub-regional level where development of particular types of renewable energy may be considered appropriate. Other criteria based policies to reflect local circumstances should be set out by local planning authorities in their local development documents. Local planning authorities should, however, only focus on the key criteria that will be used to judge applications. More detailed issues may be appropriate to supplementary planning documents.*
- o *Local planning authorities may include policies in local development documents that require a percentage of the energy to be used in new residential, commercial or industrial developments to come from on-site renewable energy developments.*

- **Zero carbon timeline and allowable solutions**

The Government has set out a timeline for improving the carbon performance of new developments through tightening Building Regulation standards for new homes (set out in the Governments 'Building a Greener Future' document):

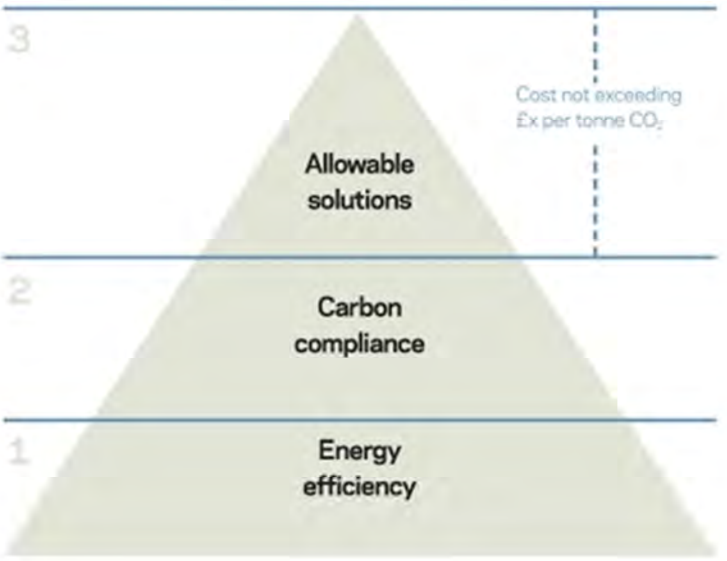
- 2013 – 44% carbon reduction beyond 2006 requirements; and,
- 2016 – 100% carbon reduction beyond 2006 requirements.

In the March 2008 budget Government also announced its intentions for all non-domestic buildings to be zero carbon by 2019. Therefore, new development going forward across the Borough will face tighter mandatory requirements, and all housing development after 2016 will need to account for all carbon emissions from regulated energy uses under current national Government proposals.

The Government is introducing a more flexible definition of 'zero carbon' to guide building policy which will apply a minimum requirement for energy efficiency and on-site renewable energy, and a set of off-site 'allowable solutions' to allow the residual emissions to be offset. The allowable measures have yet to be fully defined but could include large scale off-site renewable energy infrastructure, investment in energy efficiency measures for existing building stock, energy efficient white goods and building controls, or Section 106 contributions. The Government's proposed Energy Hierarchy structure is set out in the diagram below. This structure acknowledges the cost implications and the 'real world' effectiveness of design improvements to achieve higher energy efficiency performance.

This proposed structure also recognises the distinction between onsite building-level improvement measures (both energy efficiency measures and carbon compliance technologies), as well as allowable solutions which are expected to take the form of off-site stand-alone energy schemes or other carbon reduction measures that lie outside of the site red line. Both site-level and offsite-level solutions should therefore be considered separately but in coordination, as part of the overall energy mix looking forward to zero carbon new development.

Fig 1 The government's preferred hierarchy




Local Authorities could develop a Carbon Offset Fund in preparation for the allowable solutions mechanism so that funds can be effectively targeted towards low carbon infrastructure.

Future developments in the Borough will therefore need to achieve minimum fabric standards and some onsite renewable energy generation, with financial contributions for investment in allowable solutions to offset the residual emissions. For any specific development site, developers will need to assess the prospects for different technical solutions including combined heat and power, biomass, medium to large scale wind turbines, heat pumps, PV and solar water heating before determining the contribution of allowable solutions in offsetting the residual carbon emissions. Building Regulations will therefore drive the growth of renewable energy in the county.

- **Permitted Development Rights**

The General Permitted Development Order[2] removes the requirement to apply for planning permission to install domestic microgeneration equipment since this falls under what is referred to as permitted development. This includes the microgeneration technologies covered in chapter **Error! Reference source not found.** - solar PV, solar thermal, ground source and air source heat pumps and micro wind turbines. Certain exemptions from, and restriction to, the GPDO apply, including the exclusion of micro wind and the requirement for approved technologies to meet particular design requirements. In general terms this relaxing of the planning legislation is intended to remove barriers and drive the uptake of these technologies.

[2] *The Town and Country Planning (General Permitted Development) (Amendment) (England) Order 2011*

## 3. Energy consumption in the Borough

### 3.1 Current energy consumption and carbon emissions in the Borough

**The Borough's annual energy consumption is presented in**

Table 3-1 broken down by sector (domestic, non-domestic and transport) and by historic local authority area. The most up to date statistics produced by DECC[3] were used to calculate annual energy consumption, resulting in a base year for this study of 2009. This was a time of economic recession in the UK, circumstances which typically result in lower energy consumption since levels of production and consumption within the economy are lower than at times of economic growth.

It should be noted that this data precedes the re-organisation of local government in the Borough, hence it is available broken down by the three old local authority areas. In future years this breakdown will not be available and energy consumption will be presented as one figure for the Borough.

| | (Gigawatt hours GWh) | | | |
|---|---|---|---|---|
| | Industrial & commercial | Domestic | Transport | TOTAL |
| Former Chester | 1,177 | 1,068 | 1,609 | 3,854 |
| Former Ellesmere Port & Neston | 13,064 | 669 | 458 | 14,191 |
| Former Vale Royal | 1,479 | 1,109 | 1,381 | 3,970 |
| **Total Borough** | **15,720** | **2,847** | **3,449** | **22,015** |

**Table 3-1. Annual energy consumption in Cheshire West and Chester (2009)**

Table 3-1 highlights how energy is consumed in the Borough by sector. Of particular interest is the high consumption of energy by the industrial and commercial sector, specifically in Ellesmere Port and Neston. In 2009 this accounted for almost 60% of all energy consumed within the Borough and is considerably greater than energy consumed within any other sector or location. Further investigation was carried out to identify the source of this large consumption, including consultation with DECC. This revealed that the majority of energy consumed is industrial fuel burnt at the Stanlow refinery in Ellesmere Port. Stanlow refinery is the second largest oil refinery in the UK and accounts for approximately one sixth of the UK's petrol production[4]. The predominant fuels burnt at the refinery are petroleum coke and other petroleum gases (OPG) which are used to generate heat and power for use in the refinery operations. DECC have clarified that this energy is attributable to processing the fuel rather

[3] *2009 energy consumption statistics produced by DECC, available at:*
*http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/regional/electricity/mlsoa_2009/mlsoa_2009.aspx*
*http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/regional/road_transport/road_transport.aspx*
*http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/regional/other/other.aspx*
[4] *http://www.shell.com/home/content/media/news_and_media_releases/2011/sale_essar_stanlow_refinery_29032011.html*

than it being a raw product input to the petrol produced and is therefore consumed on site and within the Borough.

Whilst large industrial energy consumption in a Local Authority area is not unique, it does present a challenge to arrive at low carbon / renewable energy targets which are typically expressed (as per the national target) as a percentage of energy consumption.

Figure 3-1 presents the total energy consumption figures for the Borough from

Table 3-1 and includes more detail about energy use. This highlights the significance of the consumption of industrial fuels at the Stanlow refinery as described above, which far outweighs all other forms of energy consumption. Energy consumed in the form of transport fuels is also significant compared to the built environment and consistent with UK trends. Thermal energy consumption is higher than electrical in the domestic sector, with the opposite true for the industrial and commercial sector, as would be expected.

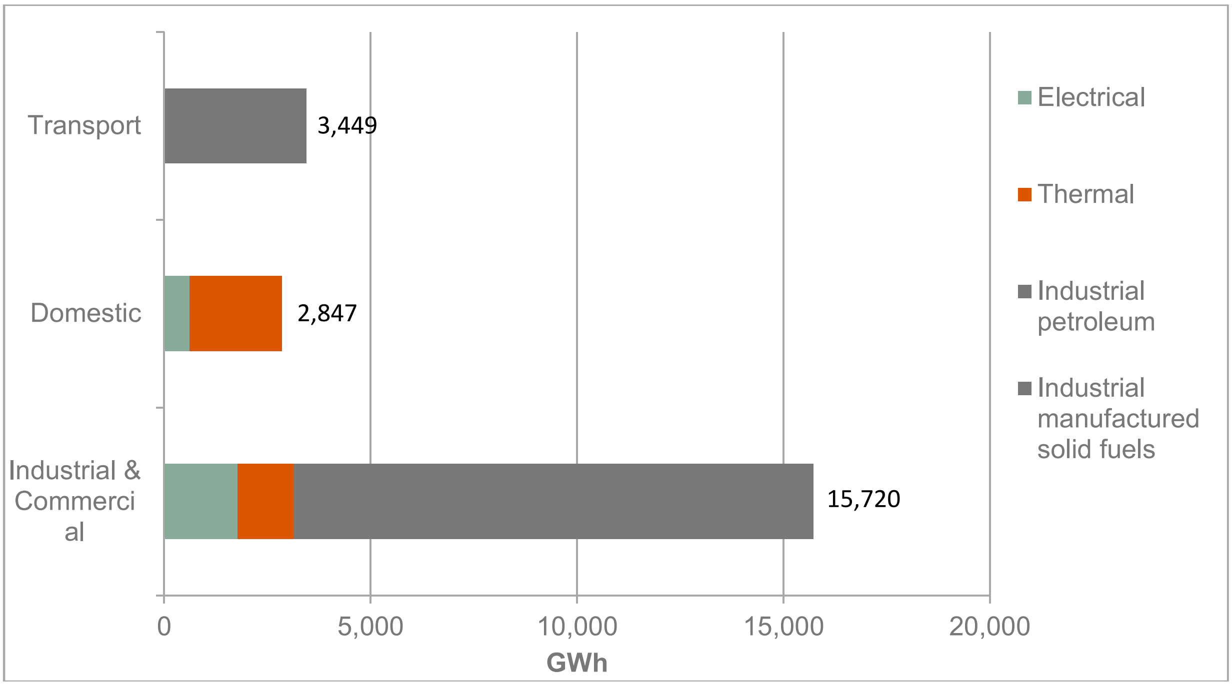



**Figure 3-1. Cheshire West & Chester energy consumption breakdown (2009)**

Due to the high consumption of industrial fuels in the Borough as explained above, it is worth considering how total energy consumption within the Borough compares to that in the wider North West region and Great Britain as a whole. A suitable metric for this is energy consumption per capita, where total energy consumption is apportioned to the number of inhabitants in an area. Table 3-2 shows how average energy consumption in the Northwest is in line with the national average for Great Britain and in the region of 25-26 Megawatt-hours (MWh) per head of population per year. However, the average for the Borough is 2.7 times greater at over 67 MWh per person per year. This can be explained by the vast quantities of industrial fuels consumed in Ellesmere Port, in particular at the Stanlow refinery.

Consideration is given to these circumstances when targets are set for generating renewable energy generation in chapter 14 of this report.

| Area | Average energy consumption (MWh/capita/year) |
|---|---|
| Cheshire West & Chester | 67.4 |
| Northwest | 25.9 |
| Great Britain | 25.3 |

**Table 3-2. Average energy consumption in the Borough, Northwest and Great Britain (2009)**

Figure 3-2 provides a breakdown of carbon emissions in the Borough in 2009. These emissions figures were calculated using detailed statistics that form the basis of the energy consumption figures presented in

Table 3-1 and DEFRA's latest (2011[5]) GHG emission factors.

Carbon emissions (expressed as Carbon Dioxide equivalent throughout this report) arising from energy consumed within the Borough totalled 5,839,390 tonnes$CO_2$ in 2009. As shown in Figure 3-2, emissions from the industrial and commercial sector contributed significantly to this total. This includes emissions from the burning of OPG and petroleum coke which totalled 3,032,426 tonnes$CO_2$, the majority of which can be attributed to operations at the Stanlow refinery as explained previously. Other significant contributors to total carbon emissions in Borough include consumption of electricity in both the domestic and non-domestic sectors, along with fuel used for transport.

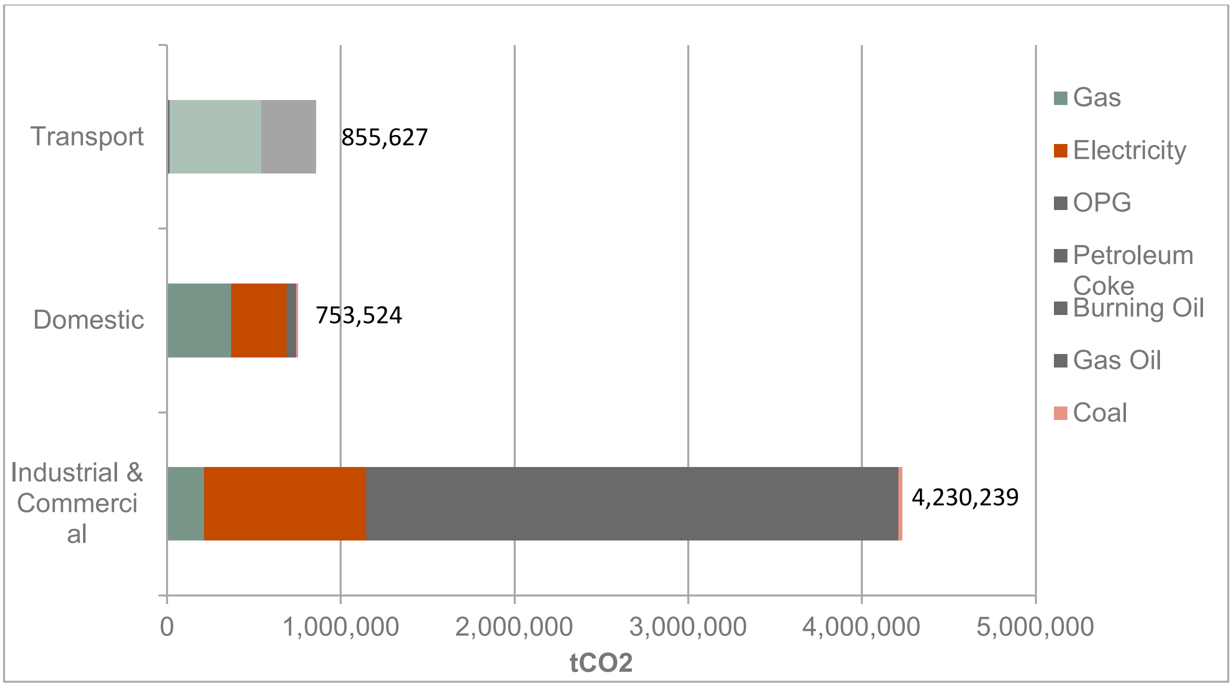



**Figure 3-2. Cheshire West & Chester carbon emissions breakdown (2009)**

*5 Defra / DECC's GHG Conversion Factors for Company Reporting (2011), available at:*
*http://archive.defra.gov.uk/environment/business/reporting/pdf/110707-guidelines-ghg-conversion-factors.pdf*

## 3.2 Projection of future energy consumption in the Borough

Projections of future energy consumption in the Borough to 2020 and 2030 are presented in Figure 3-3. These projections are based on known energy consumption in 2009 and DECC projections[6] about future energy consumption in the UK. Estimates for the energy requirements of new developments have also been included. DECC projections have not been applied to industrial fuel consumption (manufactured solid fuels and petroleum) since this is largely attributable to one large consumer at the Stanlow refinery and it is not appropriate to apply national trends to a single site. Instead, industrial fuel consumption is assumed to stay constant over the period.

As shown in Figure 3-3, total energy consumption in the Borough is expected to fall slightly between 2009 and 2020. This is a result of reduced consumption in both the domestic (electrical and thermal) and non-domestic (thermal) sectors, arising in part from energy efficiency improvements and rising energy prices. By 2030 total energy consumption is projected to rise marginally, from increased consumption of electricity in the non-domestic sector and a sustained rise in the consumption of transport fuels.

The energy consumption projections presented in Figure 3-3 are used in subsequent sections of the report to draw comparisons between renewable energy generation and total energy consumption in the Borough in 2020 and 2030.

[6] *DECC 2011 energy and emissions projections (central scenario), available at: http://www.decc.gov.uk/en/content/cms/about/ec_social_res/analytic_projs/en_emis_projs/en_emis_projs.aspx*

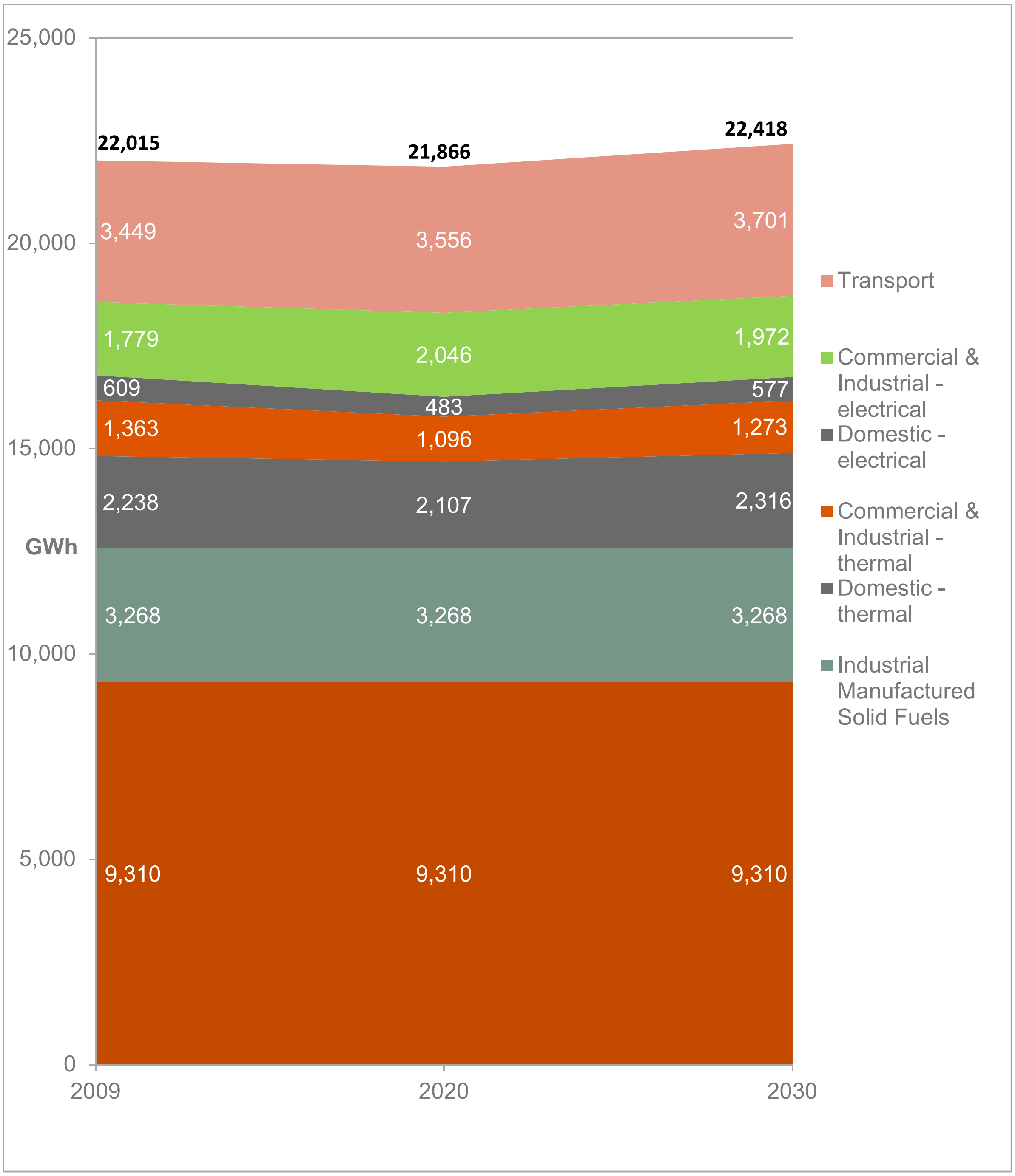



**Figure 3-3. Projection of energy consumption in the Borough to 2020 and 2030**

## 3.3 Current installed capacity

Table 3-3 provides a summary of existing renewables in the Borough in terms of installed capacity and energy generation. Capacity refers to the maximum technical capacity of energy equipment to generate energy and is expressed in Watts of power. When the load profile of the equipment is applied, the energy generation, expressed in kilo-Watt-hours, is determined. Energy generation from existing renewables is also stated in terms of the per cent contribution to total energy consumption in the Borough in 2009.

At the time of writing this report there were no commercial-scale wind energy sites operational in the Borough, nor were there any hydro-electricity schemes according to the various sources of information consulted. A negligible capacity of small-scale wind energy exists, coming from two small turbines that have been developed since 2010 and registered under the Feed-in Tariff scheme. Around 500 solar PV systems have also been installed in the Borough under the FIT scheme providing 1.5MW of installed capacity. The largest contributor to installed capacity and energy generation harnesses the Borough's biogas resources including landfill and sewage gas, with a total installed capacity of 6.67MW.

Of the existing renewable energy installations summarised in Table 3-3, all make use of their respective technologies to generate electricity (rather than heat, or a combination of the two). In total, the current renewable energy generation identified would meet only 0.24% of the total energy consumed within the Borough (2009 levels of consumption). This is below the UK average which stood at 3% in 2009 and increased to 3.3% in 2010[7]. There are two clear reasons why renewable energy currently contributes only a small fraction to the total energy consumed in the Borough. The first relates to energy consumption, a large proportion of which results from the burning of vast quantities of industrial fuels at the Stanlow refinery. The second relates to the generation of renewable energy which does not currently include any commercial-scale wind, a technology which can generate energy on a large scale and one that is seen as crucial to increasing the supply of renewable energy in the UK.

Figure 3-4 presents the locations of existing renewable energy installations within the Borough, where these can be mapped effectively. Note that building scale renewable energy technologies (e.g. small scale wind, solar PV and heat pumps) cannot be mapped at this scale as location data is not available. This map also presents the locations of proposed low carbon and renewable energy schemes which are currently in the planning process.

[7] *DECC National Renewables Statistics (2011), available at: https://restats.decc.gov.uk/cms/national-renewables-statistics*

| Technology | (Electrical) Installed Capacity (MW) | Energy Generation[8] (GWh) | % of Borough energy consumption (2009) | Data source |
|---|---|---|---|---|
| Wind (commercial-scale) | 0 | 0 | 0.00% | RESTATS (2011) |
| Landfill gas | 6.21 | 49.0 | 0.22% | RESTATS (2011) |
| Biogas sewage | 0.46 | 3.6 | 0.02% | RESTATS (2011) |
| Hydro | 0 | 0 | 0.00% | RESTATS, Ofgem FIT register, British Hydropower Association (2011) |
| Solar PV | 1.5 | 1.14 | 0.01% | Ofgem FIT register (2011) |
| Wind (small-scale) | 0.017 | 0.021 | 0.00% | Ofgem FIT register (2011) |
| **Total** | **8.2** | **53.7** | **0.24%** | |

**Table 3-3. Existing renewable energy capacity in the Borough**

[8] *Energy generation figures were calculated based on installed capacity and the same technology specific assumptions used in the wider resource assessment*

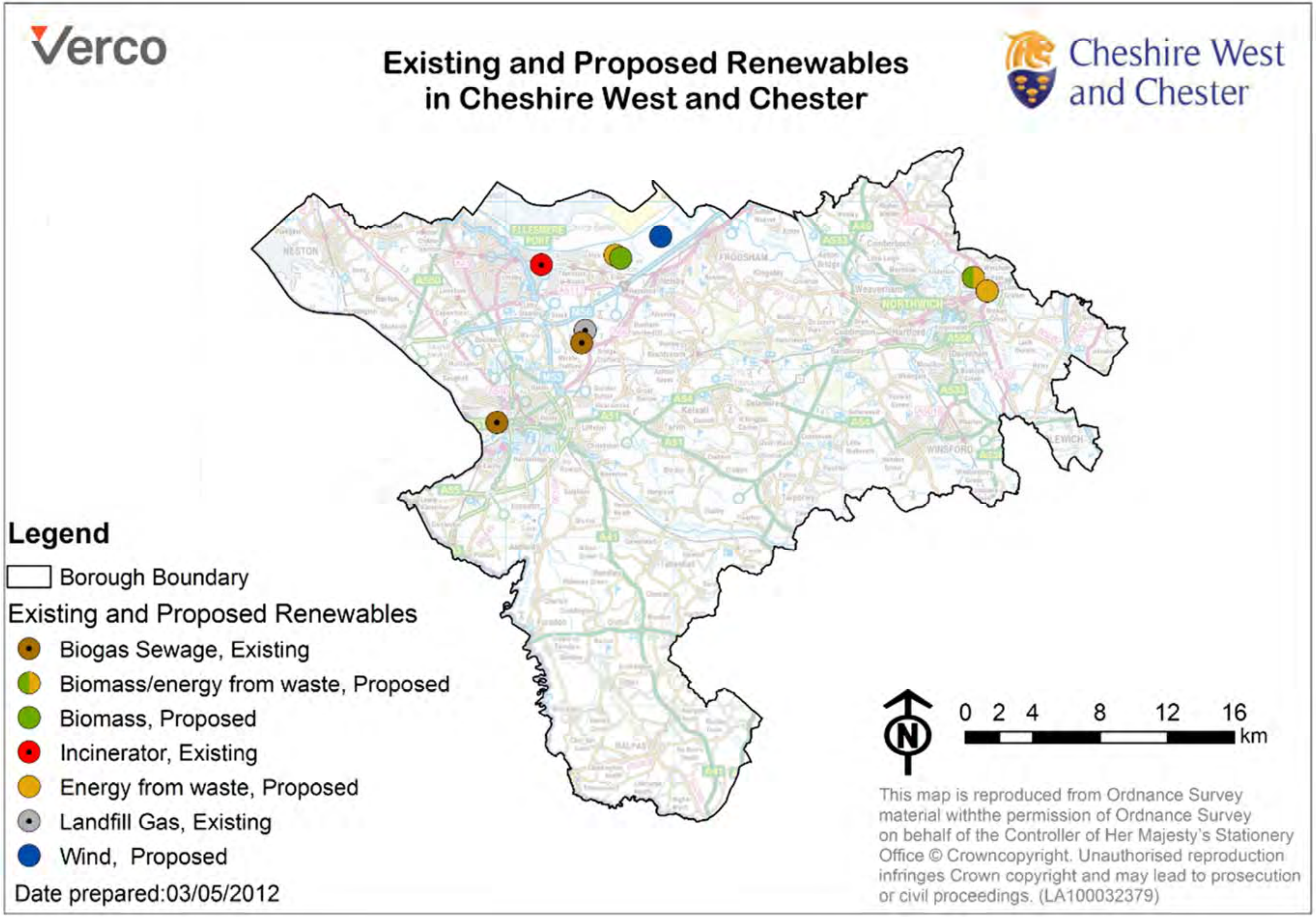



**Figure 3-4: Existing and Proposed Renewables in the Borough**

## 3.4 Fuel poverty and areas in the Borough off the gas grid

Figure 3-5 shows a map of the Borough and highlights where properties without a gas meter are concentrated, highlighted by the LLSOAs shaded in red. The map is based on data available from DECC[9] about the number of electricity and gas meters at LLSOA level. Economy 7 electricity meters were excluded from this analysis. Although properties with an Economy 7 meter will not have a gas meter, this is not a reliable indicator that they are off the gas grid. This is because some properties, in particular those constructed between 1980 and 2000, use electricity rather than gas to supply their heating requirements because this was the cheapest construction solution, rather than access to gas not being available. As a result, many properties with an Economy 7 meter are on the gas grid. The methodology is not entirely accurate and the results will be skewed by certain exceptions where a property has only one gas meter but numerous electricity meters, for example blocks of flats.

Therefore, the map provides a high level indicator of where off-gas grid properties are located, rather than an accurate geographical representation of where the gas grid penetrates. Heating properties off the gas grid requires more expensive fuel such as electricity and heating oil. As a result, the percentage of such households in fuel poverty is comparatively very high[10].

Figure 3.6 shows the spatial distribution of fuel poverty in the Borough, based on 2009 data published by DECC. The areas of the Borough where the proportion of households in fuel poverty is highest roughly correlates with the areas where Figure 3-5 indicates off-gas properties are located.

Where households in fuel poverty are off the gas grid, renewable energy technologies such as heat pumps provide an opportunity to alleviate fuel poverty by reducing electricity heating bills. However, the issue of fuel poverty should be tackled by an all encompassing approach that considers not only renewables but also measures to improve energy efficiency.

[9] *MLSOA electricity and gas statistics, DECC (2009) available at: http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/regional/electricity/mlsoa_2009/mlsoa_2009.aspx*

[10] *Energy and Climate Change Committee (2010), 'Energy and Climate Change – Fifth Report. Fuel Poverty'. Available at: http://www.publications.parliament.uk/pa/cm200910/cmselect/cmenergy/424/42402.htm*

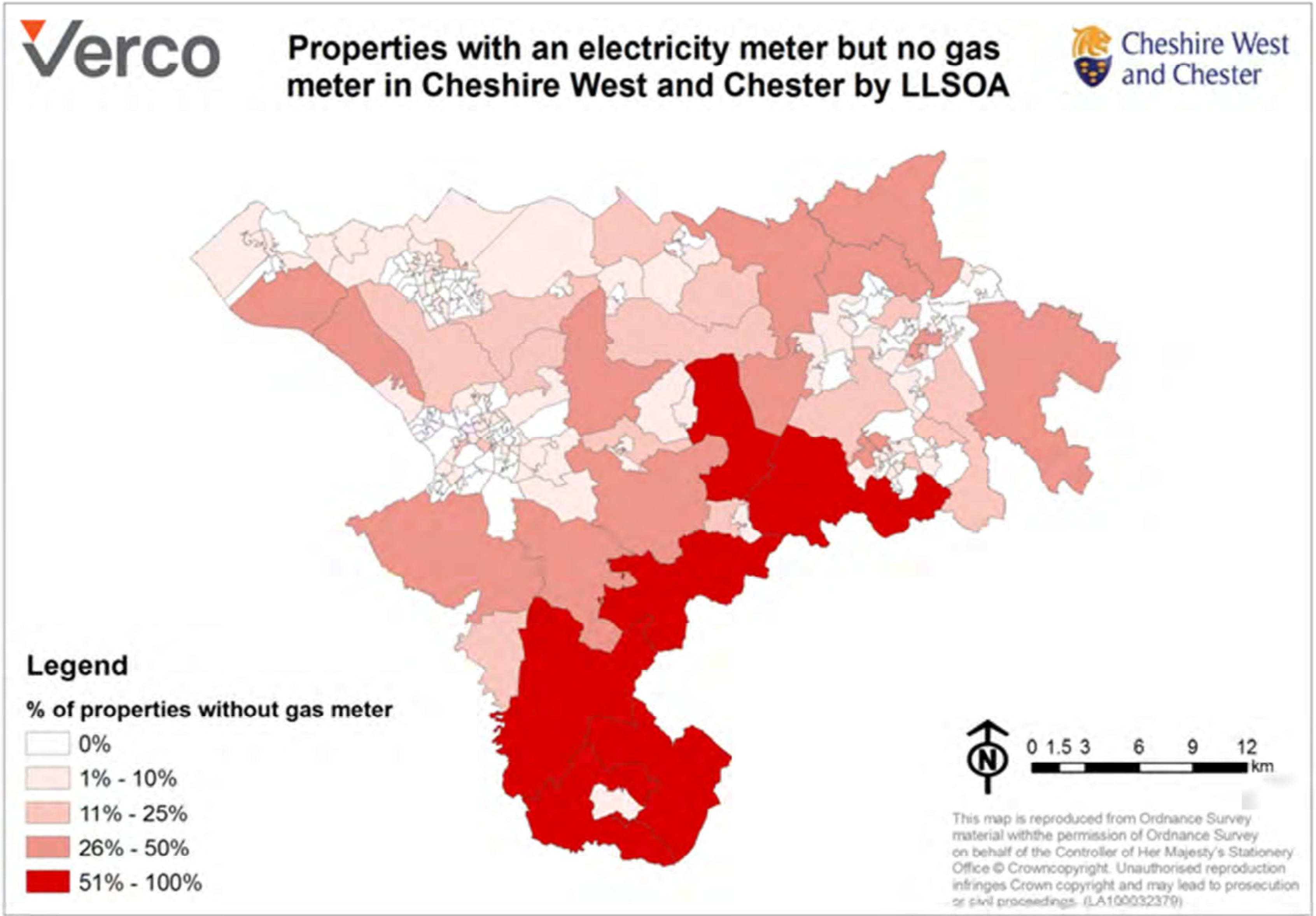



**Figure 3-5: Properties with an electricity meter but no gas meter**

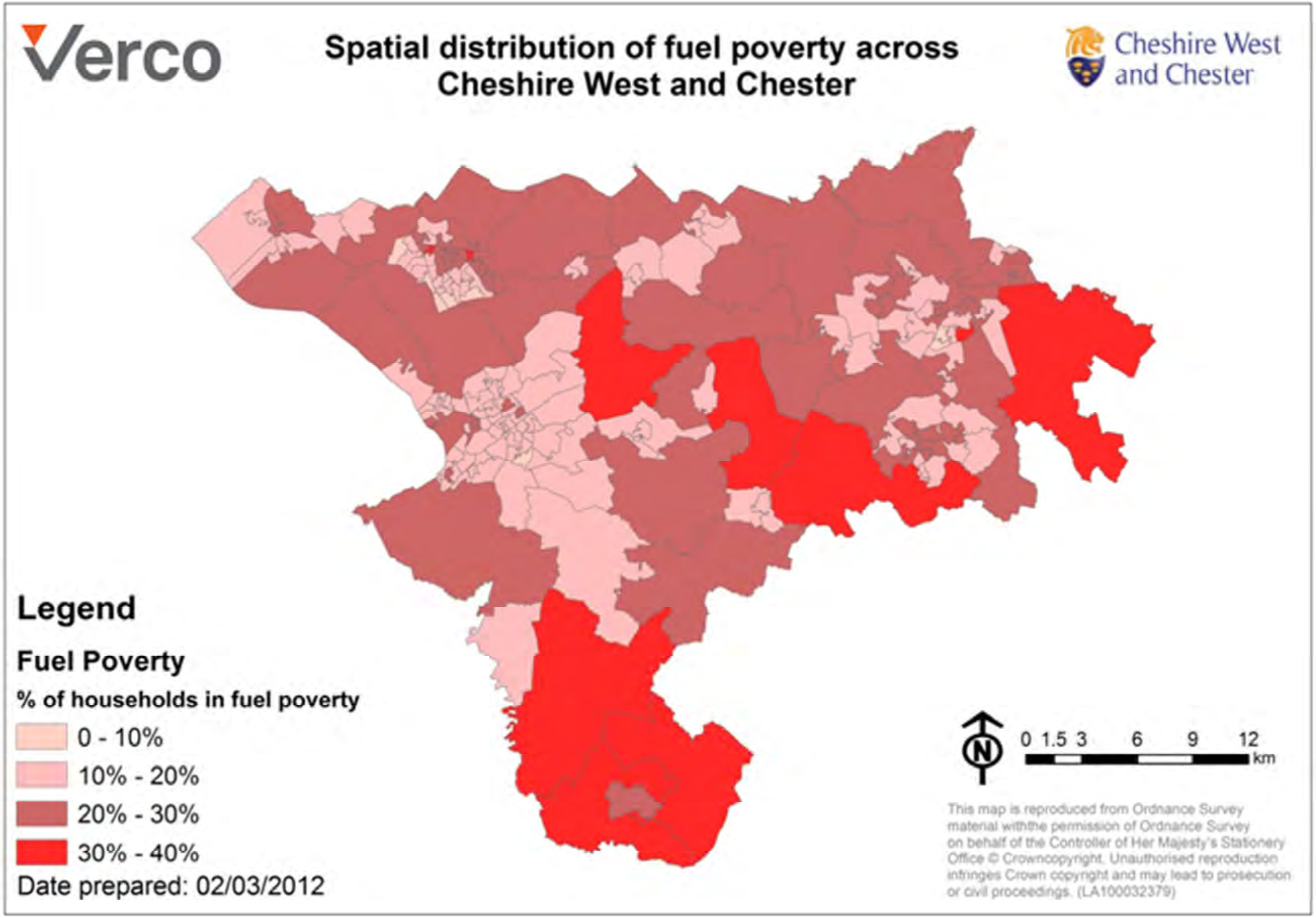



**Figure 3-6: Areas of fuel poverty in the Borough**

## 4. Renewable energy technical potential

### 4.1 Methodology

#### 4.1.1 Overview of approach

The assessment of the Borough's renewable energy technical potential has followed the key steps outlined in the Department of Energy and Climate Change's (DECC) recommended methodology. Figure 4-1 summarises the key stages of DECC's 'Renewable and Low-Carbon Energy Capacity Methodology for the English Regions' which aims to standardise regional assessments of the potential for renewable energy. The approach taken to assess the Council's renewable and low carbon energy potential has involved applying progressive layers of analysis to the theoretical potential, in order to establish a more realistically achievable potential. Although the diagram illustrates all 7 recommended stages of the assessment, the DECC methodology does not provide any guidance or criteria to address economic and supply chain constraints (stages 5 to 7). The impact of economic and deployment constraints are dealt with in later in this report so as to provide an assessment of the deployment potential of renewable energy in the Borough.

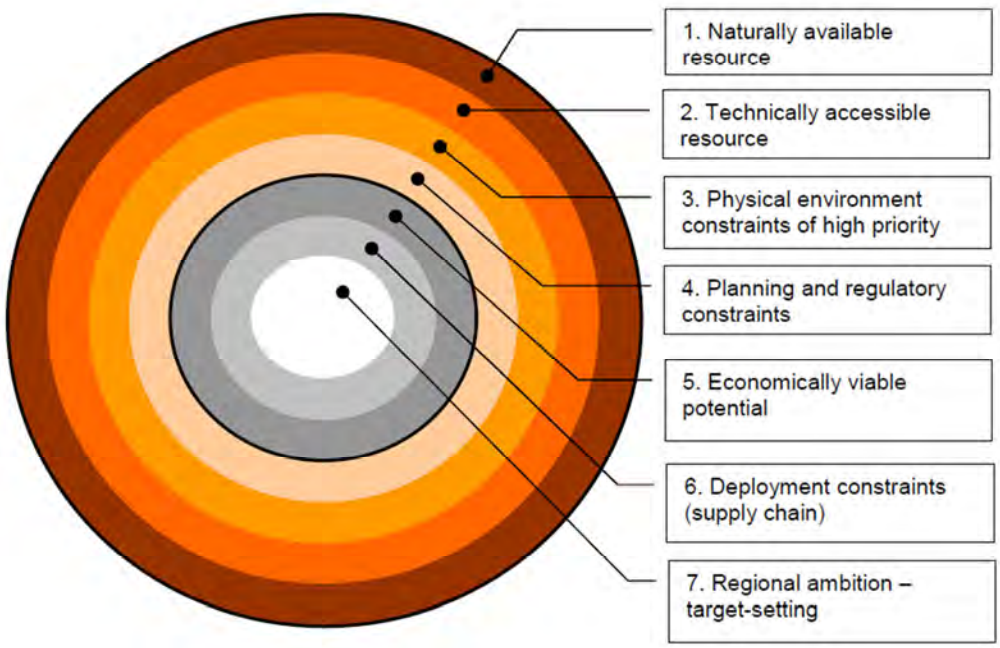



**Figure 4-1: Overview of DECC Methodology for undertaking renewable energy resource assessments (Source: DECC/SQW Energy)**

The four stages of the technical potential assessment are:

- Stages 1 and 2: Naturally available resource and technically accessible resource – this is the opportunity analysis of what currently available technology can capture and convert into useful energy.
- Stages 3 and 4: High priority physical environment constraints and planning and regulatory constraints – this is the constraints analysis of the restrictions that the physical environment and planning restrictions or other legislation places on the deployment of the technology.

The stage 1 to 4 assessments cover both the existing and the future built environment of the Borough as it includes the renewable energy potential associated with the planned new developments between 2009 (the base year for this assessment) and 2031.

The methodology was also widened to include alternative energy sources as part of the resource assessment, namely geothermal and coal bed methane. Neither geothermal nor coal bed methane are covered by the DECC methodology. Ground exploration experts GeoEnergy Ltd carried out this part of the resource assessment using their own bespoke methodology. For the study of geothermal resource, published material from the British Geological Survey was used to assess heat flow and thermal gradient. Transmissivity was estimated by analogy with the producing oil and gas fields of the East Irish Sea Basin. For the CBM study, published data was used to estimate the resource within the Cheshire Basin.

# 5. Wind potential

## 5.1 Technology overview

Wind turbines convert the kinetic energy of the wind into electrical energy. Wind energy technology is available at a range of scales, from small turbines for mounting on a house up to commercial scale wind turbines generating megawatts of power which are over 100m tall. The conversion of the wind's kinetic energy to electrical energy is achieved using blades which generate aerodynamic when the wind blows across them, and this force is then used to turn a rotor, which is attached to an electrical generator.

The energy generated by a wind turbine is proportional to the cube of the wind speed, and as a result, the wind speed on the site is a critical factor for ensuring the viability of a wind turbine – a small difference in wind speed can result in a substantial variation in a turbine's financial viability. This also means that on less windy days, the turbines generate only a small proportion of their maximum output. Most wind turbines have a minimum wind speed below which they do not operate at all (the "cut-in" wind speed) and a maximum wind speed, above which they are stopped to protect the turbine from damage - this is typically around 50mph wind speed, and occurs for only a small amount of time each year. As a result, a typical wind turbine generates an annual amount of energy equivalent to its running at full output for approximately 25-30% of the hours in the year. This does not represent the "efficiency" of the turbine, but is an indicator of typical annual performance on a typical site.

The most common wind turbine design currently in commercial use consists of a large tower, a three-bladed horizontal axis rotor attached to the generator housing at the top of the tower. Single bladed and two bladed turbines are also available, but much less common, and are typically smaller sizes (e.g. medium scale).

We have considered wind technology at two scales for this study:

**Large Scale:** This relates to large turbines as are typically seen in commercial wind farms. These turbines have electrical output in the range 1-3MW, are typically 80 – 150m tall and have rotor diameters of 60-100m.

**Medium Scale:** This relates to turbines in the mid-range, typically installed as community projects, or on large farms/manufacturing sites. These turbines have electrical output in the range 100-500kW, are typically 40 – 70m tall and have rotor diameters of 20-40m.

## 5.2 Overview of approach

A Geographical Information System (GIS) analysis has been undertaken to identify areas of potential which are technically suitable for wind turbines. The methodology undertaken is a broad desktop analysis based on national datasets which identifies areas with reduced constraints, affecting the siting of wind turbines. The analysis does not identify sites which are suitable, but general areas with few major constraints. In order for a developer to bring a site forward, , detailed site specific assessment and a full planning application would be required accounting for a range of additional issues which cannot be assessed at the resolution of this study.

Our assessment has been carried out in two stages:

1. Assessment of the "technical potential" – this relates to stages 1 to 4 of the DECC methodology and calculates the maximum possible potential for wind energy based on simple physical constraints.

2. Assessment of the "deployable potential" – this relates to stages 5 to 7 of the DECC methodology and seeks to consider the impact of additional factors such as economic factors, landscape sensitivity, grid connections, etc. (see section 5.4 for further detail)

As each of these stages is distinct from the other, they have been presented as separate sections in this chapter of our report. This is necessary to separate the fully quantitative assessment of "technical potential" (for which the process defined by DECC is relatively clear cut) and the more subjective assessment of the "deployable potential" (where no clear guidance is given in the DECC methodology).

## 5.3 Assessment of technical potential

### 5.3.1 Technical potential - methodology

The 'technical potential' is defined as the wind generation that could be delivered if turbines are installed in all areas of potential which are not subject to absolute constraints to wind development. This equates to stages 1 to 4 of the DECC methodology.

Our methodology follows the DECC methodology for assessing wind potential and an overview of the process is summarised in Figure 5-1. There is one key refinement of the DECC methodology in that proximity to individual buildings is considered when eliminating areas of potential; the DECC methodology only excludes built up areas from the areas suitable for wind turbines.

The process is essentially that of mapping areas of potential where wind turbines could be located by applying a series of constraints that limit the geographical scope for installing turbines.

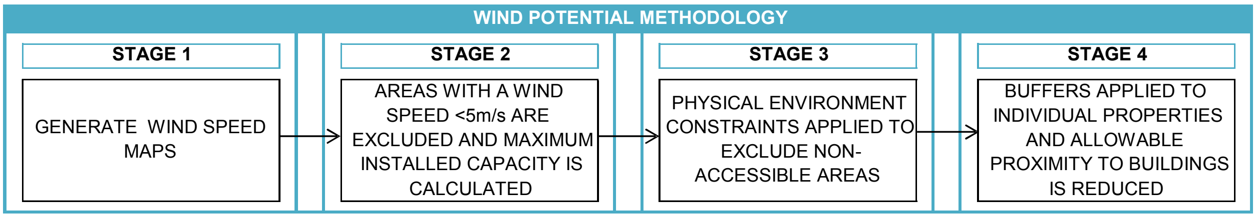



**Figure 5-1: Methodology for assessing the technical potential of wind in the Borough**

### 5.3.2 Scale and density of wind turbines

Two representative sizes of wind turbines have been considered in our study. Table 5-1 summarises the two turbines used as representative examples in our study, and the assumptions used to determine their performance in our assessment of technical potential.

| Scale | Reference turbine | Capacity | Hub height | Rotor diameter | Installation density[1] | Capacity factor[2] | Availability[3] |
|---|---|---|---|---|---|---|---|
| Large | Nordex N100 | 2.5MW | 85m | 100m | 4 turbines per sq. km | 25% | 95% |
| Medium | Vestas V27 | 250kW | 31m | 27m | 44 turbines per sq. km | 25% | 95% |

**Table 5-1: Wind turbine details and assumptions for generation potential**

Large-scale wind turbines are typically favoured commercially due to their considerably greater power output and much lower capital costs per kW installed. However, medium-scale turbines can be an alternative where smaller turbines are favoured due to their lower visual impact. The assessment has considered the potential from both large and medium scale wind turbines, and has assessed the potential output from a combination of large and medium scale turbines which would have the scope of increasing the potential through locating medium scale turbines nearer to buildings.

### 5.3.3 Absolute constraints

The absolute constraints that have been applied to the wind analysis in calculating the technical potential for large-scale wind turbines are outlined in Figure 5-1 below. These include the key constraints of buildings, roads, waterways, woodland, airports, MoD sites and buffer zones around these constraints. The assessment has also included International and National Landscape and Nature Conservation designations including Sites of Special Scientific Interest, Special Areas of Conservation, Special Protection Areas, National Nature Reserves and Ramsar Sites.

[1] *Separation distance between turbines is 5 rotor diameters as defined in the DECC methodology*
[2] *25% is taken as an reasonable estimate of performance, being a conservative reduction on the 10 year annual average wind farm performance of 28% (published by DECC, for all on-shore UK wind farms)*
[3] *Availability = the proportion of the time that the wind turbine is capable of operation (i.e. not under maintenance)*

| Assessment stage | Large scale turbines ( 2.5MW) | | Medium scale turbines ( 0.25MW) | |
|---|---|---|---|---|
| | Layer | Buffer | Layer | Buffer |
| **Stage 1: Naturally available resource** | Wind speed at 45 m above ground level | - | Wind speed at 25 m above ground level | - |
| **Stage 2: Technically accessible resource** | Exclude areas with wind speed @ 45m above ground level < 5m/s | - | Exclude areas with wind speed @ 25m above ground level < 5m/s | - |
| **Stage 3: Non accessible areas due to physical environment constraints** | Roads (A, B, and motorways) | - | Roads (A, B, and motorways) | - |
| | Railways | - | Railways | - |
| | Inland waters | - | Inland waters | - |
| | Residential properties | - | Residential properties | - |
| | Commercial buildings | - | Commercial buildings | - |
| | Airports and airfields | - | Airports and airfields | - |
| | MoD training sites | - | MoD training sites | - |
| **Stage 4: Areas where wind developments are unlikely to be permitted** | Ancient woodland | - | Ancient woodland | - |
| | Roads (A, B, and motorways) and Railways | 150m | Roads (A, B, and motorways) and Railways | 150m |
| | Residential properties | 600m | Residential properties | 400m |
| | Commercial buildings | 50m | Commercial buildings | 50m |
| | Civil airports and airfields | 5km | Civil airports and airfields | 3km |
| | MoD airbases | 5km | MoD airbases | 3km |
| | Sites of historic interest | - | Sites of historic interest | - |
| | International and National Designations for Nature Conservation | - | International and National Designations for Nature Conservation | - |
| | International and National Landscape designations | - | International and National Landscape designations | - |
| | Jodrell bank exclusion zone | - | Jodrell bank exclusion zone | - |

**Table 5-2: Parameters and constraints applied to the assessment of wind technical potential**

### 5.3.4 Deviations from the DECC methodology and the regional study

Our assessment features a number of key variations from the DECC methodology for assessment of the technical potential:

1. Buffers have been applied around individual buildings rather than built up areas only. This is treated as an absolute constraint (more detail provided below)
2. The exclusion zone around the Jodrell Bank observatory has been treated as an absolute constraint to wind development
3. Our assessment calculates the potential number of turbines based on the area of each individual area of potential. The DECC methodology simply sums up the total area of potential in the entire Borough and calculates the number of turbines based on this (as in the regional study). For example, for large turbines:

a. Verco's approach accounts for one large turbine on any area of potential of over $250m^2$, then one turbine for each ¼ $km^2$ of area as the area gets larger.
b. The DECC methodology would add up many small areas of potential until it totalled ¼ $km^2$, and treat this as a single turbine – this underestimates the potential number of wind turbines on smaller areas of wind potential, as it does not place one turbine in each location.

There are also two deviations from the approach used in the regional study:

1. We have not treated the military low fly zone as an absolute constraint; but have identified the likely scale of its potential impact on the total capacity figures – this has been done to allow for potential discussions with the MoD, rather than treating this as an outright constraints.
2. We have treated bird-sensitive areas as an absolute constraint rather than applying a reduced wind turbine density. No buffer zone is applied around bird sensitive areas in our methodology, or that of the regional study. Planning response to siting turbines in bird sensitive areas and their immediate vicinity varies; a reduced turbine density is sometimes accepted, but equally this can be a key basis for rejection of proposals. We have examined the significance of excluding these areas from the assessment rather than applying reduced wind turbine density and deem that the impact is minimal[4].

### 5.3.5 Buffers around individual buildings

The DECC methodology for large wind accounts for the presence of buildings by excluding urban areas and anywhere within 600m of an urban area from the areas with wind potential. In practice there are a significant number of buildings falling outside defined "urban" areas, therefore Verco's methodology excludes anywhere within 600m of a residential building, and within 50m of a commercial building.

This is demonstrated by Figure 5-2 below. "Areas of potential" are presented as a semi-transparent red area on the maps, urban areas as solid grey areas and residential buildings are presented as blue dots. Roads and railways are shown as coloured or cross hatched lines in line with normal conventions (red are A-roads, yellow, are B-roads, black crossed lines are rail lines). It is immediately clear from the reduction in size of the red area shown on the right hand image compared to that on the left that the impact of isolated residential buildings is substantial. Under the approach taken by DECC, many areas of potential are within very close proximity to residential buildings and the likelihood of objections during the planning process would be high.

[4] *There are two significant areas of bird sensitivity in or adjacent to the Borough – these are Ince Banks (adjacent to Ellesmere Port), and the Dee Estuary. The areas of bird sensitivity are mainly beyond the tidal limit –as the sea is excluded from the DECC methodology's wind assessment these would not be identified as areas of technical potential regardless of their conservation status.*

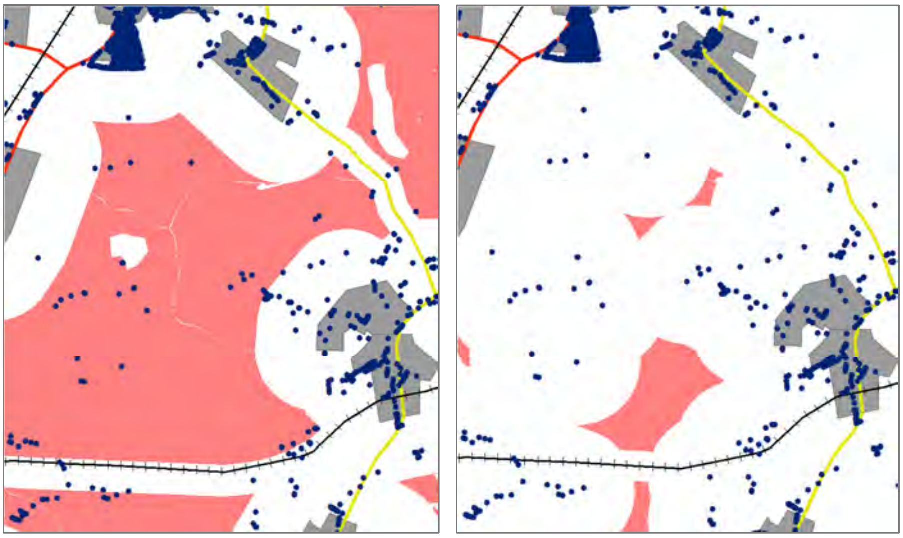


**Figure 5-2: Comparison of areas of potential with a buffer around urban areas (left) or buffers around individual buildings (right)[5]**

The buffers applied around individual dwellings are based on the typical distance required between the turbine and a dwelling to reduce noise impact to below the minimum acceptable level. The distances used by Verco represent a reasonably conservative separation distance from residential properties based on information provided by the BWEA[6]. The background noise level in a quiet bedroom is 35dB, and recommendations from the Wind Turbine Working Group[7] suggest that the change to the sound level due to wind turbine installations should be 5dB or less. Ten turbines at a distance of 500m from a house would generate sound levels of 35-45 dB; we have therefore added a further 100m safety margin to this distance for large turbines as the upper bound sits above the recommended maximum of 40dB. This results in a buffer distance of 600m. Medium turbines generate less noise[8] than large turbines, and have a lesser visual impact, so a distance of 400m has been used for these units.

In practice these distances may vary according to the landscape and layout of a particular site (e.g. noise reduced by terrain/trees, or amplified due to prevailing wind direction); however the figures we have used are representative of typical circumstances. With regard to non-domestic properties the buffer distance of 50m is based on existing precedent, as noise is far less critical issue – for example the Port of Liverpool Wind farm[9] consists of four turbines located on the docks, some of which are separated from adjacent buildings by less than their own height.

### 5.3.6 Technically suitable land - Large wind potential in the Borough

Figure 5-3 illustrates the land areas with technical potential for siting large scale wind turbines in the Borough, based on the constraints laid out in Figure 5-1. It should be noted that this is a static analysis using available data to account for most, but not all, delivery constraints for wind energy; the results

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[5] *These maps are reproduced from Ordnance Survey material with the permission of Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office © Crowncopyright. Unauthorised reproduction infringes Crown copyright and may lead to prosecution or civil proceedings. (LA100032379)*

[6] *http://www.bwea.com/ref/noise.html*

[7] *The Working Group on Wind Turbine Noise, The Assessment and Rating of Noise from Wind Farms, September 1996. ETSU-R-97.*

[8] *Noise level of Vestas V27 is circa 60dB at source (http://www.twtc.co.nz/assets/brochures/VestasV27.pdf) whereas noise level of a Vestas V100 2.6MW turbine is in the region of 100dBat source.*

[9] *http://www.peelenergy.co.uk/port-of-liverpool-wind-farm-*

therefore do not identify the areas of land that are exploitable, i.e. other areas within the Borough could support the development of wind energy in practice.

Figure 5-3 represents the less constrained areas for large scale wind energy in the Borough after all these constraints have been considered including environmental designations and the impact of the Jodrell bank exclusion zone. Figure 5-4 presents the same assessment for medium scale wind.

Housing growth and associated infrastructure over the coming decades may also reduce the total area that is potentially available for turbine locations. However, the impact of these development sites on the total area available to wind turbines is likely to be small overall, particularly as development sites are generally located on the immediate periphery of existing urban areas which are locations not usually available to turbines.

### 5.3.7 Additional wind potential as a result of medium scale turbines

Figure 5-4 illustrates the areas that could be available for medium scale turbines. These turbines could clearly be installed in any of the areas of least constraint for large turbines, plus the additional area available due to the reduced buffer around residential buildings (reduced from 600m to 400m). The additional land area is substantial due to the relatively small size of many of the areas with large wind potential.

### 5.3.8 Combined technical potential for large and medium scale wind

Figure 5-5 illustrates the maximum possible technical potential for commercial scale wind. This consists of large scale wind on all areas of least constraint for large wind, supplemented by medium scale wind in any additional areas suitable for medium wind but unsuitable for large wind.

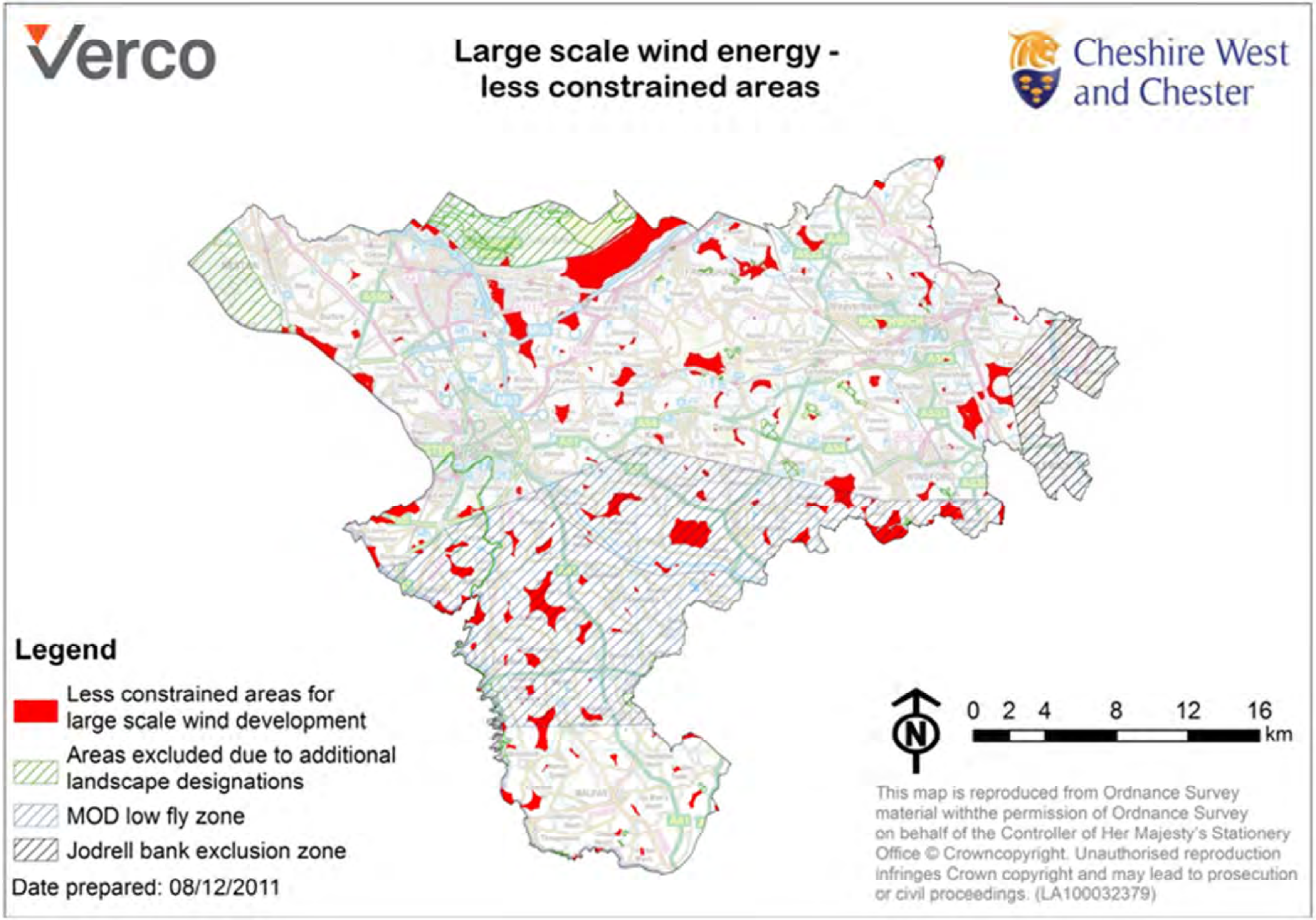


**Figure 5-3: Less constrained areas for large scale wind in the Borough**

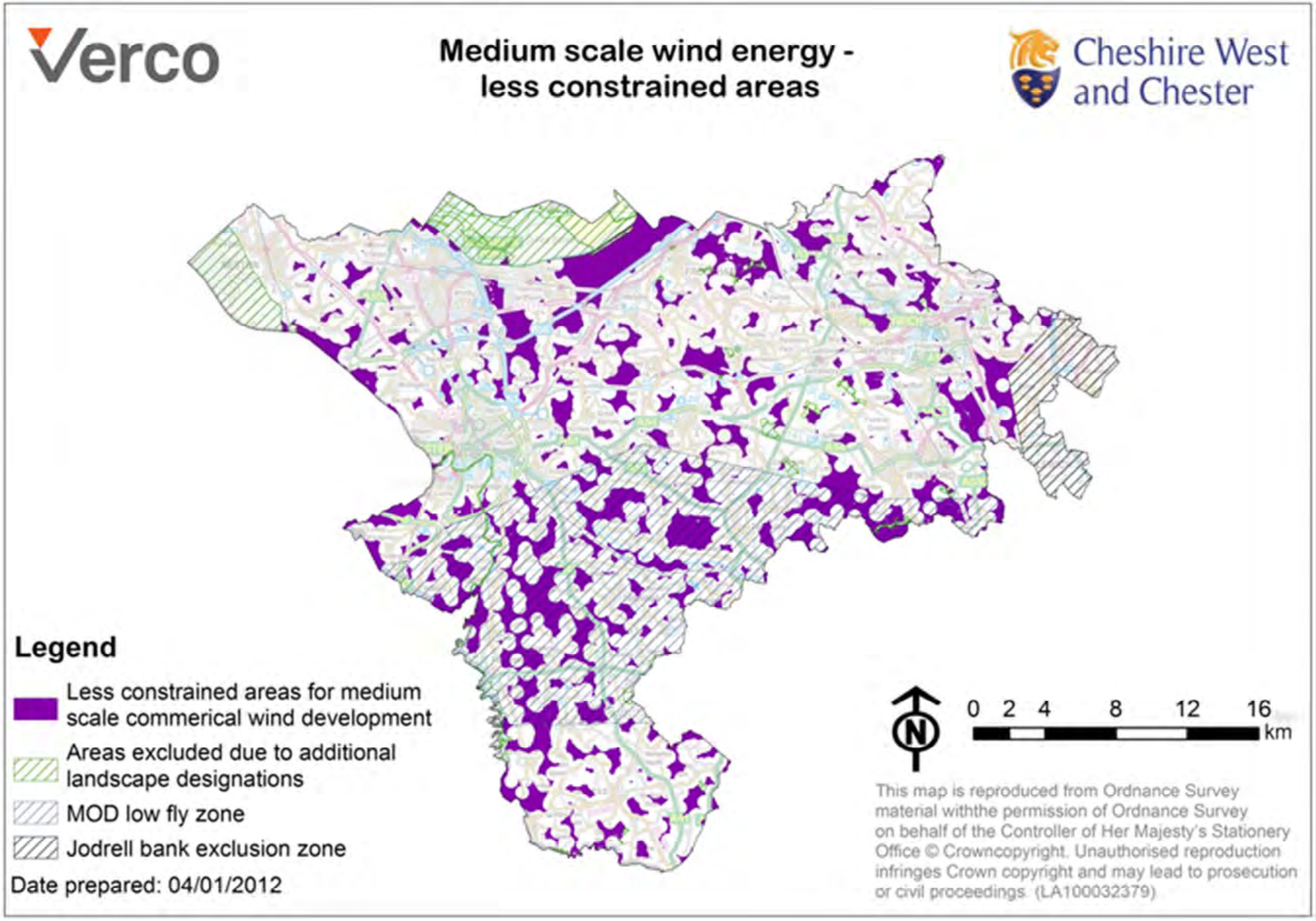


**Figure 5-4: Less constrained areas for medium scale wind the Borough**

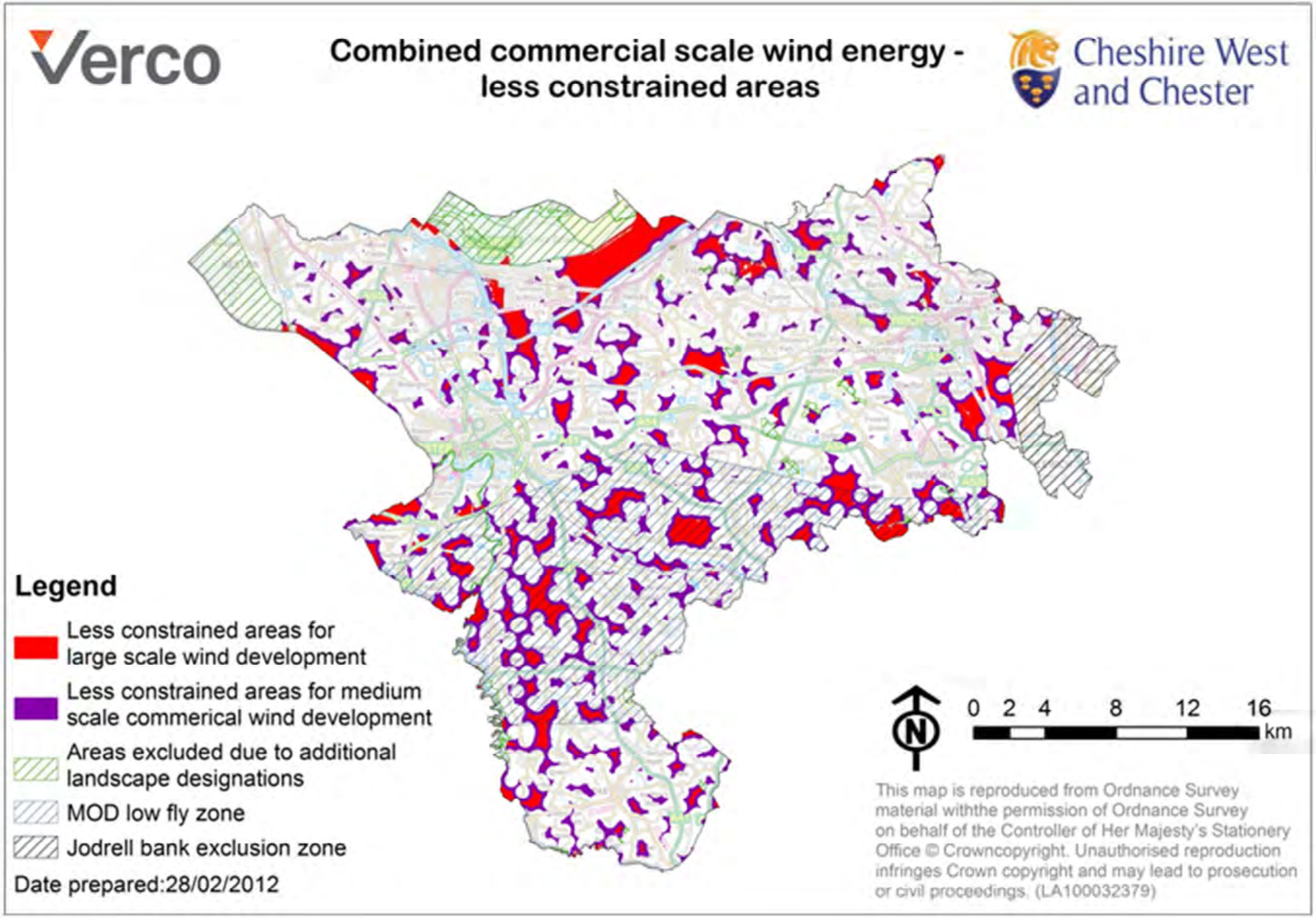


**Figure 5-5: Areas of land potentially suitable for wind energy (large and medium wind)**

### 5.3.9 Summary results: estimated commercial wind capacity in the Borough

The findings of our GIS wind analysis are presented in Table 5-3. It is immediately noted that the large wind capacity identified using our tailored methodology is substantially less than that identified in the regional study, reducing the potential installed capacity by 57% compared to the regional results.

However, the potential capacity for medium wind is very significant, and in the case of the Borough is greater than that identified for large wind.

| Capacity | No. Turbines | Total MW capacity | Annual generation (GWh) | Carbon emission reductions ($tCO_2$/annum) | Corresponding figure |
|---|---|---|---|---|---|
| NW regional study large wind capacity | 844 | 2,110 | 4,280 | 2,302,010 | n/a |
| Large wind including areas of potential in International and National Landscape and Nature Conservation designations | 360 | 900 | 1,872 | 982,240 | n/a |
| Large wind excluding areas in International and National Landscape and Nature Conservation designations | 299 | 748 | 1,555 | 815,805 | Figure 5-3 |
| Medium wind excluding areas in International and National Landscape and Nature Conservation designations | 4,388 | 1,097 | 1,825 | 957,609 | Figure 5-4 |
| Total large plus medium excluding areas in International and National Landscape and Nature Conservation designations | | 1,845 | 3,381 | 1,773,414 | **Figure 5-5** |

**Table 5-3: Summary of commercial wind capacity for the Borough**

## 5.4 Wind energy – estimate of deployable potential

### 5.4.1 Revision of quantitative analysis to reflect areas of potential more likely to be of interest to wind developers

In order to develop a wind site, there are a wide range of considerations which must be addressed. Many of these are addressed through the planning process; others are addressed primarily by the developer when they assess the site's suitability and the likely cost of the development. Many of these are very much site specific issues and cannot be assessed through the desk based nature of this study, but could have a significant impact on a site's viability.

Table 5-4 outlines a range of considerations that that Verco have considered appropriate to include or exclude to assess deployable potential for this desk based study. These may vary from those that are used to assess deployable potential on a site by site basis.

| Subject area | Discussion of issue | How this has been addressed in our stage 5 7 analysis |
|---|---|---|
| Cumulative landscape impact | It is widely accepted that siting multiple wind farms close to each other results in cumulative negative visual impact. | This cannot be addressed qualitatively as it is dependent on the order in which sites are developed. |
| Landscape Sensitivity | Certain landscapes are deemed more visually and environmentally sensitive to wind development and this may reduce or eliminate the potential for wind development | A character assessment for the Borough is required in order that this could be properly accounted for; currently this is not directly addressed in our study. |
| Planning application success rates | Success rates are typically around 25% at a national level, however there is significant variation at the local level. Objections can be due to a wide range of factors. | We have accounted for a typical success rate of 25% in our assessment of deployable potential. |
| Real wind speed | The NOABL wind speed database used in our assessment does not address local issues such as extreme terrain, forests, and other localised surface features. | Our stage 5-7 potential figures account for "cherry picking" of sites by developers, using only sites with wind speed > 6m/s. This reduces the likelihood of local terrain/topography rendering a site unsuitable due to uneconomic wind speeds. |
| Ground conditions | Although solutions exist for installing turbines across a range of ground conditions, costs of installation will vary dependent on the type of foundations required. | This cannot be addressed at the resolution of this analysis |
| Economic viability | The DECC methodology states wind speed of 5m/s as the minimum for economic wind farm development. In practice, higher wind speeds are generally sought by developers, and these sites are more likely to be developed | Selecting high wind speed areas (>6m/s) ensures good economic returns are likely. |
| Grid connection and capacity | Proximity and stability of the grid near a wind site affects the cost of connection. This can be make or break on the development of a site | Selection of higher wind speed areas (>6m/s) means that their ability to support grid connection costs would be increased. This reduces the significance of this constraint. |
| Wind farm size | Larger wind farms (e.g. 10+ turbines) are less likely to be approved due to their increased visual impact. | After filtering out the sites with higher wind speed there are no remaining sites with potential for more than 6 large turbines. |
| Local landscape and nature designations | Although not typically viewed as an absolute constraint, these designations may prevent or reduce the density of wind turbine development. | These designations have not been addressed in this study as there are a broad range of different designations , and planning response to each should be addressed at a local level. |

**Table 5-4: Considerations for commercial wind development not addressed in the technical potential assessment**

Our consideration of the deployable potential for wind energy in the Borough addresses some of these elements qualitatively and some quantitatively.

Experience on the ground indicates that relatively few planning applications have been submitted for large wind development in the Borough. Our GIS analysis identified that a large proportion of the areas identified as suitable for commercial wind development had low average wind speeds in the range of 5-6m/s; in practice developers are likely to apply for permission at locations with the highest wind speed first, hence these lower wind speed areas are unlikely to come forward early on.

We are able to assess the following issues using quantitative spatial GIS analysis:

- The military low fly zone has been excluded due to high likelihood of material objection to planning applications
- Wind speed >6m/s to reflect the more economically viable locations

The map below presents the reduction in land area that occurs due to the application of these further constraints – this is seen to substantially reduce the overall potential for wind development in the Borough.

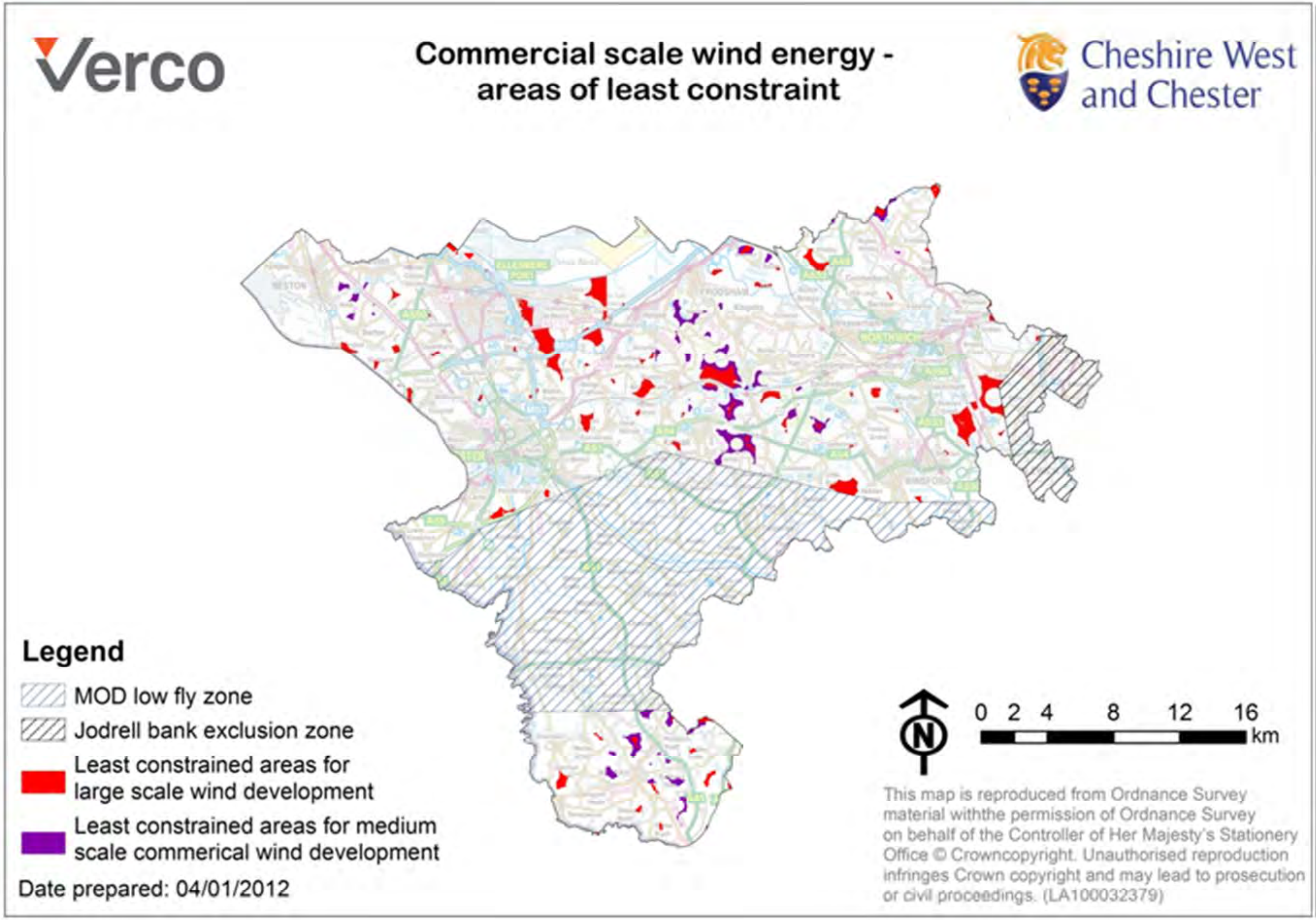


**Figure 5-6: Areas of least constraint for commercial wind development**

### 5.4.2 Revised technical potential to accounting for additional constraints

Following this further filtering of areas of potential, we identified the following revised capacity figures for wind energy potential. We have also revised the projected output of the turbines to reflect the selection of the higher wind speed areas (we have used in-house software tools to calculate the annual output of a Nordex N100 2.5MW turbine and a Vestas V27 225W wind turbine on a site with average wind speed of 6.5m/s).

It is worth noting that wind turbine manufacturers would still consider an average wind speed of 6.5m/s to be relatively low, compared to offshore sites or prime onshore locations.

| Scale | Sites | No. Turbines | Total MW installed | Annual Generation (GWh) | Carbon savings ($tCO_2$/annum) |
|---|---|---|---|---|---|
| Large wind | All | 118 | 295 | 795 | 418,923 |
| Large wind | >1 turbine only | 29 | 72.5 | 195 | 102,755 |
| Medium wind | All | 377 | 94 | 176 | 92,743 |
| Medium wind | >1 turbine only | 354 | 89 | 165 | 86,496 |
| **Combined large and medium** | **All sites** | | **389** | **971** | 511,668 |
| **Combined large and medium** | **>1 turbine sites** | | **161.5** | **360** | 189,702 |

**Table 5-5: Revised technical potential to reflect sites with least constraint**

### 5.4.3 Scenarios for deployable potential

Following the assessment described in section 5.4.1, we have made our own estimates of the impact of the likely proportion of this revised potential which might be developed in the period to 2030. This will be influenced by both market drivers and the Council's approach to wind farm planning applications. However, we have identified the following scenarios as a realistic spread over the duration considered in this study.

- Low: 6% (assumes 25% of the least constrained potential has a planning application and there is a 25% permission rate)
- Medium: 12.5% (assumes 50% of the least constrained potential has a planning application and there is a 25% permission rate)
- High: 25% (assumes all the least constrained potential has a planning application and 25% is permitted)

This equates to the following installed capacity, energy generation and carbon emissions reductions.

We have selected the low scenario for wind energy development to carry forward into our assessment of overall deployable potential to 2020. In practice this would equate to two wind farms of four or five large turbines – delivery of wind energy in the Borough depends on both the appetite of developers and the planning response to applications, and both these variables could have a substantial impact on the actual delivery of this technology.

| Scenario | % of least constrained potential | Total MW installed | Annual Generation (GWh) | Carbon savings ($tCO_2$/annum) | % of the borough s energy supply (2009) |
|---|---|---|---|---|---|
| Low | 6% | 23 | 58 | 30,563 | 0.26% |
| Medium | 12.50% | 49 | 121 | 63,673 | 0.55% |
| High | 25% | 97 | 243 | 127,347 | 1.1% |

**Table 5-6Scenarios for wind energy deployment**

# 6. Biomass and Energy from Waste potential

## 6.1 Overview of technology

A range of biomass and energy from waste options have been considered as part of this study, with the aim of quantifying the total potential resource of heat and electrical output from each of these resource options. Biomass and energy from waste streams cover a range of potential resource types, using a range of different technology options to harness the potential resource. The biomass and waste streams considered within this section include:

**Biomass**

- Energy crops
- Managed woodland
- Waste wood
- Agricultural straw

**Waste (Energy from Waste or EfW)**

- Wet organic waste (WOW)
- Municipal Solid Waste (MSW)
- Commercial and industrial waste
- Landfill and sewage gas

### 6.1.1 Energy Crops

These are crops grown and harvested specifically for the purpose of being combusted to generate electricity and heat. They can be grown on either agricultural or non-agricultural grade land. Two types of energy crop are considered in this study; Miscanthus and Short Rotation Crops (SRC). DECC suggests three different energy generation deployment scenarios for this technology; high, middle and low. The middle scenario has been considered for this study.

The high scenario assumes that all available land suitable for energy crops (agricultural and non-agricultural) will be utilised. This is unlikely and takes away land for food crops. The low scenario assumes that crops will be planted to the extent of new applications submitted to the Energy Crops Scheme. This scheme offers grants to farmers in England to grow Miscanthus and/or SRC for either their own use or to supply power stations. In summary, a rate of 50% is paid for all eligible costs incurred [10].No successful applications have been made under the scheme within the Borough[11]. The medium scenario assumes that all abandoned land and pasture (land no longer needed for food production) will be planted. This is considered the most likely resource use scenario. The specific land category chosen for the energy crop calculation is 'bare fallow and GAEC12[12]' land. The area of land used in the calculation was obtained directly from DEFRA. A full list of the assumptions and benchmarks used to calculate the resource (as suggested by DECC and other sources) can be found in Appendix 1.

For information, planning permission has been granted (subject to a Section 106 agreement) for a dedicated biomass plant at the Ince Marshes Resource Recovery Park. The proposal is for a plant with

[10] *http://www.naturalengland.org.uk/ourwork/farming/funding/ecs/default.aspx*
[11] *http://archive.defra.gov.uk/foodfarm/growing/crops/industrial/energy/opportunities/nw.htm*
[12] *Eligible land not in agricultural production*

an electrical power capacity of 20MW and a thermal capacity of 5MW, processing approximately 176,500 tonnes (30% virgin timber/70% waste wood) per annum.

### 6.1.2 Managed woodland

Woody material from the management of woodland can be used to provide energy for both heat and electric through direct combustion. The electrical and thermal capacity of residue from woodland management was calculated by referring to the North West Regional study and the DECC methodology. A full list of the assumptions and benchmarks used to calculate the resource (as suggested by DECC and other sources) can be found in Appendix 1.

### 6.1.3 Waste Wood

The DECC methodology considers three sources within the waste wood stream; waste from construction of new housing, saw mill products and furniture manufacture waste. Sawmill co-product is considered in the Commercial & Industrial (C&I) waste category and there is a lack of data for furniture production in the Borough. Hence only material from housing construction was considered (in line with the regional Northwest study). The waste wood figures from housing construction were derived from the WRAP waste wood market report [13], and then disaggregated on the basis of new housing allocations for the Borough. New housing allocations (specifically the net new housing allocations) were taken from the Council's 2010 Annual Monitoring Report[14]. As per energy crops and other managed woodland, waste wood can be combusted for electrical and thermal power generation. A full list of the assumptions and benchmarks used to calculate the resource can be found in Appendix 1.

### 6.1.4 Agricultural straw

Straw for biomass typically arises from wheat and oil seed rape. Use as a "bio-crop" is secondary to use for animal bedding, and so this must be taken into account when calculating the resource. Unlike the previous Biomass streams, heat generation is not seen as viable for straw within the methodology. Hence only electricity has been considered. A full list of the assumptions and benchmarks used to calculate the resource can be found in Appendix 1.

### 6.1.5 Animal Waste

There are two animal waste streams to consider; Wet Organic Waste (WOW) and Poultry Litter. WOW consists of manure and slurry (typically from cattle and pigs), Food, Drink & Tobacco (FDT), retail and whole sale waste. These latter streams (FDT, retail and whole sale waste) have been extracted from the animal, vegetable and non-metallic waste categories of the Commercial & Industrial Waste (C&I W) data. WOW is usually converted to biogas through the process of Anaerobic Digestion; it can then be burnt for both electrical and thermal power generation. Only electrical generation has been considered in this study as the DECC methodology does not provide guidance for heat production. Poultry Litter is organic waste from broiler birds which is most commonly converted into energy by direct combustion. Only electrical generation has been considered in this study as the DECC methodology does not provide guidance for heat production. A full list of assumptions and benchmarks can be found in Appendix 1.

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[13] *http://www.wrap.org.uk/recycling_industry/publications/wood_waste_market.html*
[14] *http://cheshirewestandchester.gov.uk/residents/planning_and_building_control/planning_policy/emerging_local_plan/background_documents/monitoring_reports.aspx*

### 6.1.6 Municipal Solid Waste (MSW) and Commercial & Industrial Waste

In line with the regional Northwest study, only the biodegradable fraction of the MSW (i.e. 68%) was considered as part of the resource assessment[15].

Commercial & Industrial Waste (C&I W) is typically composed of similar waste streams as MSW, but is strictly limited to the commercial and industrial sectors. Food Drink and Tobacco (F, D&T) and retail & whole sale waste have been removed from this waste stream as they are included within the WOW stream. This avoids double counting. As with MSW, power can be generated through direct combustion, pyrolysis or gasification. The DECC methodology, however, assumes that power is generated through direct combustion. Similar to the MSW resource assessment, the C&I W assessment has considered only the animal & vegetable waste but also non-metallic wastes. A full list of assumptions and benchmarks can be found in Appendix 1.

A list of energy from waste schemes which are operational and proposed in the Borough are listed in Appendix 1, which are at different stages of the planning and development process.

There is one operational incinerator in the Borough at Ellesmere Port which treats hazardous material. Given the nature of the facility it is unsuitable for energy generation.

In line with the DECC methodology, only electricity generation from direct combustion has been considered. A full list of assumptions and benchmarks can be found in Appendix 1.

### 6.1.7 Landfill and Sewage gas

Both Landfill sites and sewage treatment works will produce methane gas as a result of natural decomposition over time. This gas can be utilised for power generation or to provide heat. Heat is only viable through a CHP system as the generation plant needs to be on or near site. Hence, keeping in line with the DECC methodology, this resource assessment considers electricity only. DECC recommends consulting the Renewable Obligations (RO) register for a list of developed schemes, but this was inaccessible at the time of writing. Data was therefore taken from the regional Northwest study, which used the RO register. Sites within the Borough were then cross referenced with those listed in the ReStats database to establish whether any new sites have been developed, but none were identified. The only existing site is the Gowy landfill. Consistent with assumptions in the Northwest regional study, the generating capacity of this resource is assumed to continue at its current level to 2015, after which there is a linear reduction to 2030 when capacity is 20% of today's resource. It should be noted that there is extant planning permission for a new landfill site near Kinderton Lodge. However, no further information was available to determine the potential for energy generation.

Information was sought from the water utility provider in the Borough to identify existing sewage gas energy projects. However, this information was unavailable at the time of this study. The regional renewables study collates RO register data on sewage treatment sites, so this was used as an alternative source of information. It is understood from the utility providers that there are no plans for future sewage projects in the Borough, and that no new treatment sites are planned for the foreseeable future; hence the list of sites obtained from the regional study is assumed to be reasonable estimate of the short term resource.

As a note, smaller sites in the Borough that are not suitable for development have their waste "tankered" to larger sites, so this waste is accounted for in the installed capacity of developed sites. With future

*[15]Municipal waste not sent for recycling (95,749 tonnes) + Municipal waste estimated rejects (3,411 tonnes). This is then multiplied by 0.68 to arrive at biodegradable municipal waste. Figures for recycling & composting are not included within this assessment. Data source: DEFRA Municipal Waste Stats 2009/10*

technological developments it is expected that uptake of this resource could increase by 50% by 2020 and remain constant from that point (see Appendix 1 for full details).

## 6.2 Overview of approach to assess energy potential

The biomass resource for the Borough was calculated in line with the DECC methodology. In circumstances where there was a lack of data or appropriate guidance, the methodology was adapted. Further details on differing methodologies are given in the relevant sections. Resource potential is quoted in terms of electrical & thermal capacity (MWe & MWth, respectively), electrical & thermal energy (GWhe & GWhth, respectively) and Carbon saved (tCO2). The following Biomass and Energy from Waste (EfW) streams have been assessed.

**Biomass**

- Energy crops
- Managed woodland
- Waste wood
- Agricultural straw

**Waste (Energy from Waste or EfW)**

- Wet organic waste (WOW)
- Municipal Solid Waste (MSW)
- Commercial and industrial waste
- Landfill and sewage gas

Raw Biomass and Energy from Waste (EfW) materials are either measured in Hectares (in terms of land for a particular crop) or Oven Dried Tonnes (in terms of mass of material with a calorific value). To convert the area and mass of raw material into a value of energy, a number of benchmarks and conversion factors were applied from the DECC methodology or other relevant and nationally-recognised sources. Carbon figures were taken from the DEFRA emissions factor database. For landfill, sewage gas and waste incineration, Verco's own in-house tools have been used to perform the analysis. A full list of these factors can be found in Appendix 1.

A total technical potential resource is presented for the current period. Uptake figures for 2020 and 2030 are then presented as a deployable potential. Uptake figures for each resource are expressed as a percentage of the total available resource and were taken from the E4tech report 'Biomass supply curves for the UK' (2009). See Appendix 1 for uptake figures and assumptions behind them.

## 6.3 Technical Potential for Biomass and Energy from Waste

The current potential resource for each Biomass and EfW stream is detailed in Table 6-1 and displayed graphically in Figure 6-1 to Figure 6-5.

The resources with the greatest technical potential to generate electrical energy are wet organic waste (WOW), municipal solid waste (MSW), landfill gas and commercial and industrial (C&I) waste. To generate thermal energy, managed woodland and energy crops are the resources with the highest technical potential.

As a total aggregated resource, Biomass has the technical potential to generate 354 GWh of electrical and 30 GWh of thermal energy per year. This represents a contribution of 1.74% to the total energy consumed within the Borough during 2009, the base year for this study. The associated carbon savings of this contribution would be 191,077 tonnes$CO_2$ per year.

| Technology | Curent technical potential | | | | | |
|---|---|---|---|---|---|---|
| | $MW_e$ | $GWh_e$ | $MW_{th}$ | $GWh_{th}$ | % contribution to Borough energy consumption (2009) | Carbon saved ($tCO_2$) |
| Energy Crops | 0.85 | 6.68 | 3.73 | 11.44 | - | 5,764 |
| Managed woodland | 0.80 | 6.29 | 4.87 | 14.92 | - | 6,085 |
| Waste Wood | 1.22 | 9.61 | 1.04 | 3.20 | - | 5,481 |
| Straw | 1.78 | 14.02 | - | - | - | 7,211 |
| WOW | 21.11 | 166.42 | - | - | - | 87,258 |
| Poultry Litter | 0.21 | 1.66 | - | - | - | 871 |
| MSW | 6.74 | 53.16 | - | - | - | 27,884 |
| C&I W | 5.56 | 43.83 | - | - | - | 22,988 |
| Landfill gas | 6.21 | 48.92 | - | - | - | 25,654 |
| Sewage gas | 0.46 | 3.59 | - | - | - | 1,881 |
| TOTAL | 44.94 | 354.18 | 9.64 | 29.56 | 1.74% | 191,077 |

**Table 6-1. Technical potential for Biomass and Energy from Waste**

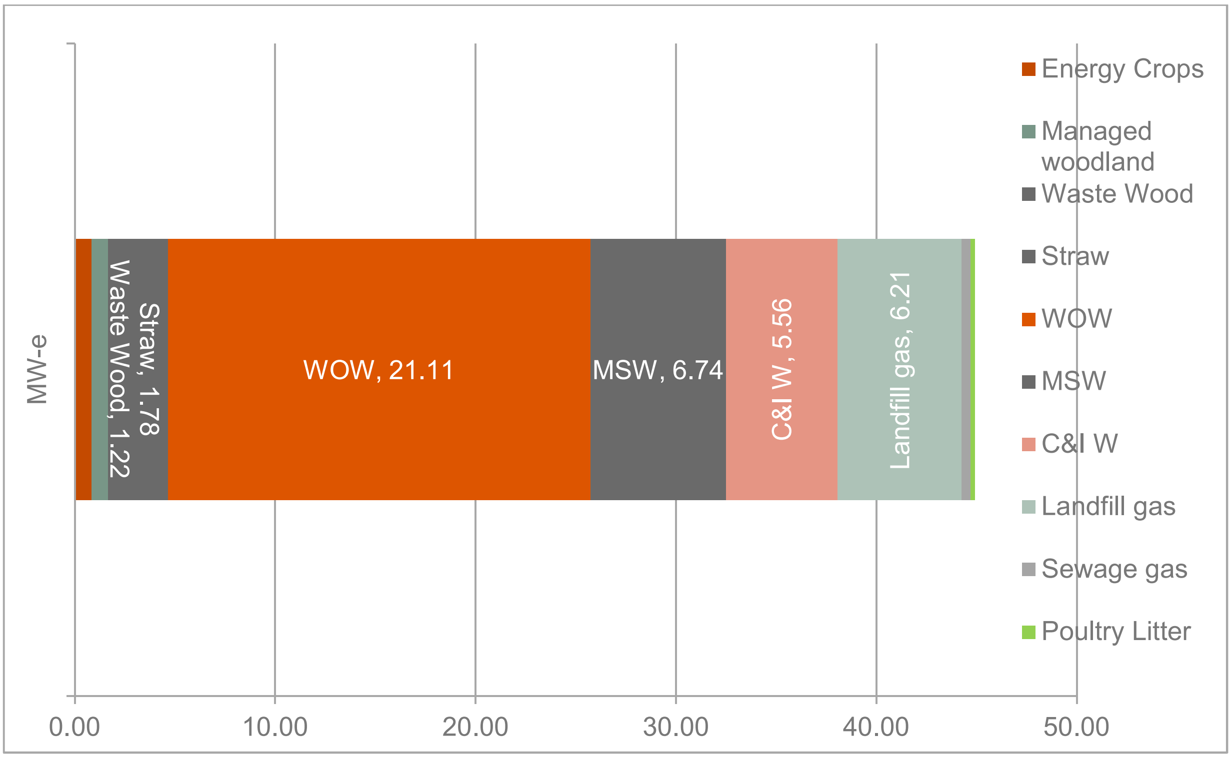


**Figure 6-1. Technical potential for Biomass and Waste in terms of installed electrical capacity**

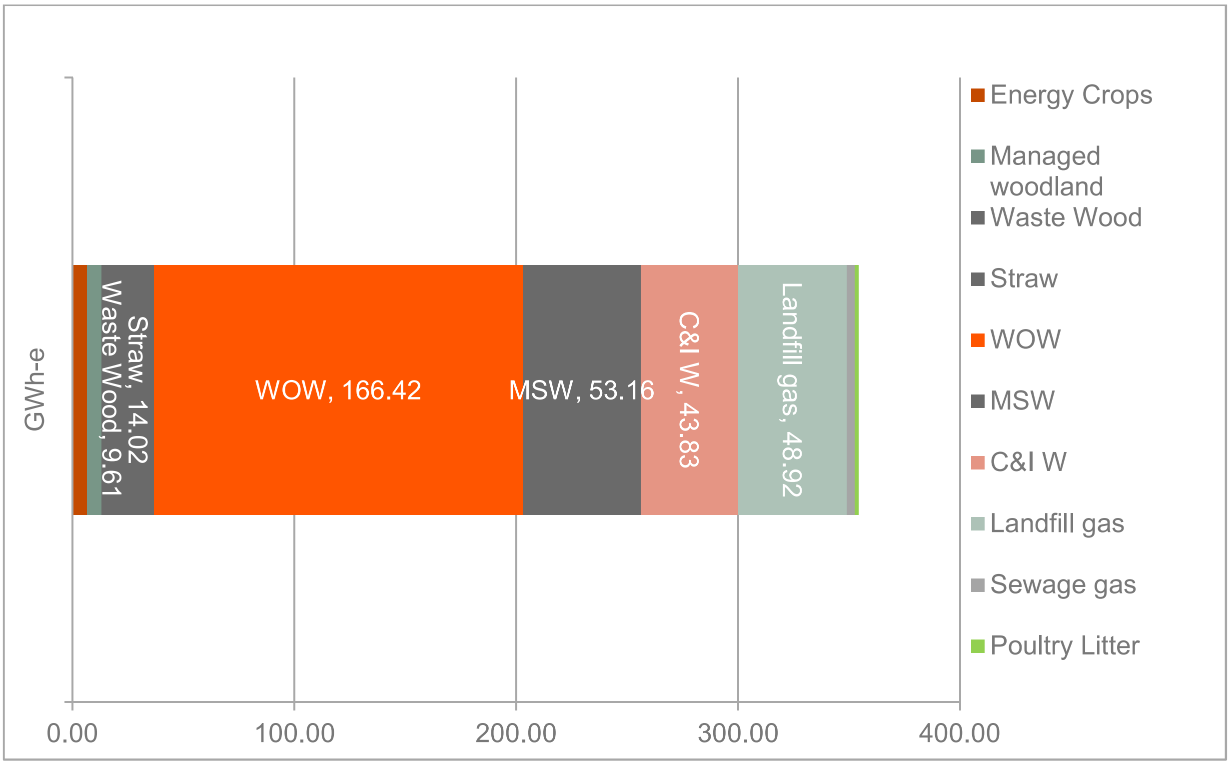


**Figure 6-2. Technical potential for Biomass and Waste in terms of electrical energy generation**

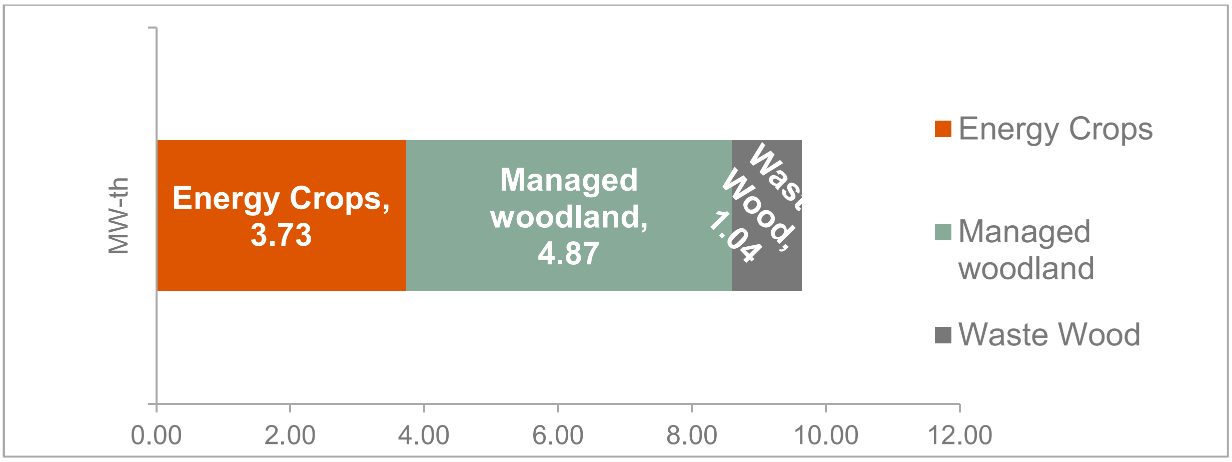


**Figure 6-3. Technical potential for Biomass and Waste in terms of installed thermal capacity**

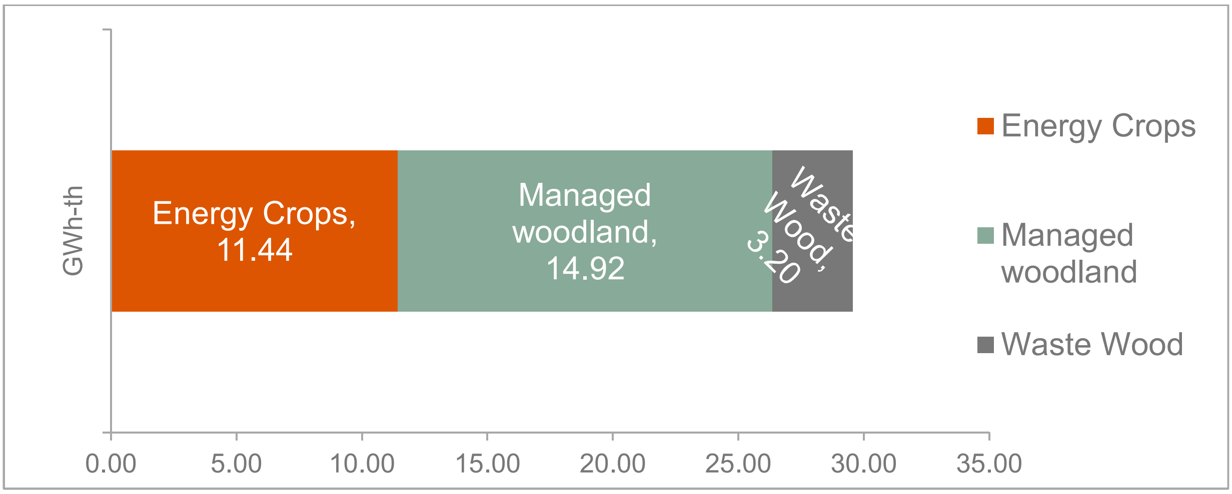


**Figure 6-4. Technical potential for Biomass and Waste in terms of thermal energy generation**

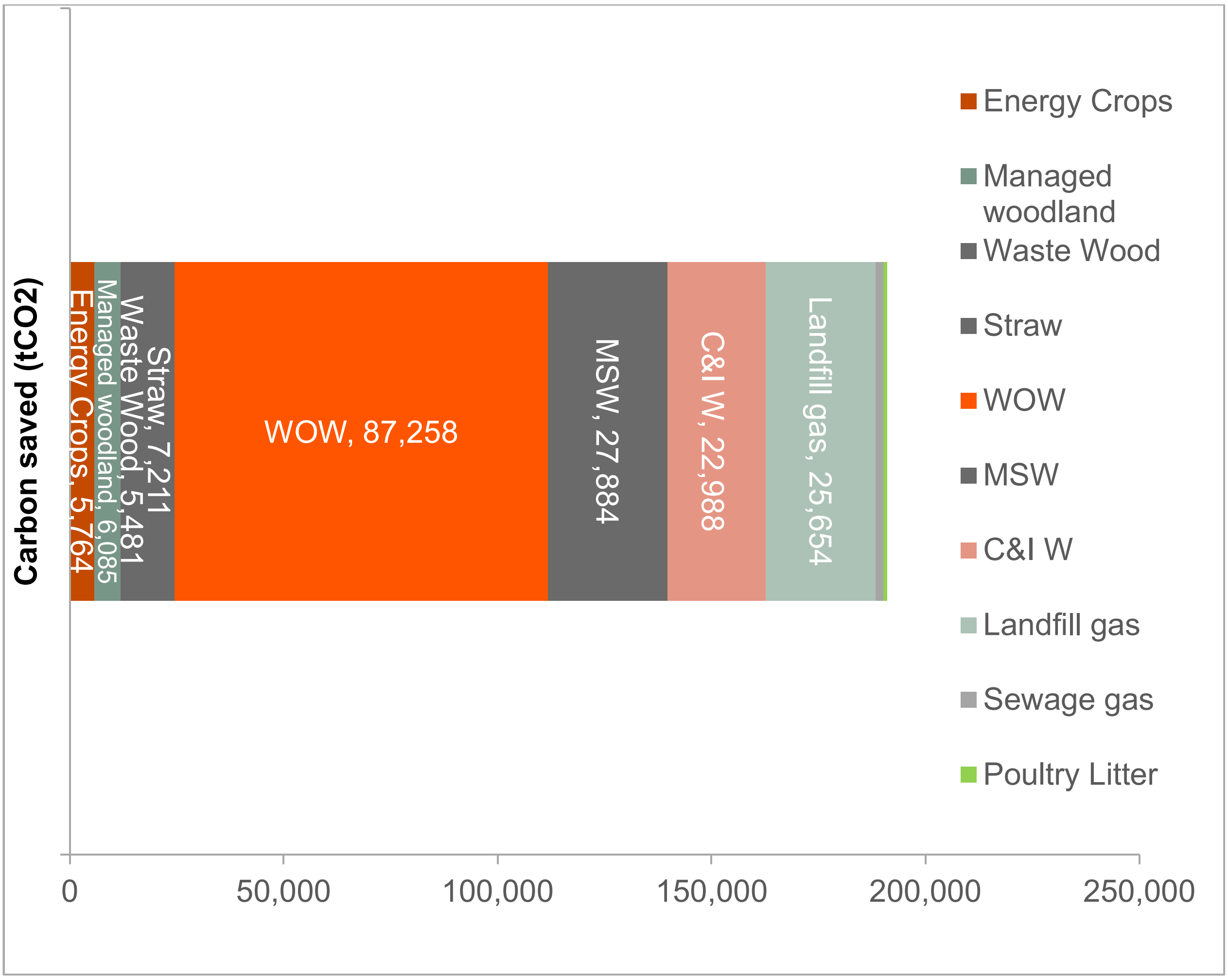


**Figure 6-5. Carbon savings associated with the technical potential for Biomass and Waste, in terms of electrical and thermal energy generation.**

## 6.4 Deployable Potential for Biomass and Energy from Waste

To establish a more realistic estimate of the resource that could be realised in practice, the uptake assumptions listed in Table 6-2 for each energy stream were applied to the technical potential outlined in the previous section. Further details on these uptake assumptions can be found in Appendix 1. Essentially, the (current) technical potential described in the above section, is the maximum amount of the resource that can be achieved. The figures below detail the fraction of the resource that could be deployed in future years. Using Energy Crops as an example, the uptake figures in Table 6-2 indicate that 30% of the technical potential (the current maximum potential) will be taken up in 2020 and 100% of it will be used by 2030. With sewage gas, technical potential is expected to increase over time as technological advances are made, to 150% of the level currently identified by 2020. The uptake figures used are based on the study "biomass supply curves for the UK"[16].

| Technology | 2020 | 2030 |
|---|---|---|
| Energy Crops | 30% | 100% |
| Managed woodland | 100% | 100% |
| Waste Wood | 100% | 100% |
| Straw | 100% | 100% |
| WOW | 100% | 100% |
| Poultry Litter | 100% | 100% |
| MSW | 100% | 100% |
| C&I W | 100% | 100% |
| Landfill gas | 73% | 20% |
| Sewage gas | 150% | 150% |

**Table 6-2. Biomass and Energy from Waste uptake assumptions**

### 6.4.1 2020 Deployable Potential

Based on the uptake assumptions from Table 6-2, estimates of the deployable potential of the biomass resource by 2020 are listed in Table 6-3 below. This suggests that the majority of the technical potential could be realised by 2020 in practice. The only biomass resource stream not expected to be fully deployable by 2020 is energy crops. Energy derived from landfill gas is also expected to be lower in 2020 that the technical potential suggests, since this resource will diminish over time as the landfill gases are diminished.

As a total aggregated resource, Biomass could generate 338 GWh of electrical and 22 GWh of thermal energy per year by 2020, with total associated carbon savings of 181,056 tCO2 per year. This represents a contribution of 1.65% to the total projected energy consumption in the Borough in 2020.

[16] *http://www.decc.gov.uk/publications/basket.aspx?FilePath=What+we+do%5cUK+energy+supply%5cEnergy+mix%5cRenewable+energy%5cRenewable+Energy+Strategy%5c1_20090716112412_e_%40%40_E4techBiomasssupplycurvesfortheUKurn09D690.pdf&filetype=4#basket*

| Technology | 2020 Deployable Potential | | | | | |
|---|---|---|---|---|---|---|
| | $MW_e$ | $GWh_e$ | $MW_{th}$ | $GWh_{th}$ | % contribution to Borough energy consumption(2020) | Carbon saved ($tCO_2$) |
| Energy Crops | 0.25 | 2.01 | 1.12 | 3.43 | - | 1,729 |
| Managed woodland | 0.80 | 6.29 | 4.87 | 14.92 | - | 6,085 |
| Waste Wood | 1.22 | 9.61 | 1.04 | 3.20 | - | 5,481 |
| Straw | 1.78 | 14.02 | - | - | - | 7,211 |
| WOW | 21.11 | 166.42 | - | - | - | 87,258 |
| Poultry Litter | 0.21 | 1.66 | - | - | - | 871 |
| MSW | 6.74 | 53.16 | - | - | - | 27,884 |
| C&I W | 5.56 | 43.83 | - | - | - | 22,988 |
| Landfill gas | 4.53 | 35.71 | - | - | - | 18,728 |
| Sewage gas | 0.68 | 5.38 | - | - | - | 2,821 |
| TOTAL | 42.88 | 338.09 | 7.03 | 21.55 | 1.65% | 181,056 |

**Table 6-3. Deployable potential for Biomass and Energy from Waste (2020)**

### 6.4.2 2030 Deployable Potential

Based on the uptake assumptions from Table 6-2, estimates of the deployable potential of the biomass resource by 2030 are listed in Table 6-4 below. This suggests that the all of the technical potential to generate thermal energy could be realised by 2030, since uptake of energy crops, managed woodlands and waste wood is expected to reach 100% by 2030. This represents an increase in deployable potential to generate thermal energy from 2020. However, the deployable potential to generate electrical energy is expected to fall between 2020 and 2030, as energy derived from landfill gas is reduced further as the resource diminishes over time.

As a total aggregated resource, Biomass could generate 316 GWh of electrical and 30 GWh of thermal energy per year by 2030, with total associated carbon savings of 171,494 tCO2 per year. This represents a contribution of 1.55% to the total projected energy consumption in the Borough in 2030.

| Technology | 2030 Deployable Potential | | | | | |
|---|---|---|---|---|---|---|
| | $MW_e$ | $GWh_e$ | $MW_{th}$ | $GWh_{th}$ | % contribution to Borough energy consumption (2030) | Carbon saved ($tCO_2$) |
| Energy Crops | 0.85 | 6.68 | 3.73 | 11.44 | - | 5,764 |
| Managed woodland | 0.80 | 6.29 | 4.87 | 14.92 | - | 6,085 |
| Waste Wood | 1.22 | 9.61 | 1.04 | 3.20 | - | 5,481 |
| Straw | 1.78 | 14.02 | - | - | - | 7,211 |
| WOW | 21.11 | 166.42 | - | - | - | 87,258 |
| Poultry Litter | 0.21 | 1.66 | - | - | - | 871 |
| MSW | 6.74 | 53.16 | - | - | - | 27,884 |
| C&I W | 5.56 | 43.83 | - | - | - | 22,988 |
| Landfill gas | 1.24 | 9.78 | - | - | - | 5,131 |
| Sewage gas | 0.68 | 5.38 | - | - | - | 2,821 |
| TOTAL | 40.19 | 316.83 | 9.64 | 29.56 | 1.55% | 171,494 |

**Table 6-4. Deployable potential for Biomass and Energy from Waste (2030)**

# 7. Hydro Power

## 7.1 Background to the technology

Any body of water that flows downstream contains potential energy. A hydro scheme uses a turbine to convert this potential energy into mechanical and then electrical energy. The quantity of electrical energy available depends on two factors: the volume of water available and the drop in height over which this water can fall, known as the flow and the head respectively. While flow is an important factor in determining power production, fast-flowing water alone contains insufficient energy for power production except on very large scales. Therefore, head is the essential element in hydropower generation and the most important factor in the design and costing of hydro schemes.

Although the North West is home to some of the wettest parts of the UK, these are mainly confined to the higher parts of the Lake District. The Met Office explains that Cheshire is a relatively sheltered area that experiences a 'rain shadow' effect from the high ground of North Wales. As a result, Cheshire receives on average less than 800mm of rain per year. This compares with annual totals of around 500mm in the drier parts of Eastern England and over 3,200mm in the higher parts of the Lake District. The Cheshire Plain is also typified by low lying and flat land.

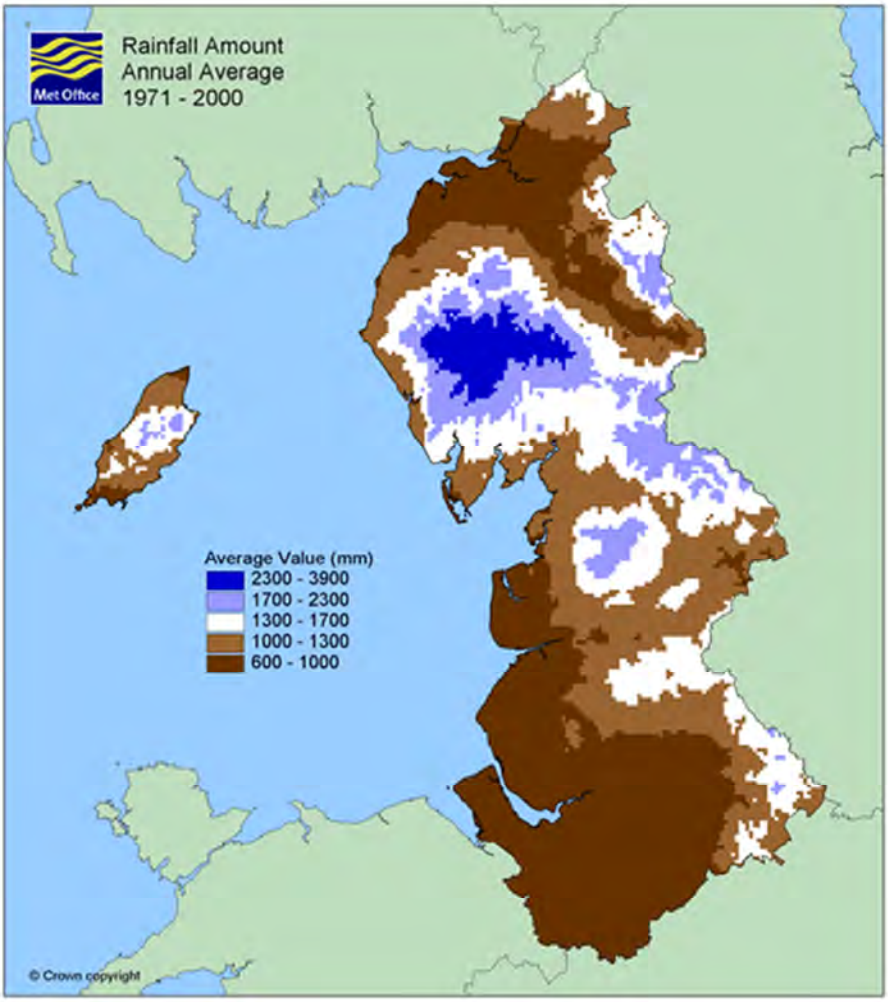


**Figure 7-1. Rainfall Amount Annual Average 1971-2000**

***Nb. Contains public sector information licensed under the Open Government Licence v1.0***

The implication is that opportunities are likely to be restricted to low-head hydro schemes that typically make use of an existing water barrier on a river, such as a weir or sluice. Low-head sites have a limited capacity to generate electricity relative to high-head schemes and other renewable energy technologies such as large-scale wind. They are however supported by the Feed-in Tariff and the Environment Agency has seen a marked increase in the number of applications for these types of installation since the introduction of the FIT subsidy. The viability of each scheme is determined by site-specific factors which can influence costs and revenues, such as site access, the state of existing civil infrastructure and proximity to the electricity grid or site of high existing electricity consumption.

## 7.2 Overview of approach

A survey of hydropower potential within the Cheshire West and Chester area was conducted by Mann Power Consulting Ltd between August and October 2010[17]. Mann Power is a specialist hydropower consultancy with experience of carrying out feasibility and design studies for hydro projects. As such, their report outlining the hydropower potential within the region is considered a reputable source of information.

It is understood that Mann Power conducted a desktop study to identify potential sites, which was supplemented by site visits along the major rivers in the Borough. This process identified 64 sites, and dialogue with Mann Power suggests that this includes the most significant hydro sites in the area (in terms of capacity to generate electricity).

The DECC methodology suggests use of the findings of a study commissioned by the Environment Agency [18] (referred to as "EA study") as the basis for determining renewable energy capacity from hydro resources in a region. However, the DECC methodology does not state that this source of information must be used, as it does when citing data sources for other renewable energy resources, nor does it prescribe how the EA data and findings be interpreted and applied.

In contrast to the Mann Power survey, the findings of the EA study are calculated entirely using desk based research and representative values are used for critical calculation values such as head height. The EA acknowledges the shortcomings of the methodology used, which was developed for a national level assessment, and suggests improvements for more detailed local studies.

In light of this, the resource potential for hydropower presented subsequently is based on the findings of the Mann Power Survey rather than the EA study, since this is considered likely to be a more accurate assessment of the potential for hydropower in Cheshire West and Chester.

## 7.3 Technical potential for hydropower

A complete list of the 64 sites identified by Mann Power in their survey can be found in Appendix 2. Details about site location are provided along with head and flow rates and anticipated power output for each potential scheme. Outline capital costs are also provided with estimated gross revenues, allowing simple return on investment and payback periods to be calculated.

Table 7-1 summarises the technical potential for hydropower in the Borough from the 64 sites identified in the Mann Power survey. Combined, the sites have a total capacity of 3.7 MW and would generate in

[17] *Mann Power Consulting Ltd, 2010, 'Survey of hydropower potential within Cheshire West and Chester area'*
[18] *Environment Agency. 2010. 'Mapping Hydropower Opportunities and Sensitivities in England and Wales'.*

the region of 11.4 GWh of electricity per year[19], resulting in savings of 5,982 $tCO_2$/yr. Table 7-1 suggests there are a substantial number of potential sites where hydropower schemes could be developed but with a relatively modest capacity to generate electricity.

| Technology | No. of schemes | Total installed capacity (MW) | Annual generation (GWh) | % contribution to Borough energy consumption (2009) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|---|
| Hydropower | 64 | 3.7 | 11.4 | 0.052% | 5,982 |

**Table 7-1.Technical potential for hydropower**

## 7.4 Deployable potential for hydropower

Following consultation with Mann Power, a set of constraints was agreed to identify the opportunities for hydropower that are most likely to be developed within Cheshire West and Chester. The constraints focus on economic factors and the financial viability of a scheme, since this will be the key determinant in a project securing funding in the vast majority of cases. Two key indicators were used to identify priority opportunities for development as outlined in Table 7-2.

| Financial viability indicator | Agreed Constraint |
|---|---|
| Payback period | Exclude projects with a payback period greater than 20 years |
| Installed capacity | Exclude projects with a capacity of less than 8kW |

**Table 7-2. Constraints to identify priority opportunities for hydropower**

The constraints listed in Table 7-2 eliminate schemes that are likely to face difficulties securing funding and are likely to be considered financially unviable by investors, reflected by a payback period greater than 20 years and a capacity of less than 8kW. By applying these constraints to the technical potential, the deployable potential for hydropower in the Borough is arrived at. This is considered more realistic than the technical potential identified previously and is summarised in Table 7-3.

| Technology | No. of schemes | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2009) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|---|
| Hydropower | 15 | 3.5 | 10.7 | 0.049% | 5,634 |

**Table 7-3. Deployable potential for hydropower**

The revised practical potential in Table 7-3 is based on a drastically reduced number of schemes – 15 down from 64 – although the total installed capacity is not greatly diminished at 3.5 MW, down from 3.7 MW. This small decrease is also reflected in annual generation of electricity and carbon savings. This is because the applied constraints filter out the very small schemes, which are large in number but small in their capacity to generate electricity.

Details of each of the 15 schemes included in the deployable potential can be found in Appendix 2, designated by an asterisk (*) next to the name of the scheme.

[19] *Based on a capacity factor of 35% (British Hydropower Association, 2011).*

It should also be noted that the applied constraints are not definitive and schemes with an installed capacity less than 8kW or a payback period over 20 years could be developed with justifications other than financial return, for example if a building is off the electricity grid the main driver may be to establish a supply of electricity. Hydro schemes are also developed for historical interest or educational purposes, often at the site of an existing watermill that has been converted to a public museum, for example Stretton watermill in Cheshire West and Chester.

### 7.4.1 Environmental and other considerations

Consideration must also be given to environmental factors when developing a hydro scheme. The Environment Agency regulates and permits hydro schemes in England and Wales, giving consideration to the following factors:

- Water abstraction – the amount of water that a scheme can take from a river to flow through a hydropower turbine
- Water impoundment – a new or changed weir will affect the water levels and flows in a river and the Environment Agency has to agree to these changes
- Flood risk – consent must be given where works to a river may increase flood risk
- Fish passage – consideration must be given to how a hydro scheme affects the safe passage of fish up and down a river. A fish pass may be required to allow this.

In addition to the above factors, the environmental sensitivity of an area has the potential to affect development of a hydro scheme, for example if the proposed location is in a Site of Special Scientific Interest (SSSI) or other designated area. However, Mann Power suggests environmental factors are more likely to influence the size and nature of a proposed scheme and delay the development process, rather than prevent it altogether.

Other factors also play a part in determining whether a hydro scheme will be taken forward and developed in practice. These include:

- Grid connection and existing onsite energy consumption – the location of a scheme in relation to the electricity grid and/or an existing site where energy is already consumed is a key determining factor of financial viability. A scheme in close proximity to the grid and an existing building to which energy can be supplied (e.g. a water treatment plant) will face lower connection costs and benefit from additional revenue streams.
- Site accessibility – hydro schemes by their nature require potentially large turbines to be installed and are likely to involve civil works depending on the existing infrastructure at a site. Access to the site for heavy lifting equipment is therefore a key determinant of project cost and will influence the financial viability of a project.
- Land ownership – developing a hydro scheme will often require negotiation with several landowners and can be a complex process, with the potential to delay or prevent development taking place. For example, the land on the river bank at a site may be owned by a water company while the weir itself may be owned by the Environment Agency, with potentially other land owners surrounding the site whose permission would be required for access.

### 7.4.2 National Uptake

As of December 2011, the British Hydropower Association database does not list any existing hydro schemes in Cheshire West and Chester and the FIT register provided by Ofgem suggests no schemes have been registered as part of the this programme since its introduction in April 2010. Since the FIT is the primary financial support mechanism for hydropower schemes with an installed capacity less than 5 MW, the FIT register is a good indicator of the number of schemes installed since April 2010.

However, hydro projects typically take between two and a half and four years to be constructed, significantly longer than other renewable technologies such as wind and solar[20]. Therefore, it is likely that schemes are being developed in Cheshire West and Chester, for example, a potential project at Chester Weir is in the early inception and discussion stages.

The Environment Agency has also seen a marked increase in the number of applications for hydro schemes since the introduction of the FIT subsidy and expects this interest to continue to 2020[21].

Following the review of the FIT scheme in November 2011, which saw subsidies for Solar PV decreased while support for other technologies such as hydropower was maintained, it is also possible that investment will be directed to technologies such as hydropower in future.

## 7.5 Mapping hydropower potential

The map in Figure 7-2 below presents the locations and scale of the hydropower sites identified in the Borough as a result of the Mann Power study. We have highlighted the sites with deployable potential in blue to differentiate these from the smaller sites which are technically feasible, but have significant constraints to implementation.

[20] *British Hydropower Association, 2011*
[21] *Environment Agency, 2011. Available at: http://www.environment-agency.gov.uk/business/topics/water/132498.aspx*

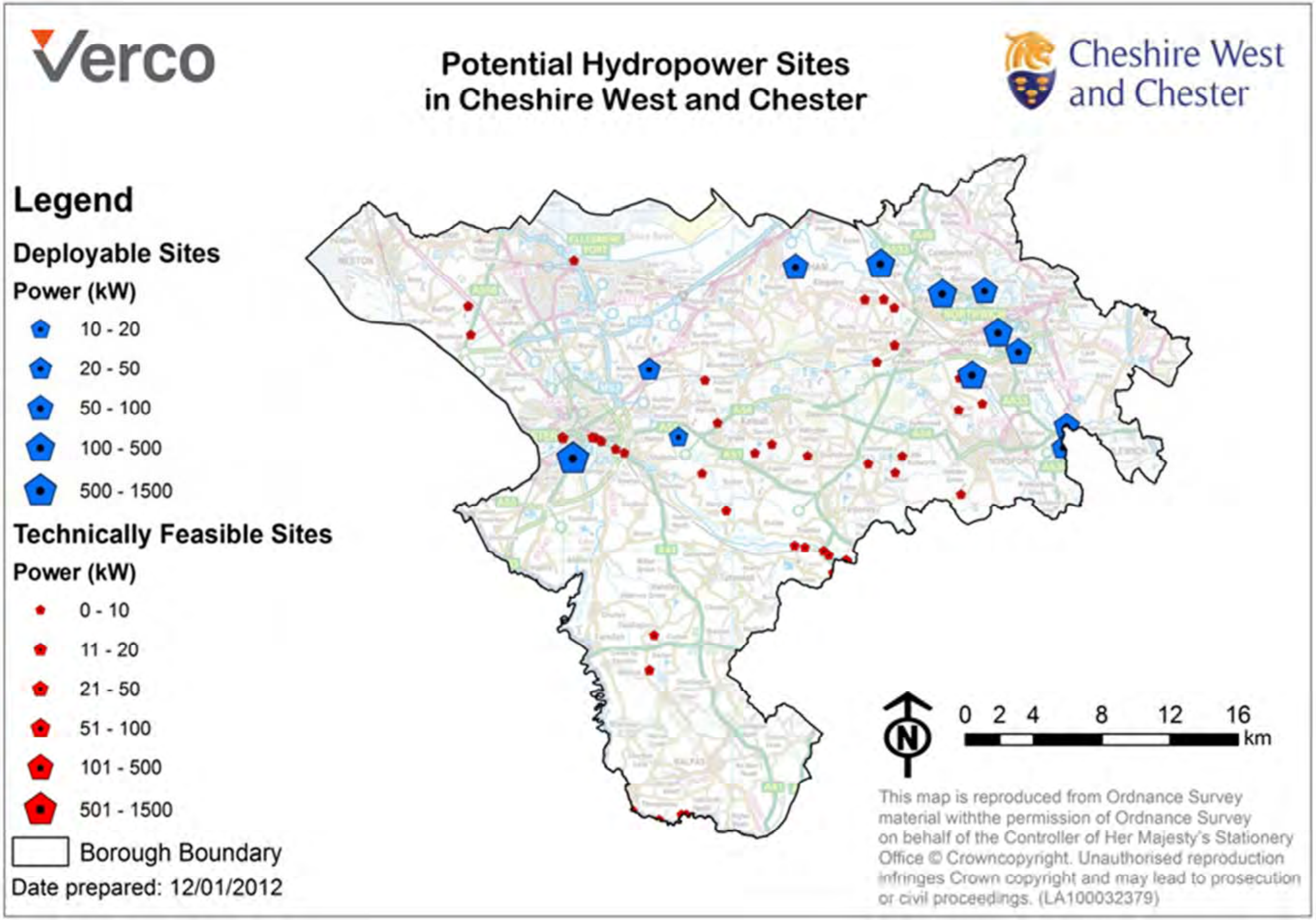


**Figure 7-2: Locations and scale of technically feasible and deployable hydropower sites in the Borough**

# 8. Microgeneration

This chapter of the report focuses on the microgeneration technologies of solar photovoltaics (PV) and solar thermal, heat pumps and small scale wind, which are described in more detail in section 8.1. An overview of the approach taken to assess the technical and deployable potential of these technologies is given in section 8.2.

Since there are multiple technologies, the technical and deployable potential for each are presented together within a separate section of this chapter.

## 8.1 Background to technology

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

In this study, the following technologies are included in the assessment of microgeneration:

- Solar Photovoltaics (PV)
- Solar thermal
- Heat pumps
- Small scale wind

Although these technologies have small overall carbon savings at an individual level, they can be rolled out in mass quantity and have the potential to deliver significant capacity to generate renewable energy and deliver carbon savings.

The uptake of microgeneration technologies in the UK has increased rapidly in recent years following the introduction of Feed-in Tariffs (FITs) in April 2010. FITs were introduced by the Government as a financial support mechanism to encourage the uptake of microgeneration technologies with a capacity to generate electricity of less than 5 MW (per installation), including solar PV and small scale wind. FITs provide financial support over a period of 20 years (25 years for solar PV) in the form of payments per kWh of renewable energy generated. Since the introduction of FITs the uptake of these technologies has increased dramatically, although the vast majority of investment has been channelled into solar PV.

While FITs provide financial support for technologies capable of generating renewable electricity, the Government is also keen to support microgeneration technologies capable of generating renewable heat. The Renewable Heat Incentive (RHI) began accepting applications from non-domestic generators in November 2011 and is expected to open to domestic generators in 2012. The RHI will provide financial support in the same way as the FIT for technologies including solar thermal and heat pumps.

The FIT and RHI schemes provide financial incentives and will drive the uptake of microgeneration technologies. Other drivers also exist such as the rising cost of traditional energy sources such as gas and electricity which will make renewable energy technologies a more attractive proposition.

Some technologies are more suited to certain circumstances and locations. Solar technologies should be mounted on southerly facing roofs to maximise their efficiency and small scale wind turbines need to be well cited to take advantage of the highest wind speeds available. Heat pumps can provide cost and carbon savings in off-gas grid properties where electricity is used for heating purposes (see **Error! Reference source not found.** for a high level indicator of where off gas grid properties are located in the Borough). However, where an efficient gas boiler is used to heat a property, installing a heat pump could potentially result in higher energy bills and an increase in carbon emissions since the heat pump consumes electricity in its operation.

The microgeneration technologies covered in this chapter - solar PV, solar thermal, ground source and air source heat pumps and micro wind turbines – are covered by the General Permitted Development Order [22]. This removes the requirement to apply for planning permission to install domestic microgeneration equipment since they fall under what is referred to as permitted development. Certain exemptions from, and restriction to, the GPDO apply, including the exclusion of micro wind and the requirement for approved technologies to meet particular design requirements. In general terms this relaxing of the planning legislation is intended to remove barriers and drive the uptake of these technologies.

## 8.2 Overview of approach

Separate methodologies were used to assess the technical potential for each technology to generate renewable energy. For solar technologies the methodology is based on calculations to determine the roof space that could accommodate PV and thermal systems. For heat pumps and small scale wind, the methodologies consider the number of buildings that could accommodate these technologies.

The methodologies employed to determine technical potential follow stages 1-4 of the DECC methodology. Where required assumptions are missing from the DECC methodology or their accuracy can be improved, alternative assumptions have been used instead. All the assumptions taken to arrive at the technical potential for microgeneration technologies are stated in full in Appendix 3.

Individual methodologies were also employed to derive an estimate of the deployable potential for each technology by 2020 and 2030. Since the DECC methodology does not provide any guidance beyond stages 1-4, bespoke methodologies were developed for each technology, as explained below.

## 8.3 Solar PV and Solar Thermal

### 8.3.1 Technical potential for solar technologies

Table 8-1 summarises the technical potential for solar technologies in the Borough. In total for both PV and thermal technologies this is equivalent to 100.8 MW of installed capacity, which would generate 54.8 GWh of electricity and 21.3 GWh of heat per year.

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|
| Solar PV (electricity) | 72.3 | 54.8 | 28,730 |
| Solar Thermal (heat) | 28.5 | 21.3 | 4,611 |

**Table 8-1. Technical potential for solar PV and solar thermal technologies**

[22] *The Town and Country Planning (General Permitted Development) (Amendment) (England) Order 2011*

### 8.3.2 Deployable potential for solar technologies

It is beneficial to examine the deployable potential for Solar PV and Solar Thermal separately, since different assumptions lie behind the uptake scenarios and while Solar PV has been supported by the FIT subsidy since April 2010, financial support for Solar Thermal in the form of the RHI will not be introduced until 2012. Hence practical potential for each technology is presented separately below.

**Deployable potential for Solar PV**

The FIT subsidy for microgeneration technologies introduced in April 2010 has been very successful in supporting the development of the UK Solar PV market, both in terms of rapidly increasing deployment and also reducing unit costs. The installation of Solar PV under FITs has exceeded the rate predicted by the Government and costs have also fallen more quickly than anticipated. As a result, FIT support for Solar PV was dramatically reduced after a comprehensive review of tariffs for Solar PV, with reduced tariffs becoming effective from December 2011. Although the Government has launched a consultation on the changes to the tariff, no changes are expected despite strong industry protests.

Ofgem's FIT register[23] provides a statistical report of all installations of microgeneration technologies registered under the FIT scheme. This source was used to determine the number of installations of Solar PV in the Borough and compare this figure to the total installed nationally. As of 16th November 2011, a total of 1.54 MW of Solar PV had been installed and registered under the FIT scheme in the Borough, compared to a total of 364.9 MW installed nationally. Taking an assumption that the installation of Solar PV in the area will continue at the rate it has so far and using DECC forecasts of national PV uptake under the revised level of FIT[24], it is possible to estimate the deployable potential for Solar PV in Cheshire West and Chester by 2020, as summarised in Table 8-2.

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2020) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|
| Solar PV (electricity) | 11.1 | 8.4 | 0.038% | 4,399 |

**Table 8-2. Deployable potential for solar PV (2020)**

The figures for 2030 are presented in Table 8-3, calculated based on an assumption that DECC forecasted national PV uptake between 2015 and 2020 will continue to 2030, since DECC does not make forecasts up to 2030. This assumption is considered reasonable because the cost of Solar PV is expected to continue falling and energy prices are forecast to continue rising. The findings of a study by the European Photovoltaic Industry Association[25] suggest Solar PV will achieve grid parity in the UK by 2020, at which point the value of the electricity supplied by PV systems will be equal to the cost of grid electricity. Once grid parity has been reached, Solar PV technologies will be able to compete in the energy supply market and uptake would be expected to continue beyond 2020 even without the support of Government subsidies.

[23] *Ofgem FIT register available at: https://www.renewablesandchp.ofgem.gov.uk/Public/ReportManager.aspx*
[24] *DECC 2011, Draft Impact Assessment: Comprehensive Review Phase 1 – Consultation on Feed in Tariffs for Solar PV*
[25] *European Photovoltaic Industry Association, 2011, Solar Photovoltaic Competing in the Energy Sector*

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2030) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|
| Solar PV (electricity) | 20.6 | 15.6 | 0.069% | 8,200 |

**Table 8-3. Deployable potential for solar PV (2030)**

### Deployable potential for Solar Thermal

As with Solar PV, the Government plans to support the uptake of Solar Thermal technologies through a financial support mechanism. The Renewable Heat Incentive (RHI) will provide a subsidy for heat generated from renewable sources in the same way that the FIT supports the generation of renewable electricity.

The RHI will be introduced in two phases spanning 2011-2012. The first phase will support the non-domestic sector and applications for financial support were being accepted as of November 2011 for renewable heat generated by the industrial, business and the public sectors, including from Solar Thermal technologies. The second phase of the RHI will include support for domestic households and is expected to be introduced in late 2012, although DECC does not intend to confirm an exact timescale until early 2012.

To predict the uptake of Solar Thermal technologies, various sources of information were considered. DECC's Impact Assessment of the RHI for the non-domestic sector[26] actually models zero uptake by 2020, since solar thermal is the most expensive of the renewable heat technologies supported by the RHI but tariffs have not been set at a level to reflect this. Unfortunately, details of the RHI for the domestic sector had not been published by DECC at the time of writing and the tariffs for individual technologies had not been confirmed. However, other policy documents were reviewed (such as the Microgeneration Strategy [27] and the Renewable Energy Roadmap [28] ) suggests Solar Thermal technologies will not play a lead role in the UK meeting its 2020 renewable energy target. The UK National Renewable Energy Action Plan[29], which was submitted to the EU and outlines how the Government intends to meet this target and considers the impact of the RHI, suggests no growth in the capacity of installed Solar Thermal technologies in the UK between 2010 and 2020.

DECC acknowledges that some uptake is expected in practice and this is most likely to occur in the new build domestic sector, where housing developers will have to meet increasingly stringent Building Regulations on low carbon developments. In order to meet these targets, onsite renewables such as solar thermal will play an increasing part and uptake has therefore been estimated on this basis, summarised for 2020 in Table 8-4. These figures are based on an assumption in the DECC methodology about the uptake of solar technologies on new properties, the assumption about the ratio of uptake between Solar PV and Thermal listed above, along with the number of new properties by 2020 forecasted by the Council. It should be noted that this is an estimate based on reasonable assumptions, but without important information about the level of support for Solar Thermal technologies under the RHI, which had not been released at the time of analysis for this study. Therefore, the response of the market cannot be fully predicted.

[26] *DECC 2011, Impact Assessment: Renewable Heat Incentive*
[27] *DECC 2011, Microgeneration Strategy*
[28] *DECC 2011, UK Renewable Energy Roadmap*
*29 DECC 2010, National Renewable Energy Action Plan for the United Kingdom*

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2020) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|
| Solar Thermal (heat) | 1.9 | 1.4 | 0.006% | 308 |

**Table 8-4. Deployable potential for solar thermal (2020)**

An estimate of deployable potential for 2030 is presented in Table 8-5, based on the same calculations as for 2020 and an assumption that the construction of new houses in the Borough will continue at the same rate up to 2030.

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2030) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|
| Solar Thermal (heat) | 3.8 | 2.8 | 0.012% | 615 |

**Table 8-5. Deployable potential for solar thermal (2030)**

## 8.4 Heat pumps

### 8.4.1 Technical potential for ground and air source heat pumps

Table 8-6 summarises the technical potential for heat pumps in the Borough. There is greater potential for air source heat pumps since a greater proportion of buildings are considered suitable for these systems, which require less space and disruption to operate. In total for both ground and air source heat pumps there is a technical potential equivalent to 560.4 MW of installed capacity which would generate 676 GWh of heat per year.

Note the estimated carbon savings for air source heat pumps is negative because this technology would produce more carbon emissions in its operation (heat pumps use electricity to operate) than an equivalent gas boiler would to generate the same heat output, based on the assumptions in Appendix 3. Ground source heat pumps are estimated to provide marginal carbon savings since they operate more efficiently.

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|
| Air Source Heat Pumps | 448.3 | 541 | -12,159 (see note above) |
| Ground Source Heat Pumps | 112.1 | 135 | 834 * |

**Table 8-6. Technical potential for heat pumps**

### 8.4.2 Deployable potential for ground and air source heat pumps

The deployable potential for heat pumps was estimated based on projected deployment rates for this technology. AEA 2010[30] projected deployment to 2020 for air and ground source heat pumps, the central estimate of which correlates very closely with DECC forecasts[31] of how the UK will meet its 2020

[30] *AEA Report to DECC, March 2010 - Analysis of Renewables Growth to 2020*
[31] *DECC 2010, National Renewable Energy Action Plan for the United Kingdom*

renewable energy target. AEA installed capacity (MW) forecasts were back-calculated based on stated assumptions to provide unit installation figures for the UK. UK figures were prorated to the Borough based on the number of domestic properties (for domestic installations) and employment statistics (for non-domestic installations). These unit installation rates for the Borough were used in conjunction with assumptions listed in Appendix 3 to estimate deployable potential in the Borough to 2020 and 2030[32].

Table 8-7 and Table 8-8 summarise the deployable potential for heat pumps to 2020 and 2030 following the methodology summarised above.

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2020) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|
| Air Source Heat Pumps | 20.9 | 25.2 | 0.12% | -566 * |
| Ground Source Heat Pumps | 19.9 | 24 | 0.11% | 147.8 * |

* Based on assumption that heat was previously supplied entirely by gas-fired boilers.

**Table 8-7. Deployable potential for heat pumps (2020)**

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2030) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|
| Air Source Heat Pumps | 40.5 | 49 | 0.22% | -1,100 * |
| Ground Source Heat Pumps | 38.1 | 46 | 0.21% | 283 * |

* Based on assumption that heat was previously supplied entirely by gas-fired boilers.

**Table 8-8. Deployable potential for heat pumps (2030)**

## 8.5 Micro wind

### 8.5.1 Technical potential for micro wind

Table 8-9 presents the technical potential for micro wind in the Borough, this being the equivalent to 103.6 MW of installed capacity which would provide 129.3 GWh of electricity a year.

[32] *AEA/DECC forecasted deployment rates to 2020 assumed to continue to 2030*

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|
| Small scale wind | 103.6 | 129.3 | 67,813 |

**Table 8-9. Technical potential for micro wind**

### 8.5.2 Deployable potential for micro wind

The deployable potential for micro wind is presented in this section as an upper and lower boundary. This approach has been employed because projections exist about the uptake of micro wind in the UK, but these are far higher than the evidence of actual uptake of micro wind in the Borough since the introduction of the Feed-in Tariff in April 2010. In reality, deployable potential will lie between these boundaries hence two estimates have been provided and can be found below.

The lower boundary is based on statistics from Ofgem's FIT register33 which provides a statistical report of all installations of microgeneration technologies registered under the FIT scheme. This source was used to determine the number of installations of micro wind in the Borough. As of 16th November 2011, only two turbines had been registered with a combined capacity of 17kW (0.017 MW). This installation rate was projected to provide a lower boundary of deployable potential for micro wind in 2020 and 2030, as summarised in Table 8-10 and Table 8-11.

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2020) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|
| Small scale wind | 0.12 | 0.16 | 0.0007% | 82 |

**Table 8-10. Deployment potential for micro wind – lower boundary (2020)**

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2030) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|
| Small scale wind | 0.24 | 0.30 | 0.0013% | 156 |

**Table 8-11. Deployment potential for micro wind – lower boundary (2030)**

The upper boundary is based on a report by Element Energy[34] that forecasts the growth potential for microgeneration technologies in Great Britain. The projected uptake of micro wind in the North West region under the 'Renewable heat and electricity FIT' policy scenario was prorated to provide an estimate for projected uptake in the Borough. This was conducted according to the number of buildings in the Borough as a proportion of those in the North West. This projection was used to estimate an upper boundary of deployable potential for micro wind in 2020 and 2030, as summarised in Table 8-12 and Table 8-13.

[33] [33] *Ofgem FIT register available at: https://www.renewablesandchp.ofgem.gov.uk/Public/ReportManager.aspx*
[34] *Element Energy 2008, The growth potential for Microgeneration in England, Wales and Scotland*

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2020) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|
| Small scale wind | 8.6 | 10.67 | 0.049% | 5,600 |

**Table 8-12. Deployment potential for micro wind – upper boundary (2020)**

| Technology | Total installed capacity (MW) | Annual Generation (GWh) | % contribution to Borough energy consumption (2030) | Carbon savings ($tCO_2$/yr) |
|---|---|---|---|---|
| Small scale wind | 15.2 | 18.91 | 0.084% | 9,922 |

**Table 8-13. Deployment potential for micro wind – upper boundary (2030)**

# 9. District heating and CHP potential

## 9.1 Overview of technology

### 9.1.1 District heating and district energy

The concept of district heating relates to the provision of energy to a defined area or areas from a central location. At its simplest form this would involve a central energy centre delivering heat to two or more buildings using a network of heat pipes typically carrying low pressure hot water. This means that there is no longer a requirement for heating boilers in the buildings served by the network (unless backup capacity is required).

More complex arrangements are becoming increasingly common, especially in new developments where the system designers effectively have a "blank canvas" and can optimise the design of the system. The use of combined heat and power (CHP) in district systems (generating electricity and heat) is increasingly common, as is the use of tri-generation (combining heat, cooling and electrical power generation).

There are a range of potential benefits to a district energy approach:

- By using large-scale central plant (likely to comprise a modular system of multiple boilers) instead of a large number of much smaller boilers, it is possible to achieve higher efficiencies in the conversion of fuel to heat.
- It is possible to use a mixture of heat technologies to supply a network (e.g. conventional boilers, CHP, biomass, solar thermal, heat pumps, or geothermal) which would be unlikely to be technically viable at an individual building level – this increases security of supply.
- The implementation of low carbon technologies can be undertaken at district scale and reduce the emissions of many end users e.g. a biomass boiler added to an energy centre could reduce the emissions from many buildings, which would otherwise be very complex.
- The buildings using the district heating only require a small amount of plant to connect to the network. The heat exchangers used for this purpose are smaller, cheaper and less costly to maintain than equivalent boiler plant.
- Economies of scale can be achieved by purchasing energy in larger amounts; this can be passed on to the users in the form of reduced operational costs for heating (and power where applicable)

However, at present the uptake of this technology for serving the heat loads of existing buildings in the UK is relatively low, and is generally restricted to areas of very high heat load density, such as city centres. This is primarily due to the high cost of installing district heating pipework and the challenge of signing up enough customers to ensure repayment of the capital within an acceptable time period. Installing district heating pipework alongside existing infrastructure typically involves closing and digging up roads; which is an expensive and disruptive process. It is therefore necessary to identify a substantial customer base (in terms of heat demand) in a small area to ensure that the scheme would be viable. This may be dependent on the timescales when the existing heating plant in the customer's buildings is due for replacement, and as a result networks serving existing buildings take more time to connect their customers, and are perceived as more risky investments than those in new developments.

In new development, the use of district heating is becoming more common, especially on larger sites. This is primarily driven by the need to achieve carbon compliance (meeting the carbon emissions targets of the building regulations) and renewable energy contributions towards a development's energy use. Installation of district heating infrastructure can be simpler in new development as pipework can be installed alongside other utilities, and the use of a centralised solution to reduce carbon emissions (e.g. a biomass boiler) may be substantially cheaper than installing renewable technologies on individual buildings.

### 9.1.2 Combined heat and power (CHP)

CHP units can be introduced into a heat network to replace the lead boilers and supply base heat load. Base heat load is the heat demand of the network that exists throughout the year – as heating loads are low or non-existent in the summer, much of the base load is often associated with hot water demand, catering and process loads. Buildings with heat demands of this type are therefore ideal customers for CHP led schemes (e.g. hotels, swimming pools, certain industrial users, etc.). CHP generates electricity as well as heat but is much more expensive than conventional boilers. Designing a CHP unit to meet the base load ensures long running hours which maximises the generation of electricity and the valuable revenue it can generate for the operator.

In order to smooth out the heat demand from customers, thermal storage can be used. Thermal storage deployed with CHP allows electricity and heat production to be de-coupled so that heat produced by the CHP unit during periods of peak demand for electricity can be stored and used later during peak heat demand periods. This avoids the need to use additional boilers to meet the peak heat demand, but incurs additional cost and requires additional space for the thermal storage system (typically a large insulated tank for the storage of hot water).

## 9.2 Heat Mapping: Overview of approach

Some work on district heating potential and viability has already been undertaken within the Borough. The Cheshire and Warrington Sub Region Energy Networks Study[1] examined the potential for a district heating system in Chester in some detail, but did not examine the case for any of the smaller settlements in the Borough. This report also sets out the process of developing a district heating scheme in some detail, which we do not propose to duplicate here.

Should the reader wish to gain further knowledge on district heating and the process required to deliver it, it is recommended that both the appendices of this report and this earlier study are referred to. Appendix 4 of this report provides further background to district heating and its implementation.

Our assessment of district heating within the Borough therefore seeks to build on and extend the findings of this earlier study in the following manner:

- Heat mapping has been carried out across the Borough at a high resolution, giving clear indication of the locations of areas of high heat load where district heating may be applicable.
- For Chester, we present heat mapping in an alternative and more refined format to that in the earlier study, which provides greater clarity on the location of areas of high heat density. We realise that there is some overlap between our study and that of the previous one; for

[1] *http://www.claspinfo.org/resources/local-energy-networks-executive-summary-and-full-report*

completeness, however, we have included an analysis of the potential for district heating in Chester and our own recommendations.

- For the remaining key settlements (Ellesmere Port, Northwich and Winsford) we have carried out heat mapping and a qualitative review of district heating opportunities.
- Regeneration sites have been selected and identified on the zoomed in heat maps and their suitability for development of heat networks considered.

The key steps in our methodology were:

- All individual buildings in the Borough (both domestic and non-domestic) have been identified through the use of three different data sets and the energy consumption of houses in each LSOA[2] area determined using national statistics data the Borough determined. (Further detail in Appendix 4). Heat demand for non-domestic buildings was determined from CIBSE[3] benchmarks which are viewed as an industry standard, and VOA (Valuation Office Agency) data identifying the floor area and usage of non-domestic buildings. Domestic building heat loads were determined from national statistics on the gas consumption of domestic properties in the Borough. Boiler efficiencies of 80 or 85% were assumed for converting fuel demand to heat demand when analysing building loads (80% was used for any those more dated benchmarks, using data from 1999).
- The representation of new development areas is in line with the Borough's emerging Core Strategy and regeneration strategies.
- Potential heat sources were identified from recognised datasets including the register of EU-ETS heat installations, waste incinerators, power stations, and large industrial users identified from the VOA dataset. Potential anchor loads are also presented on the maps; these comprise local authority buildings, and large heat users identified through filtering of the VOA dataset.

Note: Industrial process heat demands cannot be quantified using this methodology, as the heat and power loads of industrial facilities are highly process-specific and are often not suitable for supply by district heating. Therefore only a basic allowance for space heating has been applied to industrial premises.

A detailed overview of the methodology is provided in Appendix 4.

### 9.2.1 Local Authority wide heat mapping

Figure 9-1 illustrates the findings of the heat mapping exercise across Cheshire West and Chester.

The heat load has been assessed on a 100m by 100m grid basis. Areas with the strongest red/orange colouration are those with the highest heat demand density, and conversely those with very pale colouration have low heat demand density. The heat density is also "smoothed" between adjacent grid squares, making it easier to interpret. Large areas of dark red or areas with many dark red pinpoints close together are the areas which are most likely to have the highest potential for district heating. These are also likely to be areas with larger commercial demands. Areas with a more even, paler colouration will have many smaller buildings widely dispersed such as lower density housing estates, and are likely to be poorly suited to the installation of a district heating system.

*[2] LSOA = Lower Super Output Area, a defined area containing approximately 150 dwellings.*
*[3] The Chartered Institute of Building Services Engineers: Documents used: TM46 "Energy Benchmarking" (2008) and CIBSE Guide F (2004)*

The heat density is based on the total heat demand of the buildings in each grid square. Matching CHP technology to baseload heat demand of different building types is taken into consideration in the assessment of CHP capacity described later in this section. .

The DECC methodology identifies areas with a heat load of over 3,000kW/km$^2$ as areas with potential for heat networks, which are the areas appearing as orange or darker on the maps produced within this study. In practice however, areas of relatively high density housing, e.g. terraced housing, can often register at this heat density, but are very rarely economically viable for retrofitting of district heating. For this reason, we would suggest a threshold of 5,000kW/km$^2$ to be a better indicator of areas with *significant* potential. This threshold has been informed by other more detailed investigations into District Heating from Verco's experience. Examining the heat maps it can clearly be seen that there are many more large commercial energy users in the areas of heat demand above 5,000kW/km$^2$ than in those areas between 3,000 and 5,000. It is these large "anchor loads", along with public sector buildings, which would typically form the initial customer base of a district heating network serving existing buildings.

Also presented in the map are a range of potential "triggers" which could prove beneficial in the development of a district heating system, such as potential anchor loads or identified heat sources. The presence of large commercial and public sector heat loads is often key in developing heat networks in areas of existing buildings, as it is essential that a sufficient level of heat demand can be secured into a contract to justify the installation of each section of the network infrastructure. Securing a small number of large consumers is more efficient than attempting to sign up many smaller ones.

Existing heat sources such as CHP units, incinerators and waste heat from industrial processes may also be key in achieving a viable business case for district heating. Waste heat from these sources could potentially be delivered to the network. This could benefit the financial viability of the network in two ways:

- By reducing the up-front capital costs of a network as the waste heat supply could offset part of the boiler capacity required.
- Reduce the average cost of the heat used to supply the network, as the waste heat could potentially be supplied at lower cost than heat generated via the network's own boilers. This would increase the profit margin on the heat sale price therefore assist in repaying the capital costs of network infrastructure more rapidly

The Borough wide map is further disaggregated to allow closer inspection of the high heat density areas in Figure 9-3, Figure 9-4,.Figure 9-5 and Figure 9-6.

### 9.2.2 Key findings from the heat maps

Examining the Borough wide heat map, it is immediately evident that the two largest accumulations of heat loads are in Chester and Ellesmere Port, followed by Northwich, Winsford and Neston.

Closer inspection of each of these areas reveals that Chester has a significant area of high heat density in the city centre (circa 1km$^2$ area would be categorised as being of high heat density), with several larger commercial loads evident.

Ellesmere Port has an area of high heat load adjacent to the station, with only a small number of large commercial loads, but a number of significant industrial sites and potential heat sources on its outskirts. We have prepared heat maps for both Chester and Ellesmere Port to show these areas in more detail.

Northwich has fewer areas of high density heat load and few large commercial or industrial heat loads evident. The town centre is also closely bordered by rivers or railway on all sides, which represents a potential constraint to the installation of district heating infrastructure.

Winsford has only a few small pockets of higher heat load, the majority of which are located in the industrial estate. There are very few large commercial users. Again, the town is bisected by both river and railway which is a potential barrier to the installation of district heating infrastructure.

Neston only has two small pockets of high heat load greater than 5,000kWh/km$^2$ with very few commercial or public sector loads.

Cross-referencing with aerial imagery confirms that the majority of heat demands within Northwich, Neston and Winsford relate to existing medium density domestic buildings. It is not likely that these three areas will have significant potential for extensive district heating networks, but there may be limited potential for small local scale heat networks serving a number of key users in the areas of highest heat density, or smaller heat networks led by new development which could extend to certain key buildings in the immediate area. In light of the findings from the Borough-wide heat mapping exercise, we have split our consideration of district heating opportunities into two discrete sections

- The areas of greatest potential in Chester and Ellesmere Port, where larger heat networks may be viable
- Areas where smaller heat networks may be viable, but heat demand and density is insufficient to support district scale schemes. This covers Northwich, Winsford and rural areas.

### 9.2.3 New development

New development can be a key trigger for the development of district heating systems. District heating viability can also be boosted on new development sites, as the installation of pipework can be carried out in parallel with other utilities, and as the use of district heating can achieve significant carbon reductions, this can offset the costs of alternative carbon reduction technologies. New development can therefore act as an initial hub from which a wider network could be developed.

An overview map of the broad location and scale of new development over the period to 2026 is presented in Figure 9-2. In addition consideration has been given to regeneration sites in the key settlements of Chester, Ellesmere Port, Northwich and Winsford.

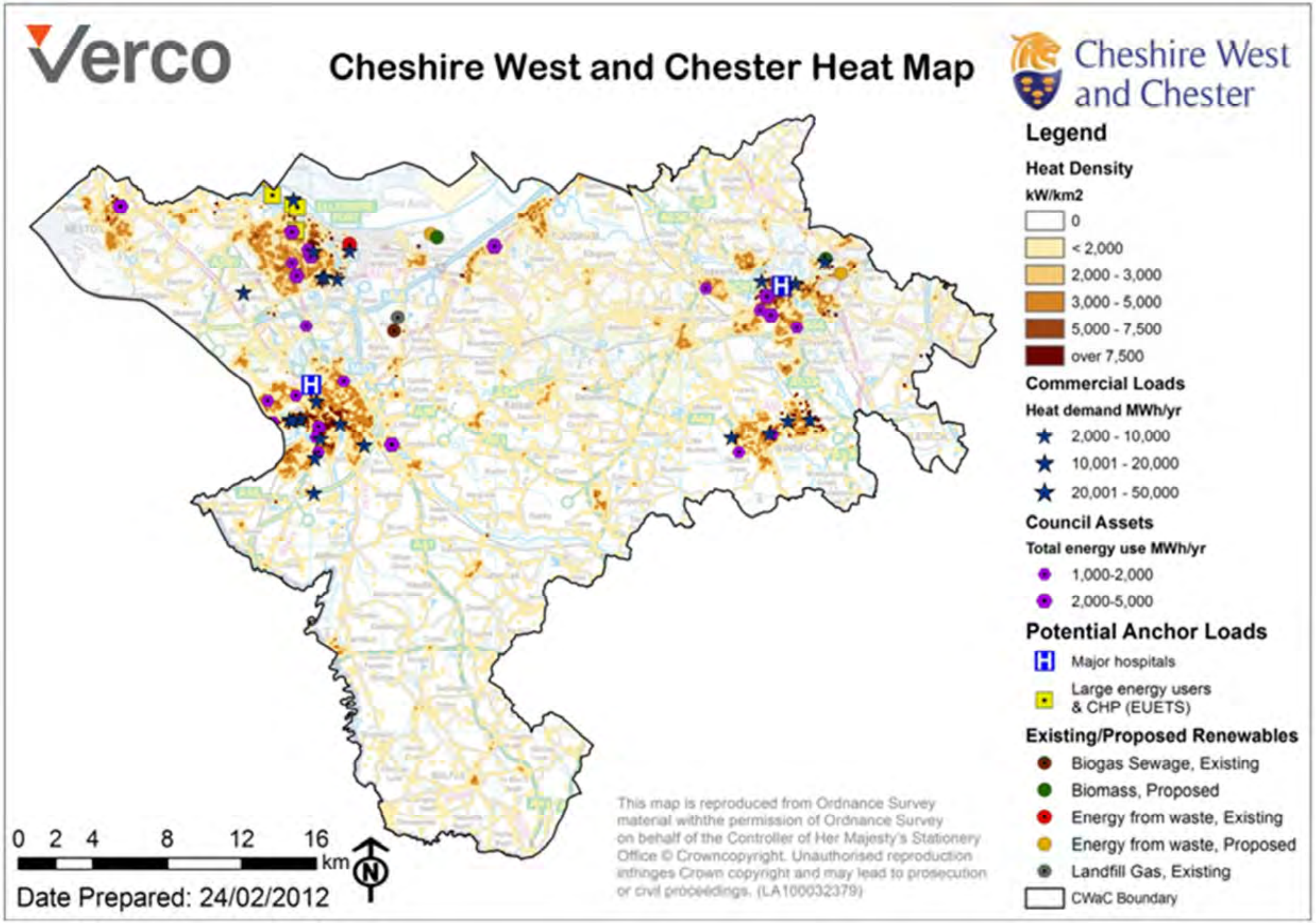


**Figure 9-1. Cheshire west and Chester Heat Map**

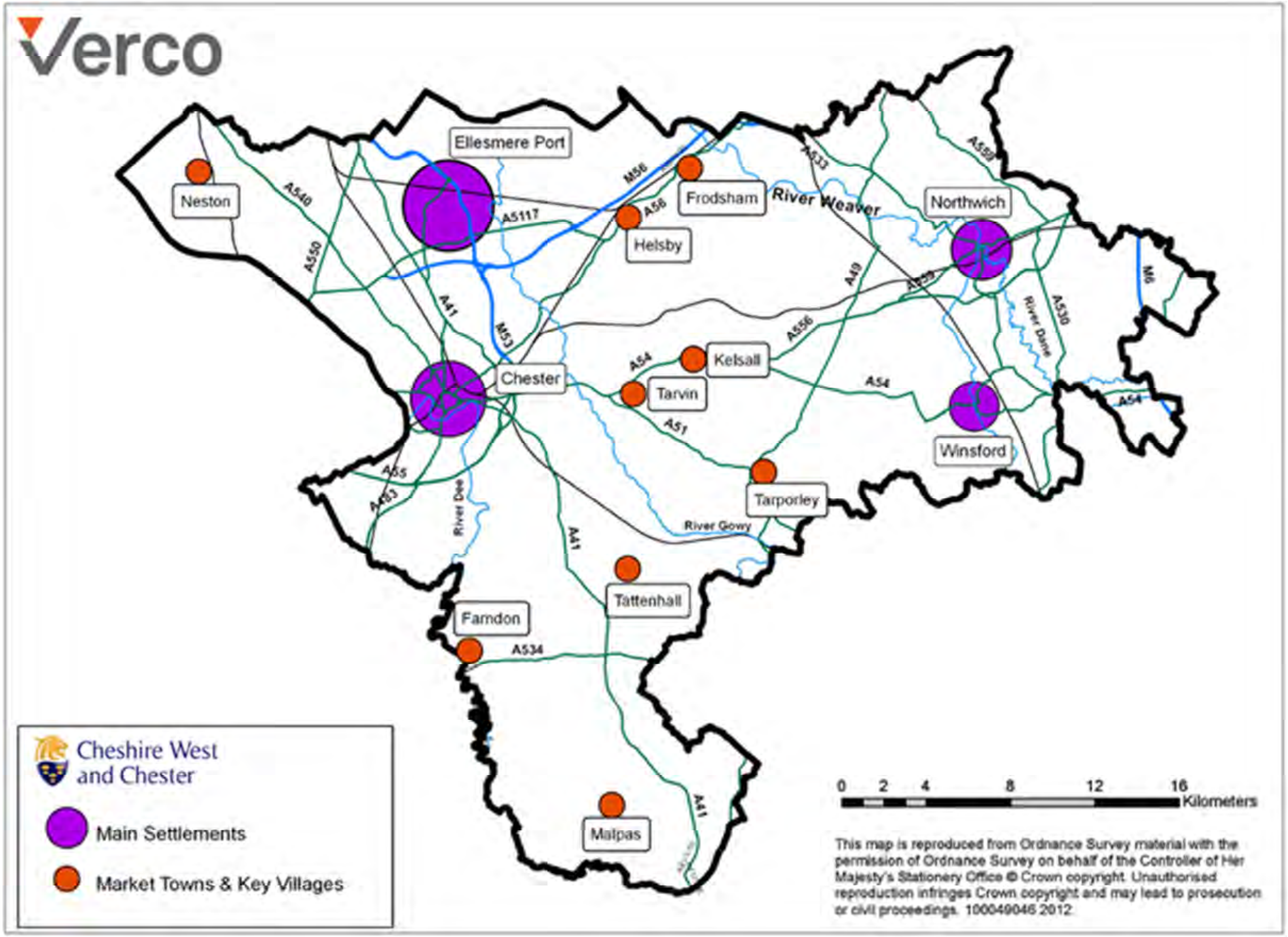


**Figure 9-2: High level indicators of proposed new development in the Borough (Copyright Cheshire West and Chester Council)**

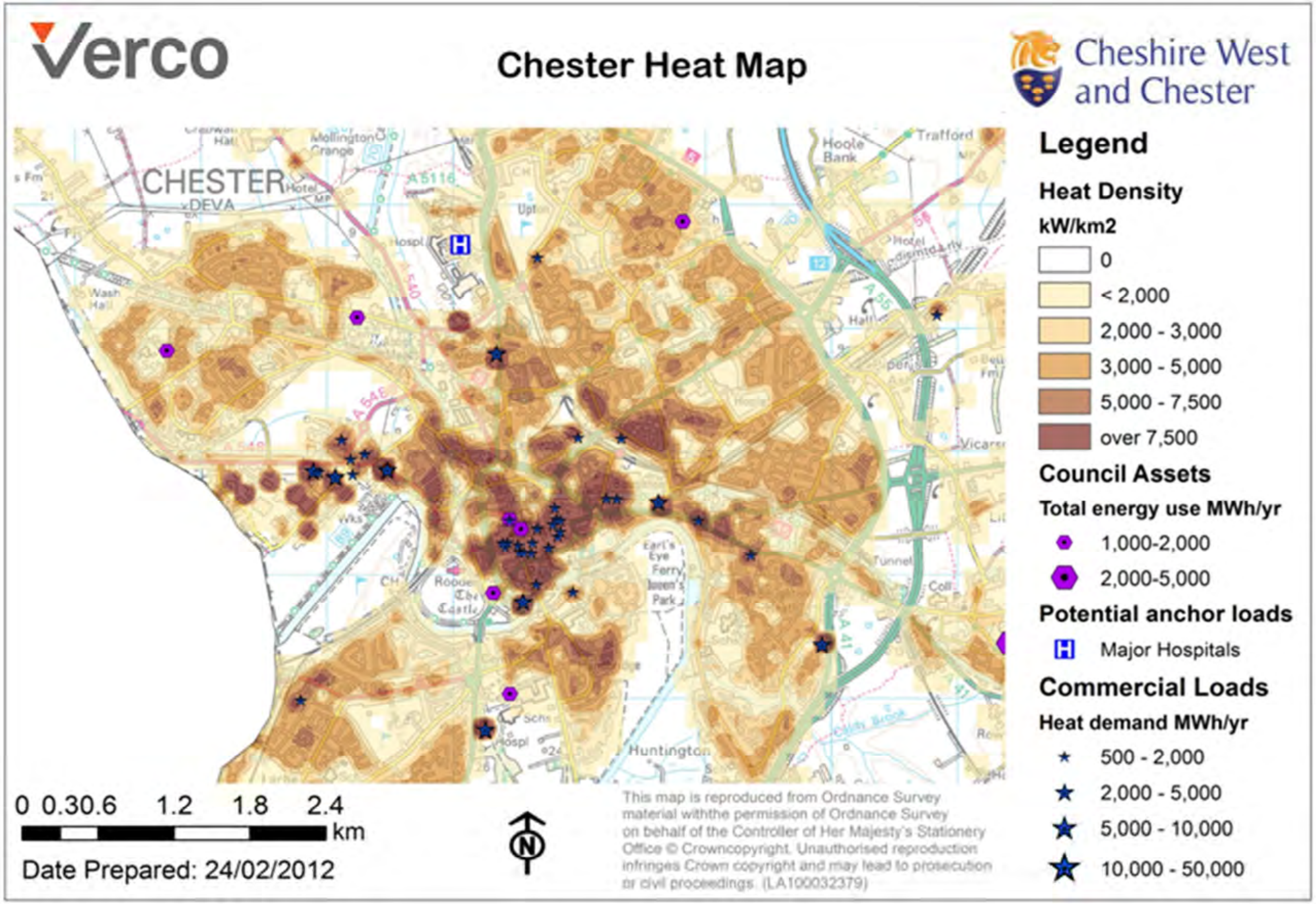


Figure 9-3: Chester Heat Map

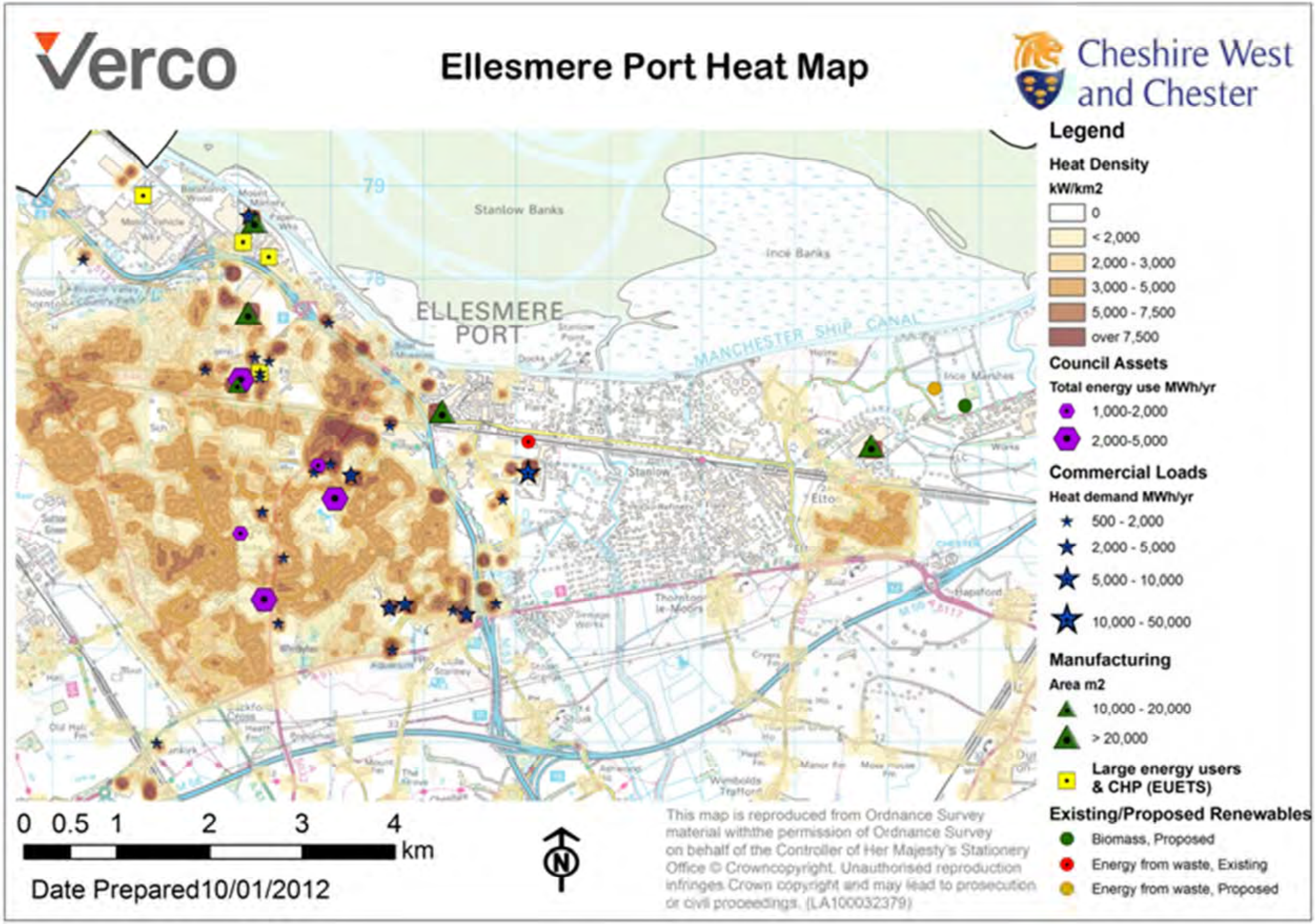


**Figure 9-4. Ellesmere Port heat map**

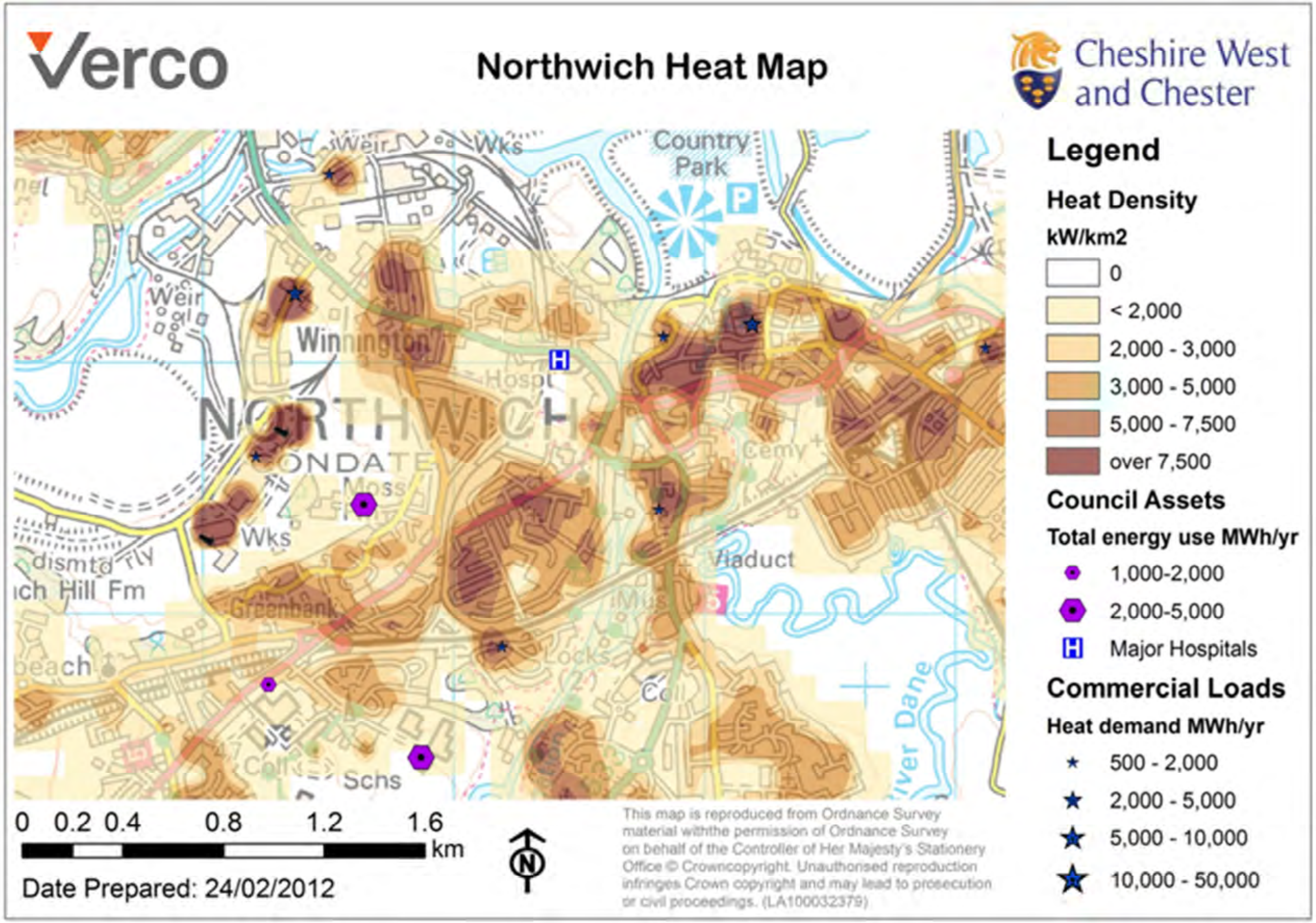


**Figure 9-5. Northwich heat map**

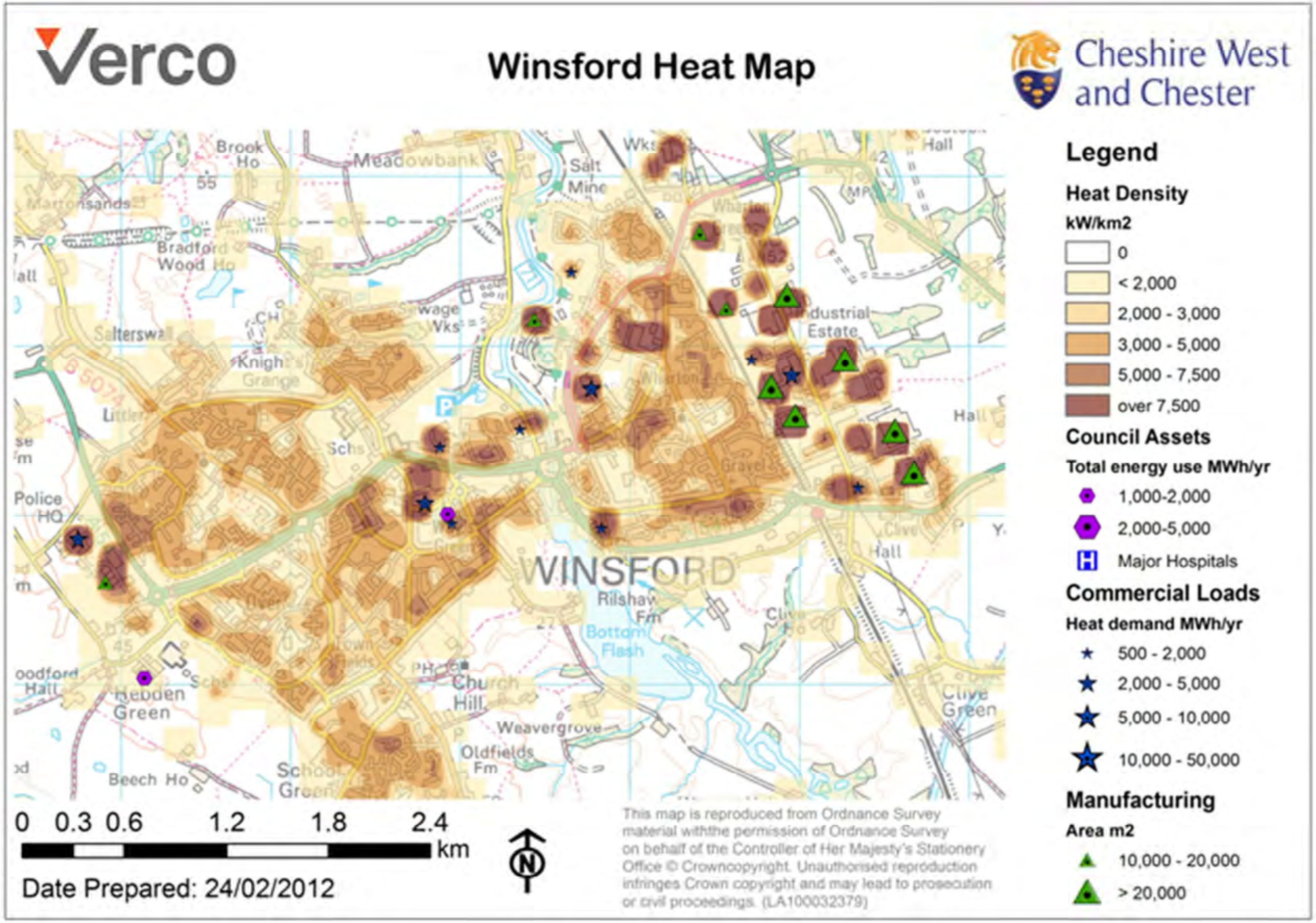


**Figure 9-6. Winsford heat map**

### 9.2.4 Discussion of areas of greatest potential

Chester and Ellesmere Port were examined in further detail using a matrix structure; see Table 9-1 below. This analysis has been carried out though interrogation of the heat maps and the underlying datasets which have been used to create them.

In assessing the potential for district heating in these areas we have employed a “decision matrix” approach to examine a number of key parameters that influence the viability of heat networks:

1. **Scale and distribution of heat load**– overall size, and spatial distribution of, areas of high heat load (> 3,000 kW/km$^2$) and very high heat load (>5,000kW/km$^2$).
2. **Heat load diversity/mix -** domestic only schemes typically have poor viability due to short periods of heat demand and extensive heat distribution networks required; a good base of commercial users or large residential blocks is typically required for schemes serving existing buildings.
3. **Proximity of major heat sources (capable of leading a scheme) -** is there a major heat source with the potential to be the lead heat source for a district heating scheme (e.g. EFW plant, power station, large CHP) nearby?
4. **Proximity of smaller heat sources** - are there smaller waste heat sources within the boundaries of the high density heat area such as smaller CHP schemes or industrial sites that could provide low cost supplementary or peak heat loads for a network?
5. **Commercial anchor loads** - are there large commercial users present within the high heat density area?
6. **Public sector anchor loads** - are there large public sector users present in the high heat density area?
7. **Major new developments** - are there major new development sites adjacent to or within the high heat density area? This can be a key trigger for new development areas.
8. **Existing DH infrastructure** - are there significant existing DH schemes present or adjacent to the high heat density area that could be extended?
9. **Previous DH studies** - have previous DH studies been carried out which could facilitate more rapid scheme development?
10. **Physical constraints** – are there constraints to the installation or routing of a hot water pipe network, such as un-bridged rail, road or rivers?

The results of our assessment are summarised in the table below, and the two priority areas (Chester city centre and Ellesmere Port) are discussed in further detail below.

| Criterion | Chester (city centre) | Ellesmere Port |
|---|---|---|
| **Scale and distribution of heat load** | The city centre area is a significant area of high heat load in a relatively compact geographical distribution. | Substantial overall heat load, but the majority of the area has a heat density below 5,000 kWh/km$^{2}$. Highest heat load is confined to one main pocket near the station. |
| **Load diversity** | Primarily commercial, three public sector assets. Chester University and Countess of Chester Hospital to the north of the city but outside the main area of high heat demand. | The majority of the heat load in the area is domestic, large commercial loads are mainly confined to the town centre, and two retail parks. |
| **Major heat sources nearby (capable of leading a scheme)?** | None identified | Ince Marshes incinerator and biomass plant proposed for location 6km west - deemed too far for economic transport of heat to Ellesmere Port. |
| **Lesser heat sources within high density heat load area?** | None identified | Several large industrial sites identified under EU-ETS including the Shell Stanlow refinery, all relatively close to the town centre. Further investigation required to determine scale. |
| **Commercial/industrial anchor loads present?** | There are a significant number of large commercial loads (primarily office/retail) in the range 500-2,000 MWh/year | Several large commercial users, but they are widely dispersed across three main sections of the town, with distances of approx. 1.5km between them. Town centre users are retail and office; at Cheshire Oaks there is a bowling alley and entertainment facilities; just north of the railway the large commercial uses are primarily workshops/industrial. |
| **Major new developments proposed?** | There are two key development sites identified in the Chester City Centre area; these are the business district (primarily office space) and the Northgate area (a broad mix including retail, commercial, leisure and entertainment). Both of these sites have the potential to support stand-alone district heating developments, however they may also act as a trigger for a wider city centre network. | There are a number of areas of potential new development identified in the Ellesmere Port SRF. A few of these development locations are located immediately adjacent to the highest heat density area in the town centre. A number of further development areas are located on the opposite side of the M53 and the railway. |
| **Public sector/other anchor loads present?** | Three public sector buildings, (town hall, forum offices and council HQ) although from the data provided, only the town hall uses gas for heating at current. | Five public sector loads - EPIC Leisure Centre and the council offices are possible anchor loads for a network in the town centre. Additionally there are two high schools further from the high density areas and a municipal depot situated just north of the railway. |
| **Existing / proposed DH infrastructure?** | None known | Proposed district heating from 20MWe biomass CHP plant to supply buildings on the Ince Resource Recovery Park (currently in the planning process); however this is circa 6km from the town |

| Criterion | Chester (city centre) | Ellesmere Port |
| --- | --- | --- |
| | | centre and is unlikely to be viable as a contributor of heat to a network in the town.. |
| **DH studies carried out?** | Cheshire and Warrington sub region energy networks study – identified potential for a heat network in Chester. | None known |
| **Physical constraints present?** | Main town centre area bounded by river and railway, plus dual carriageway inner ring road (A568). Further investigation would be required to determine whether infrastructure could bridge these barriers cost effectively. | Motorway (M53) bounds the town and separates the main town centre from the very large industrial/chemical sites, and a significant proportion of the new development. A rail line through the town separates the main retail centre from the further areas of new development along the waterfront. |

**Table 9-1: District heating decision matrix**

### Chester

The high density heat load area in the centre of Chester may be a promising hub for the development of a district heating scheme. There are a mixture of constraints and opportunities which could affect the viability of a network in this area.

Physical constraints in the form of the river, roads (dual carriageway) and railway may present a barrier to expansion beyond the main commercial district. There are relatively few large commercial loads in the city centre (circa 17,700 MWh/annum demand from commercial loads over 500MWh/year), which is concurrent with the fairly low-rise nature of the city. This could lead to any network requiring a significant number of customers at start-up which makes the initial development of a network more complex, although this is not in itself a complete barrier. There are only a relatively small number of substantial stable anchor loads in the area.

Availability of land for siting an energy centre may present an issue if a city centre network was to be developed and the location and design would have to be thought through carefully to ensure consistency with the local character. This study has not identified any sources of waste heat in the vicinity of Chester city centre.

The presence of two relatively large regeneration sites in the city centre area could present a trigger for a heat network. The larger of the two sites (the business district) consists primarily of office development. While this could present a substantial heat load and a number of large individual buildings, office buildings generally have a relatively low base heat load due to minimal demand for hot water and low heat demand in the summer months, and a high peak load relative to their total heat demand. This low base heat load can adversely affect the financial case for DH as it can limit the application of CHP to a smaller scale, or result in a need to reject large amounts of heat to the atmosphere at times of low load. This could be partially offset through the inclusion of absorption chillers to meet summer cooling loads from the hot water in the heat network, although the financial viability of this use of district heat is generally poorer than that for using the heat directly.

The Northgate development site has greater load diversity (retail, commercial, leisure, entertainment and domestic) and may be a strong candidate for forming a district heating hub. This could then be extended to serve other large heat loads in the city centre area. If a strong case could be made for developing a second hub in the business district, linking these two island networks could provide resilience while also providing a “backbone” for a city centre network

### Ellesmere Port

The heat map presented for Ellesmere Port presents the town itself, along with the immediate region to the west of the town, including the Shell-Stanlow refinery and the Ince Marshes area (to the far east of the map). It should be noted that industrial process energy loads cannot be addressed at the high resolution in this heat mapping, as they are entirely specific to each individual facility.

In this study, industrial loads are calculated as the space heat load of buildings included in the VOA dataset only. For this reason the Shell-Stanlow refinery does not appear as a significant area of high density heat load, as the process use of heat is not accounted for. In practice this is not considered to be a deficiency of the heat mapping process as process loads are usually highly specific applications of heat, and are relatively unlikely to be suitable for connection into an existing district heating system. For example, much of the process use of fuels on the Shell-Stanlow site is likely to be direct combustion of industrial petroleum products and solid fuels to achieve high temperatures for fractional distillation and cracking processes. This could not be replaced with a district heating heat supply. The refinery may, however, be a potential source of significant quantities of waste heat. In order to determine this, detailed discussions would need to be undertaken with the refinery operators.

The distribution of non-industrial heat loads in Ellesmere Port is less well suited to the development of a heat network than that of Chester city centre. The bulk of the town’s heat load is made up of medium density housing and the limited number of large commercial heat loads which at present are relatively scattered.

In terms of potential heat sources, there is one obvious possibility. The Shell-Stanlow refinery may be a viable source of waste heat.

There are two substantial thermal facilities proposed in the Ince Resource Recovery Park located to the far east of the heat map (a biomass waste wood combustion facility and a waste incinerator). However, the distance from here to Ellesmere Port is approximately 6km. The capital cost associated with installing heat mains from the Ince Resource Recovery Park to Ellesmere Port is likely to be prohibitively high, necessitating a very large base of heat users in order to achieve an attractive return on investment. It is therefore unlikely that this would be a cost-effective heat supply strategy for a heat network serving buildings in Ellesmere Port. A local heat network is proposed on the Resource Recovery Park which will permit efficient use of the heat locally.

From the heat mapping analysis, we therefore consider it unlikely that the town of Ellesmere Port would be suitable for a large “district” scale heat network based solely on the existing heat demand. However, there may be the potential for collaboration between some of the large industrial users in the waterfront area, whereby one site might make use of the waste heat from another, or a number of sites might share heat generation facilities for the raising of steam or hot water. Development of a heat network of this type would be highly customer-led and would require extensive consultation with energy users in the area in order to build a sound business case for both the network and the potential customers.

Examining the location of new development areas in Ellesmere Port, there are a number of smaller sites in close proximity to the town centre which may be suitable candidates to support the development of a heat network serving building heat loads in this area. The additional sites located along the motorway and towards the river might provide opportunities to extend a network towards the more industrial areas on the outskirts of the town.

Further new development is underway at Cheshire Oaks, on the extreme south east of the town, adjacent to the M53/A5117 junction. This consists of a large Marks & Spencer’s store, and a shopping centre development. Due to the fact that the M&S store is well under construction this is unlikely to open up any opportunities for district heating, as the mechanical services design will be fixed.

#### 9.2.4.1 Recommendations for areas of greatest potential

**Chester**

Further study is recommended to examine the viability of a city centre heat network to explore this potential resource. It is recommended that a an options appraisal is carried out for developing a District heating network in this area, considering the use of the two major development sites as initial hubs and possible energy centre locations. Should the options appraisal find favourable opportunities, a full feasibility study could be carried out leading to the development of a clear business case, identify the development risks and to explore how the Council could drive this forward. In particular this should include:

1. Detailed analysis of heating demand patterns for key buildings identified within the high heat density areas of Chester city centre.
2. Identification of viable energy centre locations close to the city centre.
3. Identification of potential infrastructure routing options to connect the large city centre heat loads.
4. Early “soft market testing” to discuss the potential for delivering a heat network in the city centre and gain an understanding of the appetite and suitability of city centre customers with regard to District heat.
5. Evaluation of low carbon heat generation options for the network – e.g. biomass boilers, CHP, large scale heat pumps or alternative sources of recovered low carbon waste heat.
6. Evaluation of the location and scale of new development as a potential trigger for a city centre network, or for a second “island” network which may have the potential to connect up to the city centre in future.
7. Detailed financial modelling which accounts for phased uptake by potential customers, energy price inflation, operation costs, losses, capital costs etc.
8. Consideration of the appropriate ESCo and financing model for delivering the DH scheme – e.g. Public / Private / Hybrid ESCo.
9. Consideration of funding opportunities

**Ellesmere Port**

The Council, supported by suitable technical evidence, may be in a position to act as a catalyst for the delivery of a heat network serving large industrial users. This could be pursued by supporting dialogue, providing expert opinion and supporting the infrastructure required to enable energy distribution. This first stage would be to convene workshops with key stakeholders, to discuss the basis on which energy consumption data could be shared and to examine whether parties are willing to collaborate based on the mutual benefit that could be generated (security of supply, process efficiency, cost reduction, carbon savings and reputational benefits)

Further investigation into the expected scale and phasing of new developments in close proximity to Ellesmere Port town centre is recommended. District heating is more likely to be viable for new development on larger sites with a mix of building types which can provide a consistent baseload heat demand. Potential development close to the motorway and river may present opportunities for extending such a network further.

### 9.2.5 Areas with opportunities for smaller schemes

**Northwich**

Northwich has only one area of existing high heat load with any significant potential for district heating (the town centre). There are other areas of relatively high heat density, but on further analysis these are seen to be areas of high density terraced housing. These areas would not be economically viable for district heating due to the high network infrastructure costs and difficulty signing up a high enough proportion of the heat demand for district heat use.

There is a significant regeneration site to the north of the town, Baron's Quay. A master plan has been set out for the site for retail and leisure development. The proposed energy strategy is a district heat, cooling and power network (otherwise known as tri-generation or CCHP). There may be potential for an energy network on this site to provide heat and/or cooling to other select town centre buildings along the main high street, however on a wider scale the town has only limited areas of large heat load away from this site and the extension of a network into residential areas is unlikely to be economically favourable.

**Winsford**

Winsford is a relatively small town which presents no large areas of very high heat density (e.g. >5,000kW//km$^2$) in the existing building stock. Although significant parts of the town present heat density in the range 3,000-5,000kW/km$^2$, closer inspection of aerial imagery[4] reveals that the vast majority of these areas are made up of medium density housing, which typically has poor viability for district heating.

To the East of the town lies an industrial estate. Our heat mapping indicates a number of significant heat loads in this area; however, due to the fact that the majority of these users appear to be of an industrial nature, their heat demand is likely to vary substantially on a case by case basis. Many warehouses and manufacturing sites have minimal space heating, or employ electric radiant

[4] *Using Google Mapping*

heating, or direct gas fired air heating, to selectively heat spaces where personnel work full time (e.g. an electrically heated office in a larger unheated distribution warehouse). Successful implementation of district heating in industrial areas is often therefore dependent on individual users with large process heat loads which can be fed by hot water or steam; this cannot be assessed at the resolution of this study. We would not anticipate this area would be viable for a dedicated network, and our assessment has not identified any potential waste heat sources in this area.

There is one key development site located in the town: the Winsford Waterfront area[5]. This is a primarily residential led redevelopment including aspirations for a hotel.

This degree of development could equate to a peak load in the range of 2-4 $MW_p$, which is a suitable scale for implementation of a local heat network. There may be potential to locate an energy centre on the hotel site (as the hotel will have a substantial independent load) and serve the whole site from this. However, it should be noted that the A54 dual carriageway would present a physical barrier to the routing of district heating pipes; installing heat pipes across this highway would likely incur substantial costs and disruption which could adversely affect the viability of a network.

Adjacent to this development site to the west is a small commercial/civic precinct including an ASDA store, public sector office building (Wyvern house), Winsford Lifestyle Centre and Winsford Cross shopping centre. If a heat network was to be included in the Waterfront development, it would be advisable to consult with energy users in this area to determine whether there was an appetite to connect into the network immediately or at a later date.

**Rural and off-grid areas**

Generally, the viability of heat networks in rural areas is very minimal. This is due primarily to the fact that there is usually a low density of development with properties widely dispersed – this results in prohibitively high installation costs for network pipes.

Viable schemes may be possible in off grid areas of very high density housing (e.g. terraces or closely spaced flat blocks) if a community scheme could be developed with a very high participation rate. Schemes of this type may be in a good position to benefit from the installation of biomass heat generation under the RHI, especially where local sources of biomass fuel are available.

#### 9.2.5.1 Recommendations for areas with potential for smaller schemes

Delivering district heating is more challenging in areas of lower heat demand and fewer large heat users and is likely to rely more heavily on new development as a trigger. There are two locations where opportunities may exist to develop smaller scale networks:

1. Northwich: examine opportunities extending the proposed scheme on the Baron's Quay development to serve any large heat users in close proximity to the site.
2. Winsford: if district heating is investigated for the Waterfront regeneration area, then opportunities for extending the network into the Winsford Cross shopping area should be considered.

[5] *http://weavervalley-org-uk.temp.connectedcheshire.org.uk/?page_id=142*

## 9.3 Assessment of the technical potential for CHP in the Borough

### 9.3.1 Overview of approach used to estimate CHP potential

In order to arrive at a quantitative assessment of the potential for CHP in the borough, we have carried out an assessment of the extent and scale to which CHP could be delivered through two separate pathways:

1. Delivery of CHP to feed district heating an local heat networks
2. Delivery of CHP to meet the demands of individual buildings (in-building CHP)

In order to avoid double counting, our methodology therefore assumes that in areas where district and local heat networks are deemed to be viable, these will be implemented. In-building CHP is then assumed to be an option in areas where heat networks are not viable.

The methodology for assessing the potential for CHP and district heating is summarised in Figure 9-7 on the following page. The heat mapping exercise identified areas with a high heat demand density which may be suitable for district heating or local heat networks. For the areas where district heating is not feasible, large buildings with a high heat demand have been assessed for their suitability for in-building CHP, whereby an individual CHP unit can be installed in large buildings that have a suitable balance of heat and electricity demand. Note that, following the DECC methodology, this section assessed the potential specifically for CHP, rather than quantifying the potential for district energy (as above).

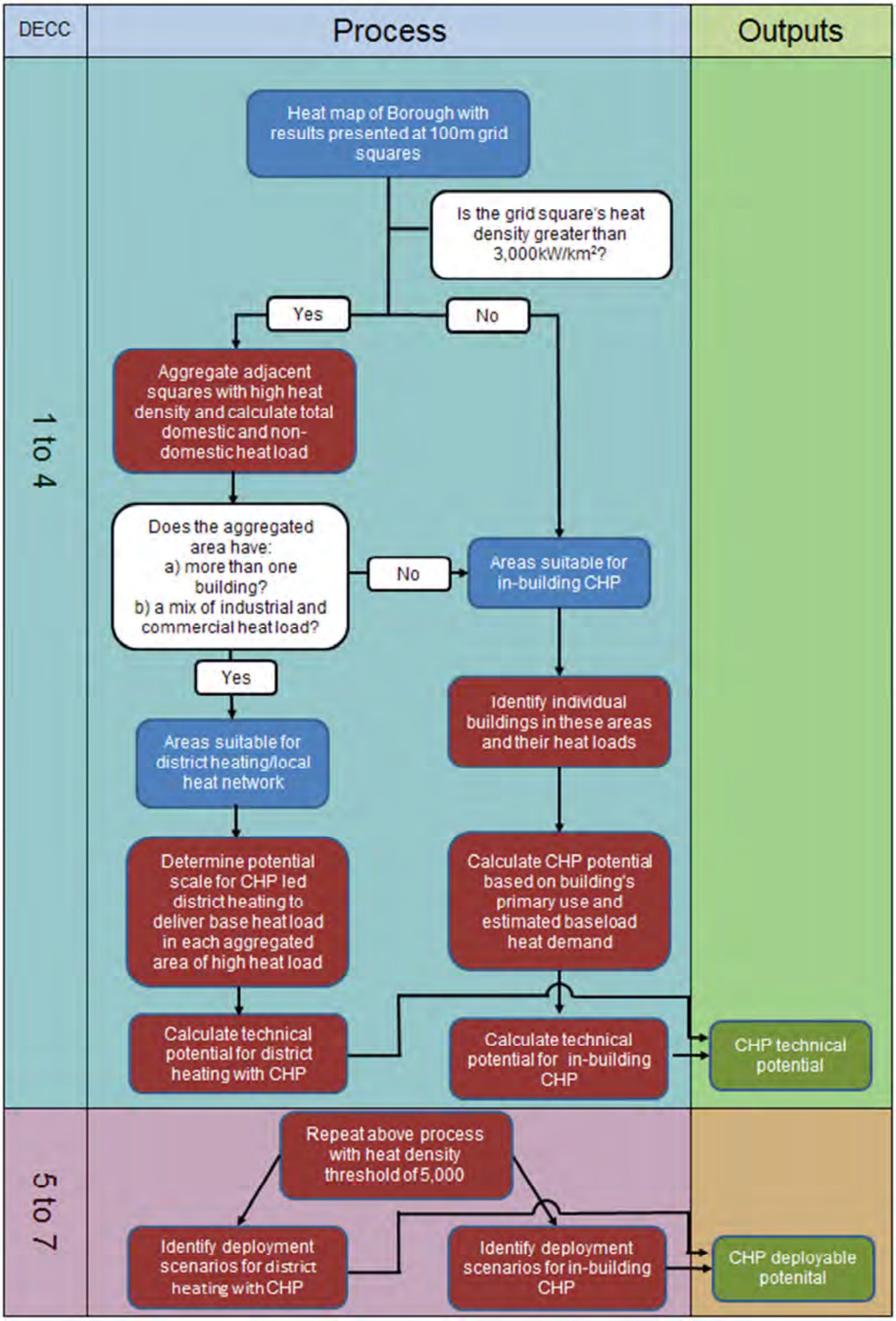


**Figure 9-7: Overview of approach used to estimate CHP potential across the Borough**

## 9.4 Potential for district heating led by CHP

### 9.4.1 Overview of approach

Key elements of our approach: Technical potential (DECC 1-4):

- Our assessment addresses existing building stock only. New development must be assessed on a case by case basis; at the resolution of this study insufficient information is available to assess the suitability of potential new development for CHP.

- The potential heat delivered to the DH schemes was based on the estimated baseload heat demand for each area, as CHP should be sized to meet baseload in order to maximise efficiency and running hours.

- The baseload heat demand for each District heating area was determined as 20% of domestic heat demand plus 30% of non-domestic heat demand. This heat load was then used to determine the scale of CHP technology suitable for each of the areas of high heat demand

- The likely peak output (in $kW_e$ for electricity and $kW_{th}$ for thermal) of each CHP unit was determined on the basis of the baseload to be met and the assumed number of annual running hours (these are specified in the appendices).
- We select only areas with containing more than one building, and having either commercial, or a mix of domestic and commercial heat load, as suitable for District heating. The DECC methodology's heat density threshold of 3,000kW/km$^2$ often includes areas of existing medium density housing e.g. housing estates, which are not viable candidates for District heating. Our methodology addresses this issue and produces a more realistic assessment of technical potential.

Key elements of our approach: Deployable potential (DECC 5-7):

- Our assessment of the deployable potential identifies only those areas with a heat density of over 5,000kW/km$^2$, and having an either commercial only, or a mix of domestic and commercial heat load, as suitable for District heating. This threshold is based on Verco's experience of more detailed District heating studies. Areas with heat load above this threshold consistently contain a larger proportion of non-domestic heat load relative to domestic, in these areas significant anchor loads are generally located and District heating development is most likely to be viable.
- Our scenarios for deployment potential are estimates based on our experience of the UK market, and our knowledge of the rates of uptake for District heating and CHP. Both of these technologies feature substantial technical and economic challenges, and thus far the uptake rates in the UK have been very low.

### 9.4.2 Technical potential of CHP serving district heating networks

The technical potential of CHP linked to both district heating networks is presented in **Table 9-2**.

| CHP scale | Capacity ($MW_e$) | Capacity ($MW_{th}$) | Heat delivered (GWh) | Carbon savings (tonnes per annum) |
|---|---|---|---|---|
| Heat networks - v. small scale | 9.4 | 11.2 | 56.2 | 3,749 |
| Heat networks - local scale | 14.4 | 17.3 | 86.4 | 5,761 |
| Heat networks - district scale | - | - | - | - |
| **Total** | **23.8** | **28.5** | **142.6** | **9,510** |

**Table 9-2: Technical potential for district heating led by CHP**

Our analysis identified 867 individual 100m grid squares in a total of 592 separate aggregations which had heat densities of over 3,000kW/km$^2$ and a potentially suitable heat load profile for technical potential for District heating.

It is noted that a significant proportion of the potential ascribed to heat networks is associated with "very small" heat networks – this would relate to small areas of high heat demand with only a few buildings with significant heat load "local scale heat networks" relate to larger networks which are likely to incorporate a larger number of buildings and a greater diversity of loads – these are much more likely to be deliverable in practice.

In practice, due to the broad scale of our study, it is not feasible to carry out a detailed analysis of each small area of high heat load to identify whether it would be well suited to District heating or not (e.g. is it made up of a few large heat loads or many smaller ones?)

### 9.4.3 Deployment potential of CHP serving district heating networks

The technical potential of CHP serving District heating networks is 5% of the Borough's heat demand. The technical potential assessment assumes that 100% of the buildings in the high heat density areas would be connected to the District heating systems and that CHP systems would serve 100% of the base heat load. In practice each connection would be made only if it was economically viable to do so, and the network is likely to serve less than 100% of the buildings in any given area.

***Refinement of the technical potential to reflect more deliverable heat networks***

In order to present a more realistic deliverable potential for CHP through heat networks we have made the following refinements to the technical potential:

1. Selected areas with heat loads above 5,000kW/km$^2$ rather than 3,000 kW/km$^2$ (see the first section of this chapter for explanation of the value selected)
2. Excluded any areas where the CHP unit serving the heat load would be smaller than 50kW$_e$/60kW$_{th}$ (micro scale). Micro scale CHP is typically only cost effective as a single building installation, and all the areas selected as having with potential for heat networks have multiple buildings within them.
3. Identified potential uptake rates for District heating (see discussion below)

The actions described above reduced the overall potential figures to those in the following table. These figures represent the CHP capacity which would correspond to development of district heating to feed every building in the areas meeting the two criteria above.

| Scale of technology | Capacity ($MW_e$) | Capacity ($MW_{th}$) | Heat delivered (GWh) | Carbon savings (tonnes) |
|---|---|---|---|---|
| Smaller or communal systems | 3.3 | 3.9 | 19.6 | 1,305 |
| Local heat network | 10.9 | 13.1 | 65.6 | 4,372 |
| **TOTAL** | **14.2** | **22.3** | **85.2** | 5,676 |

**Table 9-3: Deployment potential for CHP with district heating in very high heat density areas**

In order to identify a realistically deployable potential, it is necessary to identify deployment scenarios to apply to these figures, to account for further barriers in the UK district heating market. This is described in the following sections.

### Context of district heating uptake in the UK

The uptake of District heating in the UK has been limited, especially when compared with certain European countries such as Norway and Denmark. This is due to a wide range of barriers. A recent report[6] identified the three key barriers to UK development of District heating networks as follows:

- Economic barriers – Project risk: the very large up-front capital required is the greatest barrier to development of DH networks. DH is viewed by many to be a risky investment due to the following:
  - A perceived lack of experience and knowledge of DH in the UK
  - Limited understanding of tariff structures and management of the customer connection process
  - Barriers to accessing capital due to uncertainty in predicting financial viability and customer uptake
  - Unfamiliarity with the concept of District heating among consumers and the public sector.
- Economic barriers – Project cost:
  - Lack of local expertise and supply chain for DH delivery.
  - UK housing mix is less suited to DH development than many other European countries, as there are fewer large blocks of flats or apartments and more individual dwellings
  - Lack of standardisation of contract structures
  - Increased financing costs due to uncertainty over revenue risks

[6] *POYRY/DECC/Faber Maunsell: "The potential and costs of district heating networks", 2009*

- Institutional issues – the UK has variable levels of engagement from the public sector to underwrite the risks of DH schemes and provide anchor loads for the core of new schemes – this can be due to:
    - Energy viewed as a lower priority by LA's compared to education and health
    - Inconsistency and lack of transparency in the application of planning policy and/or building regulations
    - Lack of familiarity among LA's with District heating technologies

Examining the areas of potential for local heat networks with CHP in the Borough, it is noted the Chester city centre area has a CHP potential of nearly 20% of the total deployable potential identified. The larger schemes (e.g. over 250kW) are generally more likely to be viable than smaller schemes; these schemes make up 50% of the deployable total. We have therefore set our uptake figures at 20%, 40% and 60% of the deployable potential to reflect the installation of the Chester scheme only, this scheme plus several of the larger remaining schemes, and all the larger schemes plus a few of the smaller schemes, respectively. This also reflects the fact that networks would not serve 100% of the buildings in the high heat density areas.

In light of the economic and institutional barriers affecting the uptake of District heating and local heat networks, it is very difficult to predict the likeliness of a scheme being delivered; the figures selected in our scenarios reflect possible outcomes but substantial further work would be required in order to confirm the viability of these schemes and implement them. For our 2020 and 2030 deployment scenarios presented in section **Error! Reference source not found.** of this report, there is assumed to be no uptake of district heating up to 2020 (due to the carbon savings from existing buildings connecting to district heating networks not coming to fruition until post 2020).

These results are presented in **Table 9-4** and **Figure 9-8** below.

| Scale | 60% Uptake (GWh) | 40% Uptake (GWh) | 20% Uptake (GWh) | 60% Uptake ($tCO_2$) | 40% Uptake ($tCO_2$) | 20% Uptake ($tCO_2$) |
|---|---|---|---|---|---|---|
| Smaller or communal systems | 11.7 | 7.8 | 3.9 | 782 | 522 | 260 |
| Local heat network | 39.3 | 26.2 | 13.1 | 2,623 | 1,749 | 874 |
| **Total** | **51.1** | **34.1** | **17.0** | **3,406** | **2,271** | **1,135** |
| **% of Borough's heat demand for domestic and commercial buildings** | **1.77%** | **1.18%** | **0.59%** | | | |

**Table 9-4: Deployment potential of CHP serving District heating networks**

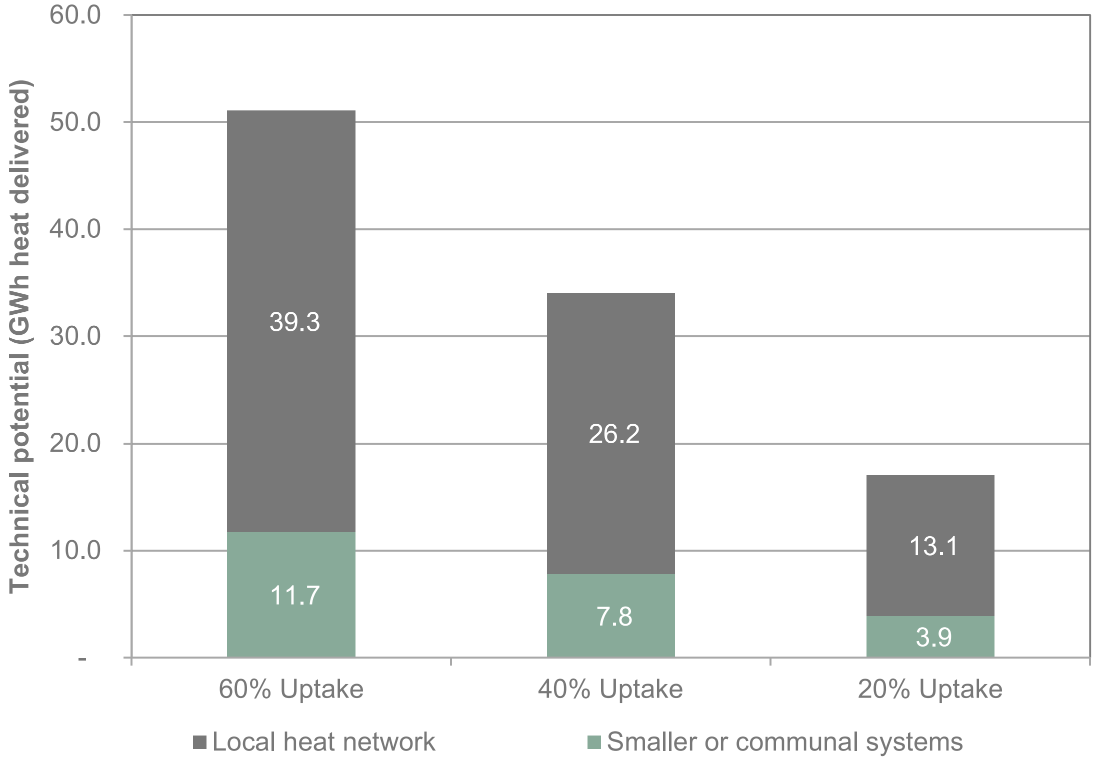


**Figure 9-8: Potential uptake scenarios for heat networks**

### 9.4.4 Potential for in-building CHP

### 9.4.5 Introduction

Large buildings often have a suitable scale and balance of heat and power demand to support their own CHP unit. Combined heat and power technology can prove to be a cost effective means of meeting a building's heat load and electrical consumption and a useful carbon reduction technology due to the efficiency benefit of generating heat and power simultaneously. Although in-building CHP units are likely to be fuelled by natural gas in the short term, there is potential in future for the use of biogas or biodiesel in CHP units.

CHP is best suited to buildings with a high baseload heat demand. This means that there is a high year-round demand for heat, allowing the unit to run for as many hours as possible in the year. Baseload heat demand is any year round process requiring heat such as: hot water generation for showers, toilets and catering, swimming pool heating, process heat loads which can be fed by hot water (e.g. in food production or drying and forming processes). For this reason buildings such as hotels, sports centres, swimming pools, hospitals, and certain industrial users are generally best suited to the installation of CHP at building level.

It is assumed that no systems below 5kW (domestic scale) would be installed in non-domestic buildings. This is due to the emergent nature of the technology, and the fact that very small non-domestic buildings frequently have no gas supply, relying on electric space and water heating.

| Benchmark category | Baseload (% of total heat load) |
|---|---|
| Dry sports and leisure facility | 35% |
| Fitness and health centre | 25% |
| General accommodations | 30% |
| General manufacturing | 20% |
| Hospital (clinical and research) | 50% |
| Hotel | 40% |
| Laboratory or operating theatre | 20% |
| Swimming pool centre | 60% |
| University campus | 10% |

**Table 9-5: Buildings suitable for CHP and assumed baseload level**

### 9.4.6 Overview of approach

Key elements of our approach: Technical potential (DECC 1-4):

- Our assessment addresses existing building stock only. New development must be assessed on a case by case basis; at the resolution of this study insufficient information is available to assess the suitability of potential new development for CHP.

- The assessment only includes buildings in areas that were not selected as being suitable for district heating (see section  for details)

- The likely peak output (in $kW_e$ for electricity and $kW_{th}$ for thermal) of each CHP unit was determined on the basis of the baseload to be met and the assumed number of annual running hours (these are specified in the appendices).

Key elements of our approach: Deployable potential (DECC 5-7):

- Again we have included any areas not identified as suitable for district heating in the stages 5-7 assessment described in section REF – as fewer areas are deemed suitable for district heating in the stage 5-7 assessment, there are more opportunities for in-building CHP.
- Our scenarios for deployment potential are estimates based on our experience of the UK market, and our knowledge of the rates of uptake for District heating and CHP. Both of these technologies feature substantial technical and economic challenges, and thus far the uptake rates in the UK have been very low.

### 9.4.7 Technical potential for in-building CHP

The technical potential of CHP linked to both District heating networks and individual CHP in large buildings is presented in **Table 9-6** below.

| CHP scale | Capacity ($MW_e$) | Capacity ($MW_{th}$) | Heat delivered (GWh) | Carbon savings (tonnes per annum) |
|---|---|---|---|---|
| Building scale | 6.6 | 8.2 | 44.1 | 2,879 |

**Table 9-6: Technical potential for in-building CHP**

Across the Borough, approximately 116,000 domestic buildings and 2,066 non-domestic buildings are located outside the areas identified as potentially suitable for District heating, and may have the potential for installation of in-building CHP. Of the total technical potential (44 GWh/year), 86% of the total potential is from non-domestic buildings with the remaining 14% in large non-domestic buildings.

### 9.4.8 Deployment potential of CHP units in individual buildings

The technical potential of in-building CHP outlined above estimates that 1.2% of the Borough's heat demand could be provided by CHP units in large buildings. However, in practice, the uptake of CHP units serving large buildings in the UK has been relatively slow, and it is limited by a range of constraints. Successful implementation of a CHP unit into a building requires a detailed appraisal of the building's energy demand and potentially complex design solutions to integrate the technology into the building. CHP technology is also significantly larger than equivalent heat-only plant and additional plant space is therefore required for its installation.

The following are a range of key constraints to CHP development:

- *Physical*: Plant room space required, routing of flues, noise, air quality legislation (biomass CHP systems)
- *Technical*: Integration with existing building services plant, whether there is sufficient baseload heat demand.
- *Economic*: Economic viability varies and can be affected by energy prices, the amount of heat rejected, the ratio of gas to electricity price, availability of financial support or incentives.
- *Knowledge barriers*: Lack of understanding of CHP technology and investment risk.

In response to these barriers we have selected deployment potential scenarios for CHP units in individual large buildings based on uptake rates of 2.5%, 5% and 10% of the technical potential. These are presented in Table 9-7 and Figure 9-9 below

Barriers to the deployment of CHP units in buildings have changed relatively little in recent years, and the future uptake of CHP in the Borough is unlikely to exceed a small percentage of the technical potential unless there is a substantial change in the general policy framework.

It should be noted that CHP units serving industrial process loads cannot be assessed through this methodology; therefore there may be a significant opportunities for large scale units in industrial applications that fall outside this scope.

| Scale | 10% Uptake (GWh) | 5% Uptake (GWh) | 2.5% Uptake (GWh) | 10% Uptake (tCO2) | 5% Uptake ($tCO_2$) | 2.5% Uptake ($tCO_2$) |
|---|---|---|---|---|---|---|
| Non Domestic | 3.9 | 1.9 | 1.0 | 257 | 128 | 64 |
| Domestic | 0.7 | 0.4 | 0.2 | 44 | 22 | 11 |
| **Total** | **4.6** | **2.3** | **1.1** | **300** | **150** | **75** |
| **% of Borough's domestic and commercial heat demand** | **0.16%** | **0.08%** | **0.04%** | | | |

**Table 9-7: Deployment potential for in-building CHP**

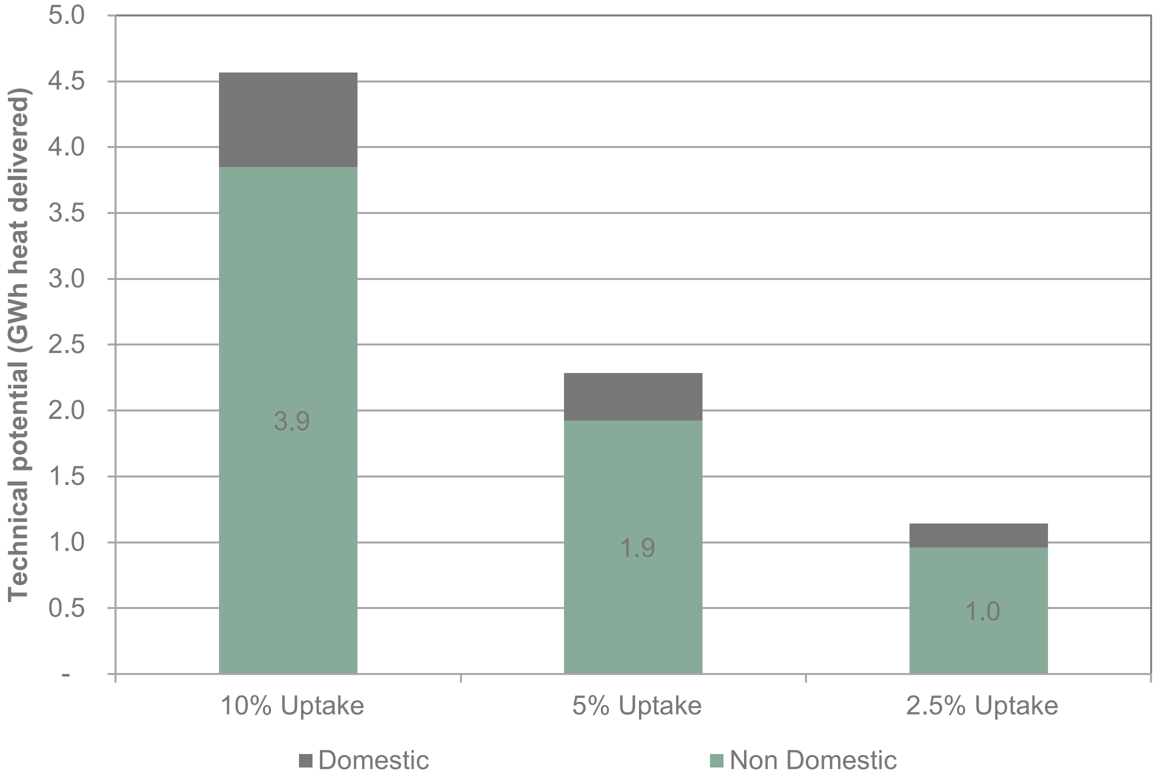


**Figure 9-9: Potential uptake scenarios for in-building CHP in the Borough**

# 10. Geothermal

A review of the potential Geothermal resource in the area has been explored as an extension to the other technologies considered within this study. Geothermal resource is generally consider outside the scope of a Local Authority low carbon resource study but the known local potential around the Cheshire Basin has driven the desire to investigate this potential further.

Note that this section comprises a summary of the information and analysis that was provided by ground exploration experts GeoEnergy Ltd. This summary has been produced to increase the accessibility of the technical review that has been carried out - the original document produced by GeoEnergy Ltd can be found in Appendix 5 of this report.

## 10.1 Introduction to Geothermal energy

Aquifers at depth can yield water of high enough temperature for domestic heating (if at least 60°C for direct heating) and electricity production (if at least 70°C). Water from the aquifer is pumped to the surface where its heat can be exchanged via heat exchangers or water could be fed directly onto a district heating network if appropriate.

There are two main types of geothermal wells; a singlet and a doublet system. In the former, the water is spent at the surface, often known as an open loop system. In the latter system, the water is returned to the aquifer at approximately 30°C, often known as a closed loop system. An aquifer can be treated as a series of localised reservoirs, which will provide a localised energy resource typically lasting 20-30 years. Each reservoir can be re-commissioned after a rest period but the longevity can be improved by using a doublet system to speed up the recharging period of the geothermal well. During a well's "rest period", a secondary well can be drilled and commissioned to provide energy to the same area, essentially covering for the "rest period". This principle is analogous to that of a farmer's field being left fallow for a period of time.

## 10.2 The Cheshire Basin

The Borough falls within the geothermal area of the Cheshire Basin. The approach taken was to assess the entire Cheshire Basin and its technical resource, before considering how this is likely to be apportioned to the land area in the Borough. The Cheshire Basin contains two aquifers, in direct succession with one another (see Figure 10-1, which shows a cross section through the line A-A' on Figure 10-2). These two aquifers are known as the Sherwood Sandstone Group (SSG) and Permo-Triasic Sandstone (PTS) aquifers.

The first aquifer lies under a layer of mudstone, which at the deepest point (towards the Southeast of the basin), starts at a depth of approximately 1km. At this same point, the thickness of the SSG aquifer extends to depth of just over 3km. This is followed by approximately 1km of PTS aquifer. The depth and areas of these two aquifers lying within the Borough area is a relatively small proportion of the overall basin resource in geographical terms.

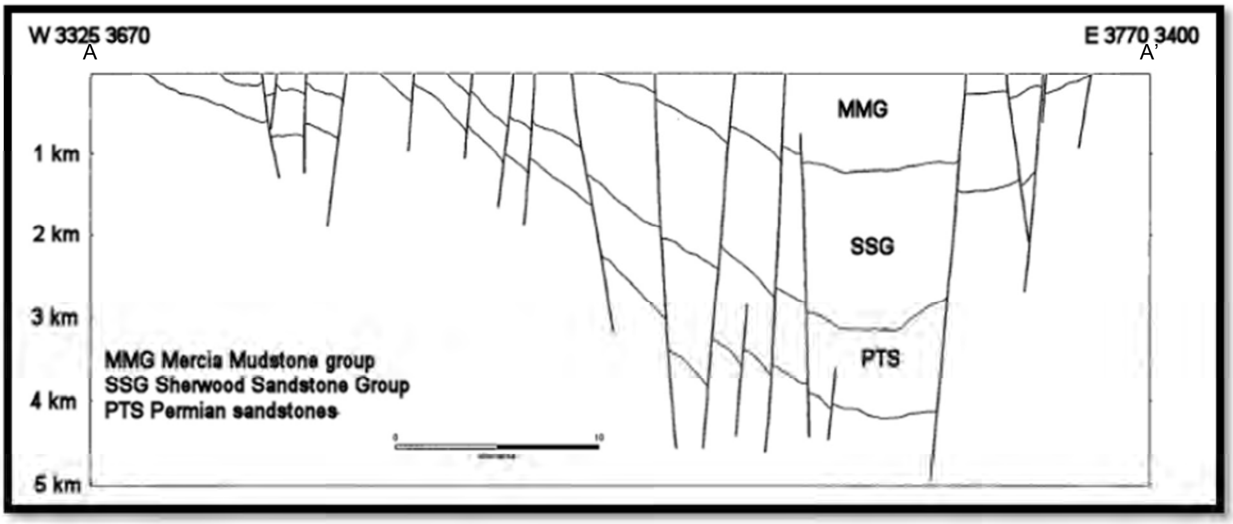


**Figure 10-1: Geological Cross-Section through the Cheshire Basin running Northwest to Southeast[1]; shown as line A-A' on Figure 10-2 below.**

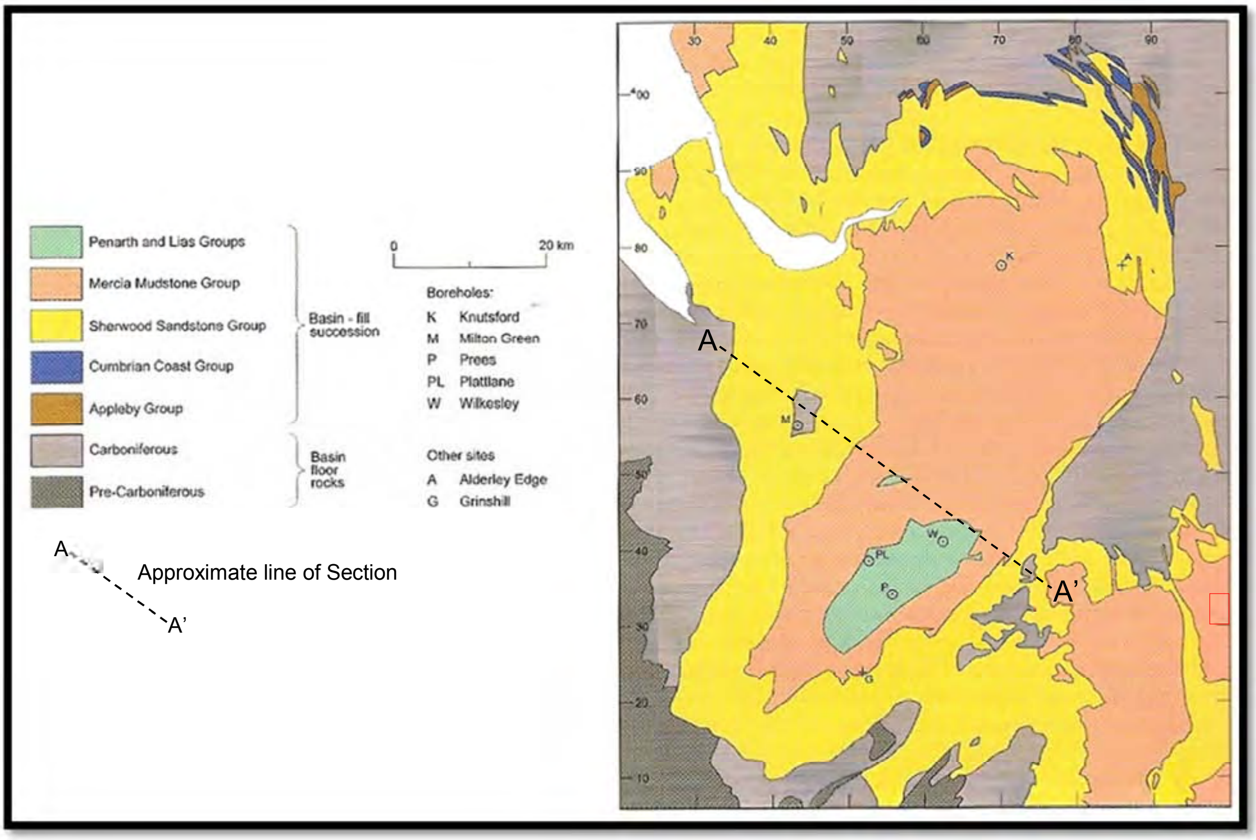


**Figure 10-2: Geological Map of the Cheshire Basin[2].**

[1] PLANT, J.A., JONES, D.G. & HASLAM, H.W. (Eds.)(1999). The Cheshire Basin - Basin evolution, fluid movement & mineral resources in a Permo-Triassic rift setting. British Geological Survey, Nottingham, UK.
[2] PLANT, J.A., JONES, D.G. & HASLAM, H.W. (Eds.)(1999). The Cheshire Basin - Basin evolution, fluid movement & mineral resources in a Permo-Triassic rift setting. British Geological Survey, Nottingham, UK.

## 10.3 Geothermal Resource

Figure 10-3 and Figure 10-4 show the area of coverage of each aquifer at significant enough depth to yield useful temperature water. Figure 10-3 indicates the area where the SSG aquifer lies at a depth of at least 1-1.5km. This is deep enough to yield water of at least 40°C, which could be used in conjunction with heat pumps but is not high enough to be used for direct heating. Figure 10-4 indicates the area within the basin where the PTS aquifer lies at a depth of between 4-4.5km. Temperatures of up to 100°C can theoretically be achieved (see Appendix 5) but these high output temperatures are unlikely to be consistently achieved in practice. Even if these temperatures existed at that depth, they may be impractical to access using current pumping technology in a cost-effective way.

Figure 10-5 details the range of temperatures that could be reached at various depths within the basin. On average, to achieve a temperature of 60°C or above, a well must be drilled to a depth of at least 2.5km. From Figure 10-1 this depth within the Borough is most likely to be encountered in the PTS Aquifer, which covers a smaller geographical area than the top SSG aquifer (as detailed in blue on Figure 10-3). The nearest substantial heat demand to potentially make use of this resource is over 12km away in Northwich. Although district heating networks can operate across distances much greater than this, the setup of a system using this configuration is not likely to be cost effective unless the heat demand was large enough and sufficiently clustered to justify the large infrastructure setup cost. The lack of substantial heating demand over the surface of the deep geothermal resource makes this resource difficult to access and utilise cost-effectively in practice, although future fossil fuel price rises may eventually justify the initial investment required and this should be reconsidered in future years.

The production of electrical energy using deep geothermal is only effective at extraction temperatures greater than 80°C, with these temperatures only occurring in the deepest of well locations, typically at greater than 4km depth. From Figure 10-4 it can be seen that this is most likely to occur in the PTS aquifer, which lies in a narrow area against the boundary with East Cheshire (in the Northeast of the Borough). Though the target area is small (hence reducing the availability of suitable sites for development), the underlying resource is large. It is also understood that a single well in this area could access the full extent of this well resource, thereby providing access to the resource that lies beneath Cheshire East, as well as Cheshire West and Chester. Further detailed modelling is recommended to assess the practical feasibility of drilling wells in the specific locations within the Borough to allow the deep geothermal resource to be accessed.

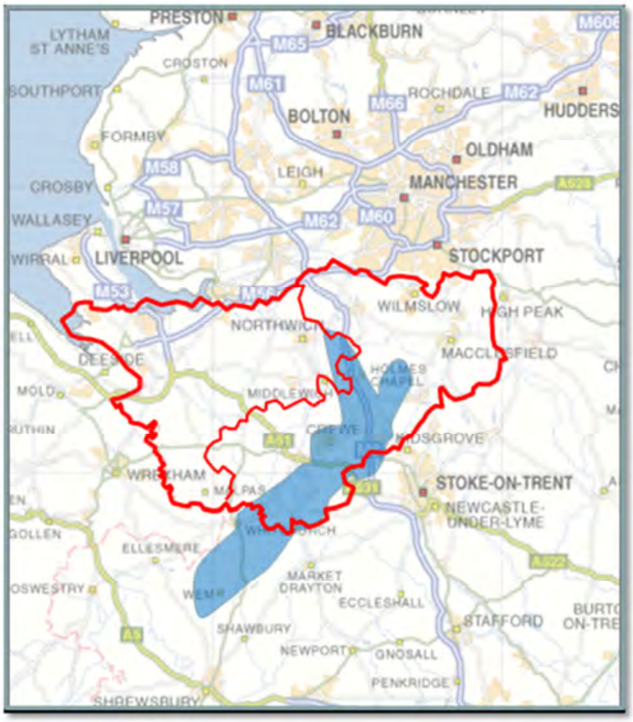


**Figure 10-3: Area (shaded blue) where top of SSG lies at depths of 1 to 1.5km[3]**


**Figure 10-4: Area (shaded red) where base of PTS lies at depths of 4 to 4.5 km[4]**

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[3] *ROLLIN, K. E., KIRBY, G. A., ROWLEY, W. J. & BUCKLEY, D.K. 1995. Atlas of Geothermal Resources in Europe: UK Revision. Technical Report WK/95/07, British Geological Survey, Nottingham, UK.*

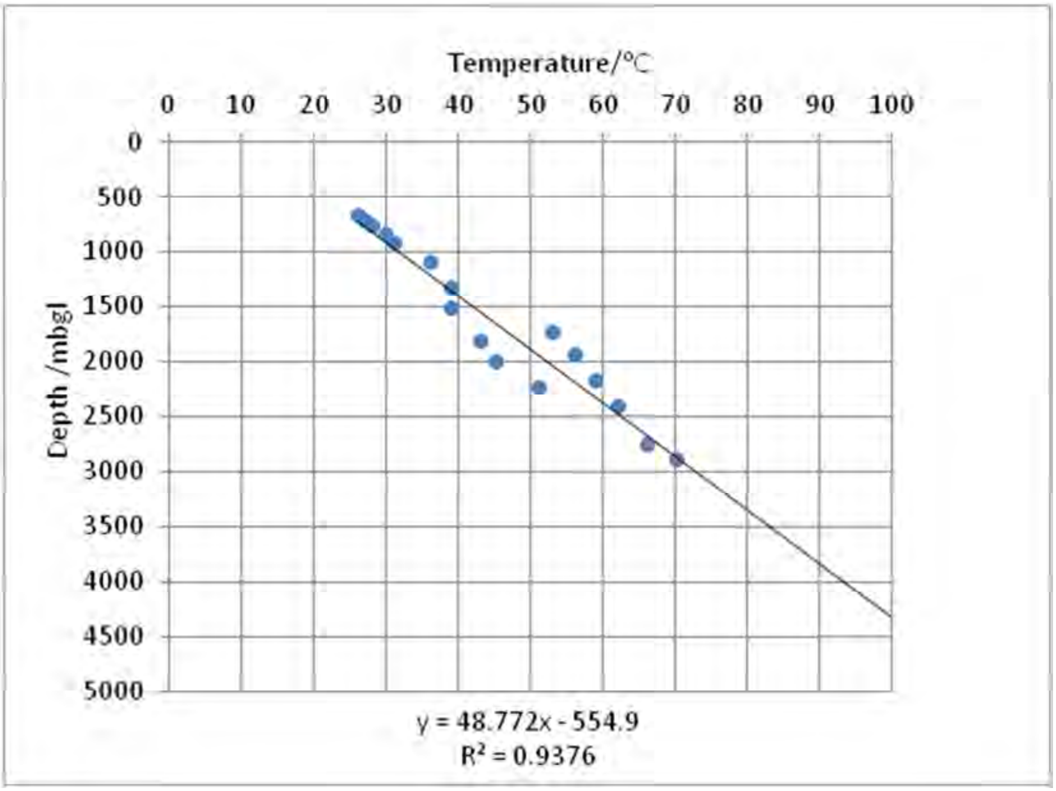


**Figure 10-5: Depth temperature profiles in the Cheshire Basin**

It should be noted that groundwater abstracted from significant depth for the purposes of geothermal exploitation is likely to be saline and therefore the well infrastructure would need to be designed with consideration to this corrosive environment.

Given the inland location of the basin, a doublet system would be more suitable than a single abstraction well and would avoid issues associated with brine disposal while maximising the reservoir life. The abstraction of groundwater for geothermal energy is likely to take place at depths that should not threaten the abstraction of a potable water supply. However, this would require further consultation with the Environment Agency to satisfy them that groundwater potable water sources are not at risk from depletion or contamination.

The total estimated geothermal resource potential across the SSG Triassic and CS Permian aquifers is 4,722 GWh in total, making this a potentially large resource, but one that is currently difficult to access cost-effectively.

A number of potential barriers to the development of a utilised deep geothermal resource have been detailed in Appendix 5. The main considerations are around infrastructure development costs (such as district heating networks or electrical connections to the grid), social considerations and geographic constraints (e.g. the use drilling equipment during construction). Well failures and unexpected

[4] *ROLLIN, K. E., KIRBY, G. A., ROWLEY, W. J. & BUCKLEY, D.K. 1995. Atlas of Geothermal Resources in Europe: UK Revision. Technical Report WK/95/07, British Geological Survey, Nottingham, UK.*

geological occurrences can also be a considerable risk to the project's success and a sum of money is typically allocated to cover unforeseen risks at the start of a project. Drilling costs also vary with location, as a guide the 1.8km geothermal well recently drilled by the universities of Newcastle and Durham cost in the order of £1.2 million. To access water of 60°C or above, well depths in excess of 2.5km would be required, costing at least £2-3 million before the cost of any additional infrastructure has been included. There is therefore a significant upfront cost associated with deep geothermal extraction, with uncertainty around the output yield. This level of uncertainty and risk has been the main driver for the lack of geothermal exploration and extraction within the UK.

At present, there are no licensing issues regarding geothermal boreholes but this may well change as more geothermal exploration takes place and an increasing resource becomes utilised across multiple Boroughs or land owners.

## 10.4 Examples of other schemes

Table 10-6 displays a number of other geothermal projects in different geological conditions and locations. This provides an example of the range of locations and variety in system types and depths to achieve a wide spectrum of thermal and electrical outputs.

| Name | Type | Output | Source Depth (m) | Source Temp (°C) | Yield ($m^3$/day) | Output (MW) |
|---|---|---|---|---|---|---|
| Southampton (E) UK | Aquifer | Heating | 2000 | 76 | 860 | $1.4_{th}$ |
| Chena Hot Springs (E), USA | Volcanic | Heat and Power | 217 | 74 | 2850 | $0.4_{e}$ |
| Soultz-sous-Forets (E), France | Granite, EGS | Heat and Power | 5000 | 200 | 3024 | $1.5_{e}$ |
| Landau-Pfalz(E), Germany | Granite, EGS | Heat and Power | 3300 | 160 | - | $3_{e}$ |
| Eastgate (P), UK | Granite, EGS | Heating | 995 | 46 | >1600 | $0.75_{th}$ |
| Redruth (P), UK | Granite, EGS | Heat and Power | 5000 | 170 | Not known | $55_{th}$, $10_{e}$ |

**Table 10-6: Range of outputs from differing geothermal systems**

(E) Denotes existing project, (P) Denotes planned project, $_{th}$ Denotes thermal energy output, $_{e}$ Denotes electrical energy output

As discussed in the previous section (and detailed in Appendix 5) temperatures of 70°C are achievable within the basin. Yields in excess of 4,320m$^3$/day are expected to be achievable for large diameter boreholes from the SSG aquifer. For the PTS aquifer, yields in the range of 1,728 – 2,592 $m^3$/day are predicted to be achievable. These compare favourably with yields at the Southampton scheme which currently feeds into a district heating system serving a portion of Southampton's city buildings. However, acknowledging the distances between the points of useful geothermal extraction and the nearest substantial heat demands (distance of approximately 12km from point of extraction to Northwich heat demand), it is unlikely that a scheme directly equivalent to that in Southampton (i.e. extraction of geothermal heat to support a district heating network) will be developed in Cheshire West and Chester in the short term. The extraction of a higher grade geothermal resource for the generation of electricity is also unlikely to be developed in the short term due to the uncertainty over high-end extraction temperatures. Further detailed investigation and test drilling would be required to confirm the extraction temperatures at depths of 4-4.5km before any commitment could be made on quantifying high grade deep geothermal extraction as a deployable resource.

A summary of potential next steps for the Council is provided below:

- A visit to the Southampton geothermal district heating scheme and a further visit to meet with representatives from Durham and Newcastle Universities who have recently drilled the Science City borehole in Newcastle upon Tyne.
- Economic assessment of the proposed system and comparison with the base case which would be conventional energy supply arrangements.
- Economic assessment of the proposed system to consider the economic case for drilling a deep (4-4.5km) well that may yield temperatures suitable for generating power against a shallower well that would only produce heat.
- If the Council has a greater interest in exploiting the resource associated with Cheshire West and Chester then more detailed modelling of this portion of the basin could be undertaken, including test drilling and sampling to feed into an outline business case for the potential development of a deep geothermal extraction well.

# 11. Coal Bed Methane

A review of the potential Coal Bed Methane resource in the area has been explored as an extension to the other technologies considered within this study. Coal Bed Methane resource is generally consider outside the scope of a Local Authority low carbon resource study but the known local potential in the North West has driven the desire to investigate this potential further.

Note that this section comprises a summary of the information and analysis that was provided by ground exploration experts GeoEnergy Ltd. This summary has been produced to increase the accessibility of the technical review that has been carried out - the original document produced by GeoEnergy Ltd can be found in Appendix 6 of this report.

## 11.1 Introduction to technology

Un-mined coal seams, deep underground, are rich in Methane gas which can be extracted and used for power generation, direct heat provision and cooking (similar to conventional natural gas). The technology and processes used to extract Coal Bed Methane (CBM) is similar to that which is used for conventional hydrocarbon extraction. The process involves drilling a series of horizontal & vertical wells into the coal seam. Water is then drawn out of the coal through these wells to create a pressure difference; allowing the methane to escape upwards to the point of gas capture. The gas can then be transported for storage, piped directly into a gas network (if appropriate infrastructure exists) or piped to a nearby/onsite gas fired power plant. CBM can also be used in CHP systems to generate both heat and electricity.

It should be noted that Coal Bed Methane is still a non-renewable fossil fuel, albeit mined from a different (more local) resource than conventional gas and petroleum fuels. It can deliver relative carbon savings in carbon dioxide emissions where it substitutes for other more carbon intensive fuels, e.g. solid coal, or is used in a district heat or CHP process.

Utilising CBM will increase local fuel security and can reduce the level of reliance on imported fossil fuels from outside of the UK.

## 11.2 The Cheshire Basin

It should be noted that this assessment has been done for Cheshire West and Chester, which falls within the Cheshire Basin. Therefore in order to assess the needs of the Borough, the entire basin has been analysed. Figure 11-1 displays the area of Cheshire and the Borough underlain by productive coal measures (2,194km$^2$ for all of Cheshire and 918km$^2$ for the Cheshire West and Chester). The lighter areas of Figure 11-1 show where the coal measures are nearest to the surface (and hence most easily accessible). This is toward the north west of Cheshire and is predominantly within the Borough. Further towards the south east, the coal resource lies deeper beneath the ground and so it becomes more difficult to access cost effectively. This is reflected by Figure 11-2 which shows the surface of the coal measures becoming deeper (and hence harder to access) towards the Southeast of Cheshire. Hence the region local to the Borough (in the northwest) is easiest to access.

It is important to note when looking at Figure 11-2, that the area representing the coal measures is only there to indicate where the surface of the measures starts. It does not represent the entire thickness of the coal measures; coal seams will occur in thicknesses of typically between two to three feet throughout the depth of the basin represented by the grey area. This has been accounted for in the methodology (see Appendix 6).

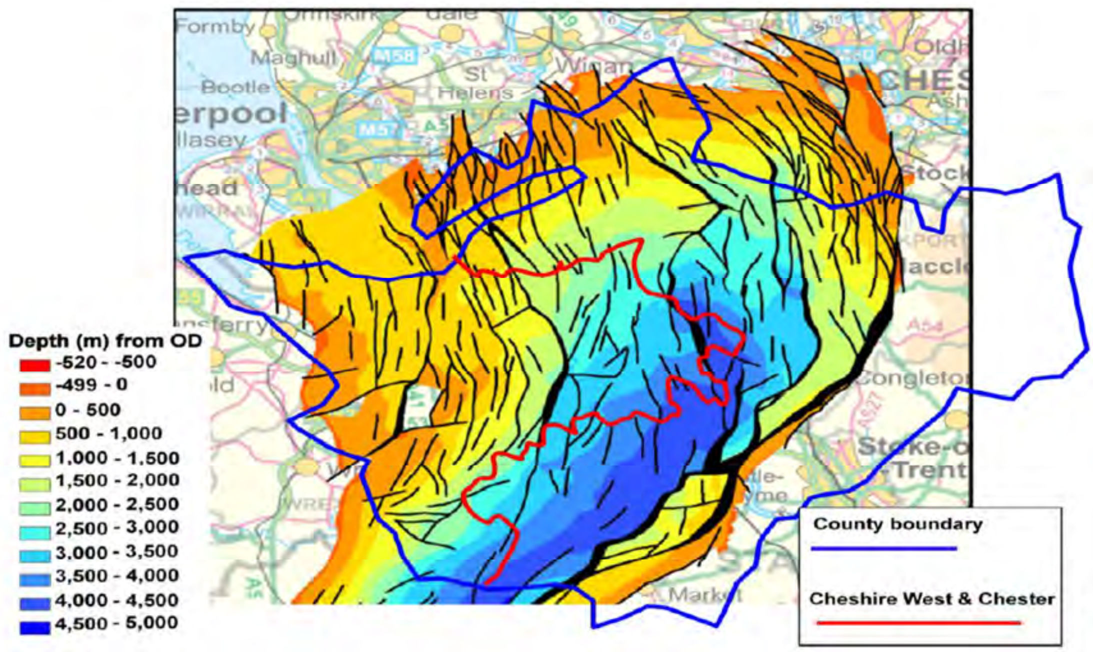


**Figure 11-1: Cheshire Basin, depth to Base Permian (from Evans et al, 1999)**

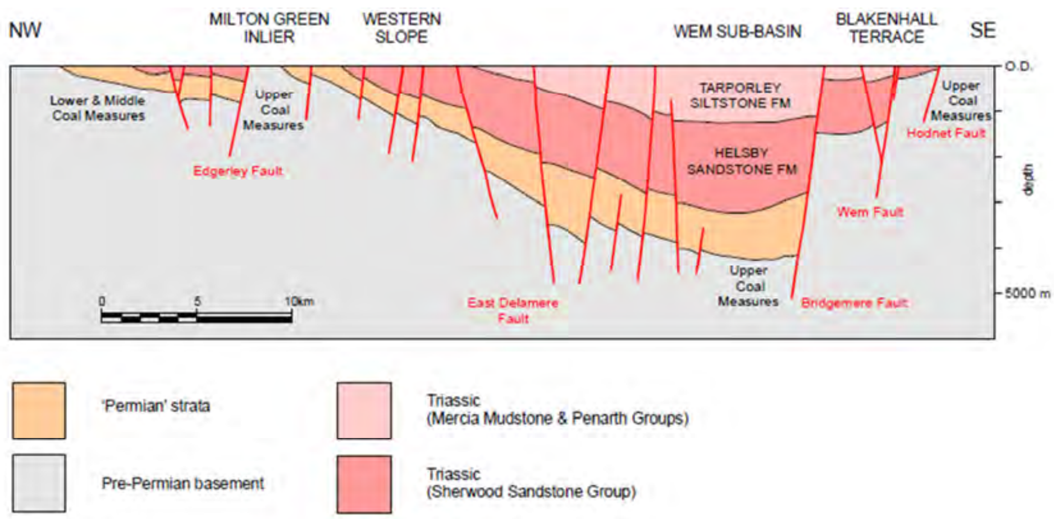


**Figure 11-2: NW-SE geological section through the central Cheshire Basin[5]**

[5] PLANT, J.A., JONES, D.G. & HASLAM, H.W. (Eds). (1999) *The Cheshire Basin: Basin evolution, fluid movement and mineral resources in a Permo-Triassic rift setting*. British Geological Survey.

## 11.3 Current activity in the Borough

The Petroleum Act of 1998 vests all rights to the nation's petroleum resources to the Crown. The UK's coal reserves are managed by the Coal Authority and access to coal formations requires their agreement. In order to extract hydrocarbons, including CBM a license from the Department of Energy and Climate Change is required, as is the permission of the landowner, planning permission for the local authority and adherence to the Health and Safety Legislation.

Figure 11-3 shows current licensing in the Borough which exists for exploration and development of petroleum-related resources (including CBM). The main operators which have licensing are IGAS Plc (PEDL 145,190,184), Greenpark Energy (PEDL 147), Dart Energy (PEDL 188, 189) and Alkane Energy (PEDL 191)[6]. IGAS PLC is currently operating a CBM field in the Warrington region (indicated in the region just North of the Borough). There has also been successful exploration in the Flintshire region (indicated area covered by PEDL 107; in the far west of the map). Since the geological features between these two locations (Warrington & Flintshire) and the rest of the north west of Cheshire do not differ significantly, this may suggest that further exploration within the Borough could yield further extractable resource.

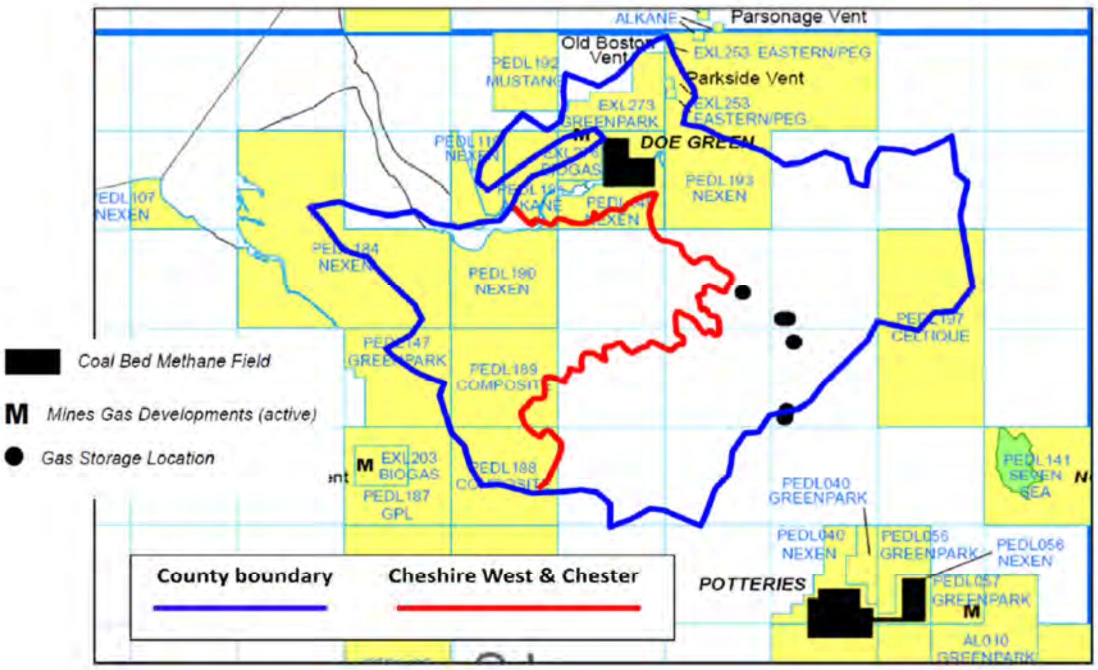


**Figure 11-3: Illustration the Petroleum Exploration and Development Licences which already exist in the area of the Cheshire Basin (outline of Cheshire in blue)** [7]

The costs of exploration programmes are largely dependent on local drilling costs. As a guide, a recent geothermal well drilled by the universities of Newcastle and Durham cost in the order of £1.2 million for a basic well to 1.8km. For a CBM well with testing, the price during 2011-2012 is likely to be in the range £2-3 million (the majority of which is the cost of drilling).

[6] https://www.og.decc.gov.uk/information/licence_reports/onshorebyblock.html
[7] http://og.decc.gov.uk/assets/og/data-maps/maps/landfields-lics.pdf

## 11.4 CBM Resource

The methodology for assessing CBM resources falls outside the scope of the standard DECC methodology for assessing low carbon resource potential. For the purposes of this study, we have therefore adopted a methodology common to that used for other hydrocarbon exploration - see Appendix 6 for full details.

This study makes reference to two key parameters within the context of subterranean exploration: a resource and a reserve. These are defined as follows:

- A *resource* is an estimate of the total amount of CBM in the area under analysis, regardless of any constraints such as practical accessibility, technology available, cost of extraction or any other constraint.
- A *reserve* is an estimate of the total amount of CBM that can be practically accessed using currently available technology. Note that this definition of reserve should not be confused with the technically "proven" reserve, which would be based on the reserve that is technically and economically accessible.

Initial estimates indicate that the Borough is likely to contain a total resource of 357 $x10^9$ $m^3$ ($357km^3$) of CBM. This represents 42% of the entire basin resource. Using deep basal exploration criteria, common to the hydrocarbon industry (which limit the exploration depth to 1,500m), the resource translates to a total reserve of 96 $x10^9$ $m^3$ ($96km^3$). It should be noted that a depth of 1,500m was chosen as the limit to represent the "easiest" part of the basin to access. If exploration were to be carried out to a greater depth, then the reserve would increase, but so too would the complexity of extraction and associated costs. The reserve estimates translate to total lifetime energy values 1,056 TWh and at constant operation all year round for a reserve lifetime of 50 years, this equates to a load of 2.4GW of raw fuel extractable, which represents a sizeable resource. If this were to be used to supply a CHP unit, this could equate to a thermal resource of approximately 1.0GW and electrical resource of approximately 0.7GW.

The uptake of CBM as a local fuel resource has been relatively slow until the last decade, where an increased number of applications have been noted across particular opportunity areas within the UK. An increased number of applications for the exploration (rather than extraction) of CBM resources has been noted by the Council and was acknowledged during our initial project inception meeting. For the purposes of this study, an assumed deployable uptake of 1% over the total theoretical reserve has been estimated to be deployed by 2020, equating to 7 MW of electrical resource and 10 MW of thermal resource. This outline estimate has been provided based on the expected installed capacity to be permitted and developed over the period to 2020.

These figures reflect an initial high-level examination of the CBM potential of the Cheshire Basin, based upon published maps and well logs together with a representative methane-yield analysis. It should be noted that early-stage estimates of this resource have a large margin for error and are intended only to provide an approximation to the resource and not an accurate figure. In order to improve the analysis for the CBM resource base, a number of recommendations have been included in Appendix 6; as a part of the full CBM report by GeoEnergy Ltd. A description of the key technical barriers to development has also been included within Appendix 6.

Coal Bed Methane has been included within the overall resource potential figures but is noted as not being a renewable source of energy and may typically be developed for power generation alone, thereby not maximising the carbon reduction potential available. Only where CBM can be used to generate both electricity and recovered heat, will it be considered to be low carbon, in line with natural gas CHP systems.

It is therefore recommended that the Council seeks to promote the development of power generation equipment using CBM only where heat can be usefully recovered and supplied to a local point of demand. This combined heat and power approach is the most effective way of utilising this local fuel resource and not only reduces carbon emissions through the generation of both heat and power, but also maximises the financial value of the resource as a fuel and assists in supporting the Authority's fuel security. Consideration must be given to suitable locations for CBM combustion that not only allows for waste heat to be fully utilised, but also promotes the development of schemes that are financially viable and do not negatively impact on the local surroundings. Where possible, the Council could utilise the development of Coal Bed Methane combustion in locations that may link to the development of local heat networks.

# 12. Summary of Renewable and Low Carbon Energy Potential and Energy Opportunity Map

## 12.1 Summary of potential

The preceding chapters of this report provide an assessment of the renewable and low carbon energy potential in the Borough. The technical potential provides an overestimate of the resource that can be realised in practice considering factors such as economic viability and deployment constraints.

This chapter provides a summary of the deployable potential within the Borough, which is considered a more realistic estimate of the resource that can be utilised in practice. A timescale of 2020 has been chosen since this corresponds with the UK's target to source 15% of its energy from renewable resources. This allows figures for the Borough to be presented in the context of this national target which the government is striving to meet. A summary of deployable potential for 2030 is also given to cover the period of the Core Strategy. Figures for 2030 are presented after discussion of the 2020 figures.

For the resources and technologies associated with biomass, solar (thermal and PV) and heat pumps, deployable potential figures relating specifically to 2020 were estimated previously and these are the figures quoted in this chapter. For micro-wind, estimates of deployable potential for 2020 were also stated previously as an upper and lower boundary, based on the data available about forecasted uptake of this technology. Actual uptake by 2020 is expected to fall between these boundaries, hence the figures quoted in this chapter are based on the mid-point between the upper and lower boundary figures. For the hydro resource assessment, no timescale was attached to the estimate for deployable potential since detailed forecasts are not available about the predicted uptake of this technology as they are for other technologies. The figures quoted in this chapter assume all of the deployable potential is realised by 2020. While this may be possible, it is acknowledged that this would require substantial coordinated action, although this assumption does not heavily influence the final outcome since the hydro resource is only a small proportion of the total resource. For commercial-scale wind, the low scenario for deployment potential is taken to be the most likely estimate for 2020 based on the lack of deployment of this technology in the Borough so far, and these figures are quoted in this chapter.

For district heating, deployment is not anticipated before 2020 predominantly because of the long lead time for such schemes. This excludes district heating as part of new developments since this such development is difficult to predict. Therefore it is acknowledged that in practice there may be some district heating capacity in the Borough by 2020. For in-building CHP, the medium scenario was selected as the most appropriate to reflect deployment by 2020.

Table 12-1 presents a summary of the deployable potential of the renewable and low carbon energy resources in the Borough for 2020. The installed capacity (MW) is given for each technology along with the expected electricity and/or heat generation (GWh). The anticipated carbon savings ($tCO_2$/yr) are also stated along with an estimate of how this resource will contribute to total energy consumption in the Borough by 2020. It should be noted that this table summarises the predicted *deployable* resource and goes beyond the total *potential* resource to attempt to achieve a realistic figure for technology take-up.

| Technology | Installed capacity (MWe) | Installed capacity (MWth) | Electricity generation (GWh) | Heat generation (GWh) | Carbon savings ($tCO_2$) | % of the Borough s energy demand |
|---|---|---|---|---|---|---|
| **Commercial scale wind** | **23** | | **58** | **-** | **30,563** | 0.3% |
| **Biomass** | **43** | **7** | **338.1** | **21.5** | **181,056** | 1.6% |
| - Energy Crops | 0.3 | 1.1 | 2 | 3.4 | 1,729 | |
| - Managed woodland | 0.8 | 4.9 | 6.3 | 14.9 | 6,085 | |
| - Waste Wood | 1.2 | 1.0 | 9.6 | 3.2 | 5,481 | |
| - Straw | 1.8 | | 14 | - | 7,211 | |
| - WOW | 21.1 | | 166.4 | - | 87,258 | |
| - Poultry Litter | 0.2 | | 1.7 | - | 871 | |
| - MSW | 6.7 | | 53.2 | - | 27,884 | |
| - C&I W | 5.6 | | 43.8 | - | 22,988 | |
| - Landfill gas | 4.5 | | 35.7 | - | 18,728 | |
| - Sewage gas | 0.7 | | 5.4 | - | 2,821 | |
| **Hydro** | **3.5** | | **10.7** | - | **5,634** | 0.05% |
| **Solar PV** | **11.1** | | **8.4** | - | **4,399** | 0.04% |
| **Solar Thermal** | **1.9** | | - | **1.4** | **308** | 0.01% |
| **ASHPs** | **20.9** | | - | **25.2** | **- 566 *** | 0.12% |
| **GSHPs** | **19.9** | | - | **24** | **148 *** | 0.11% |
| **Micro-wind** | **4.4** | | **5.4** | - | **2,841** | 0.02% |
| **District Heating** | | | | | | |
| **In-building CHP** | **0.3** | **0.4** | **1.9** | **2.3** | **150** | 0.02% |
| **Deep geothermal** | | | | | | 0.00% |
| **Coal Bed Methane CHP** | **7** | **10** | **61.1** | **87.5** | **12,243** | 0.68% |
| **TOTAL** | **134.9** | **17.4** | **483.6** | **161.9** | **237,194** | **3.0%** |

**Table 12-1: Summary of deployable potential for renewable and low carbon energy in the Borough (2020)**

Note that Coal Bed Methane is included within Table 12-1 but is noted as not being a renewable source of energy and may typically be developed for power generation alone, thereby not maximising the carbon reduction potential available. Only where CBM can be used to generate both electricity and recovered heat, will it be considered to be low carbon, in line with natural gas CHP systems.

Table 12-1 highlights the collective biomass resource as having the greatest deployable potential in terms of energy generation, which could supply 1.65% of the Borough's total energy consumption by 2020. Of the individual biomass resource streams, those with the greatest potential include wet organic waste (WOW), municipal solid waste (MSW) and commercial and industrial (C&I) waste. Following biomass, Coal Bed Methane has the second greatest potential to generate energy in the form of both heat and electricity, where these installations can be suitably located to make full use of the recovered heat. Where this technology can only be used to generate electricity, its energy and carbon saving benefits are diminished dramatically. The importance of coordinating the suitable location of these installations is therefore recognised as being of strategic importance and is consequently acknowledged in the proposed draft policy wording, included later in this report.

Commercial-scale wind has the third greatest potential to generate energy and could supply 0.3% of the Borough's total energy consumption by 2020. Heat pump technologies (ASHPs and GSHPs) provide the next greatest potential, while other microgeneration technologies and hydro would only be expected to provide a fraction of the energy consumed within the Borough in 2020. Collectively, renewable and low carbon energy resources could provide 3.0% of the energy consumed by 2020.

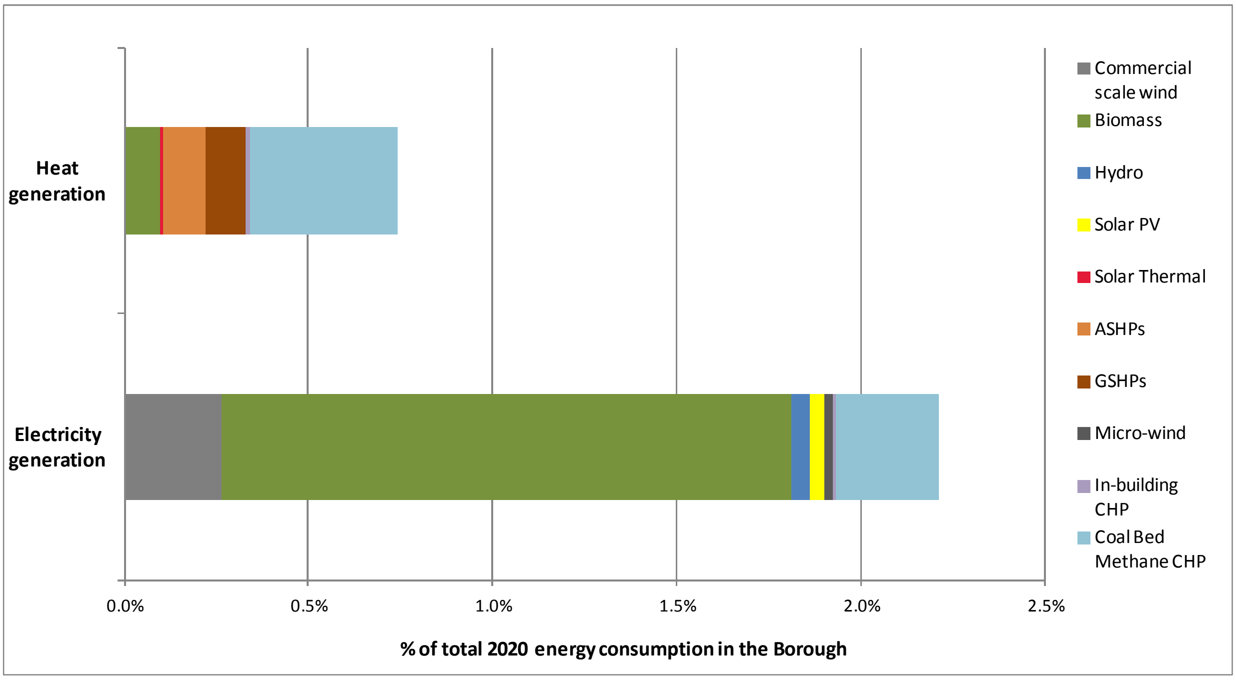


**Figure 12-1. Summary of deployable potential for renewable and low carbon energy as a percent of 2020 energy consumption in the Borough**

The 2030 deployable potential figures for biomass, solar (thermal and PV) and heat pumps were estimated previously in this report and these are the figures quoted in this chapter. For micro-wind, estimates of deployable potential for 2030 were also stated previously as an upper and lower boundary, based on the data available about forecasted uptake of this technology. Actual uptake by 2030 is expected to fall between these boundaries, hence the figures quoted in this chapter are based on the mid-point between the upper and lower boundary figures. As explained above, it is assumed that all of the deployable potential for hydropower is realised by 2020 therefore the figures for 2030 remain unchanged. For commercial-scale wind, the medium scenario for deployment potential is taken to be the most likely estimate for 2030 and reflects a similar level of uptake pre and post-2020 up to 2030.

For district heating, the low scenario was selected, reflecting the installation of one large scheme or several medium schemes by 2030. This is in addition to any district heating capacity associated with new developments which cannot be predicted with any certainty. For in-building CHP, the high scenario was selected.

Table 12-2 presents a summary of the deployable potential of the renewable and low carbon energy resources in the Borough for 2030.

| Technology | Installed capacity (MWe) | Installed capacity (MWth) | Electricity generation (GWh) | Heat generation (GWh) | Carbon savings ($tCO_2$) | % of the Borough s energy demand |
|---|---|---|---|---|---|---|
| **Commercial scale wind** | **49** | **-** | **121** | **-** | **63,673** | 0.5% |
| **Biomass** | **40.9** | **9.64** | **316.83** | **29.56** | **171,494** | 1.5% |
| - Energy Crops | 0.85 | 3.73 | 6.68 | 11.44 | 5,764 | |
| - Managed woodland | 0.8 | 4.87 | 6.29 | 14.92 | 6,085 | |
| - Waste Wood | 1.22 | 1.04 | 9.61 | 3.2 | 5,481 | |
| - Straw | 1.78 | | 14.02 | - | 7,211 | |
| - WOW | 21.11 | | 166.42 | - | 87,258 | |
| - Poultry Litter | 0.21 | | 1.66 | - | 871 | |
| - MSW | 6.74 | | 53.16 | - | 27,884 | |
| - C&I W | 5.56 | | 43.83 | - | 22,988 | |
| - Landfill gas | 1.24 | | 9.78 | - | 5,131 | |
| - Sewage gas | 0.68 | | 5.38 | - | 2,821 | |
| **Hydro** | **3.5** | | **10.7** | - | **5,634** | 0.05% |
| **Solar PV** | **20.6** | | **15.6** | - | **8,200** | 0.07% |
| **Solar Thermal** | **3.8** | | - | **2.8** | **615** | 0.01% |
| **ASHPs** | **40.5** | | - | **49** | **- 1,100 *** | 0.22% |
| **GSHPs** | **38.1** | | - | **46** | **283 *** | 0.21% |
| **Micro-wind** | **7.7** | | **9.6** | - | **5,039** | 0.04% |
| **District Heating** | **2.8** | **3.4** | **14.2** | **17** | **1,135** | 0.14% |
| **In-building CHP** | **0.7** | **0.9** | **3.7** | **4.6** | **300** | 0.04% |
| **Deep geothermal** | | | | | | 0.00% |
| **Coal Bed Methane CHP** | **14** | **20** | **122.2** | **174.9** | **24,487** | 1.33% |
| **TOTAL** | **221.6** | **33.9** | **613.8** | **323.9** | **280,577** | **4.2%** |

**Table 12-2: Summary of deployable potential for renewable and low carbon energy in the Borough (2030)**

## 12.2 Energy Opportunities Map

Not all of the renewable and low carbon energy resources examined in this study are location specific, however some of the technologies are closely linked to a location. We have therefore mapped key technology opportunities for the Borough in the map on the following page.

The summary below identifies the approach and rationale for mapping (or excluding) technologies from this map:

1. Wind potential: The “areas of least constraint” from the wind analysis have been presented for wind development at large and medium scale. The areas identified are therefore the broad areas from which the deployable potential for wind energy was determined. (See section **Error! Reference source not found.** of this report for further details).
2. Biomass: Biomass resource cannot be mapped effectively due to the wide variety of resource streams involved in the analysis, many of which are not spatially defined. For example waste presents a major part of the biomass resource and this is dispersed across the entire building stock.
3. Hydropower: We have mapped the deployable hydropower sites identified as in this study
4. Microgeneration: Excluded. The areas of potential for the microgeneration technologies examined in this study essentially correspond to the location individual buildings; therefore this cannot be clearly mapped at this scale. Small wind potential is focussed on buildings in more rural areas where there are fewer obstructions to cause turbulence.
5. District heating and CHP: We have presented areas of high heat demand on the energy opportunity map. “Very high” heat demand represents areas with heat demand over 5,000kW/km$^2$, i.e. areas included in the assessment of deployable potential. “High” corresponds to heat density of 3,000-5,000kW/km$^2$, or areas of technical potential.

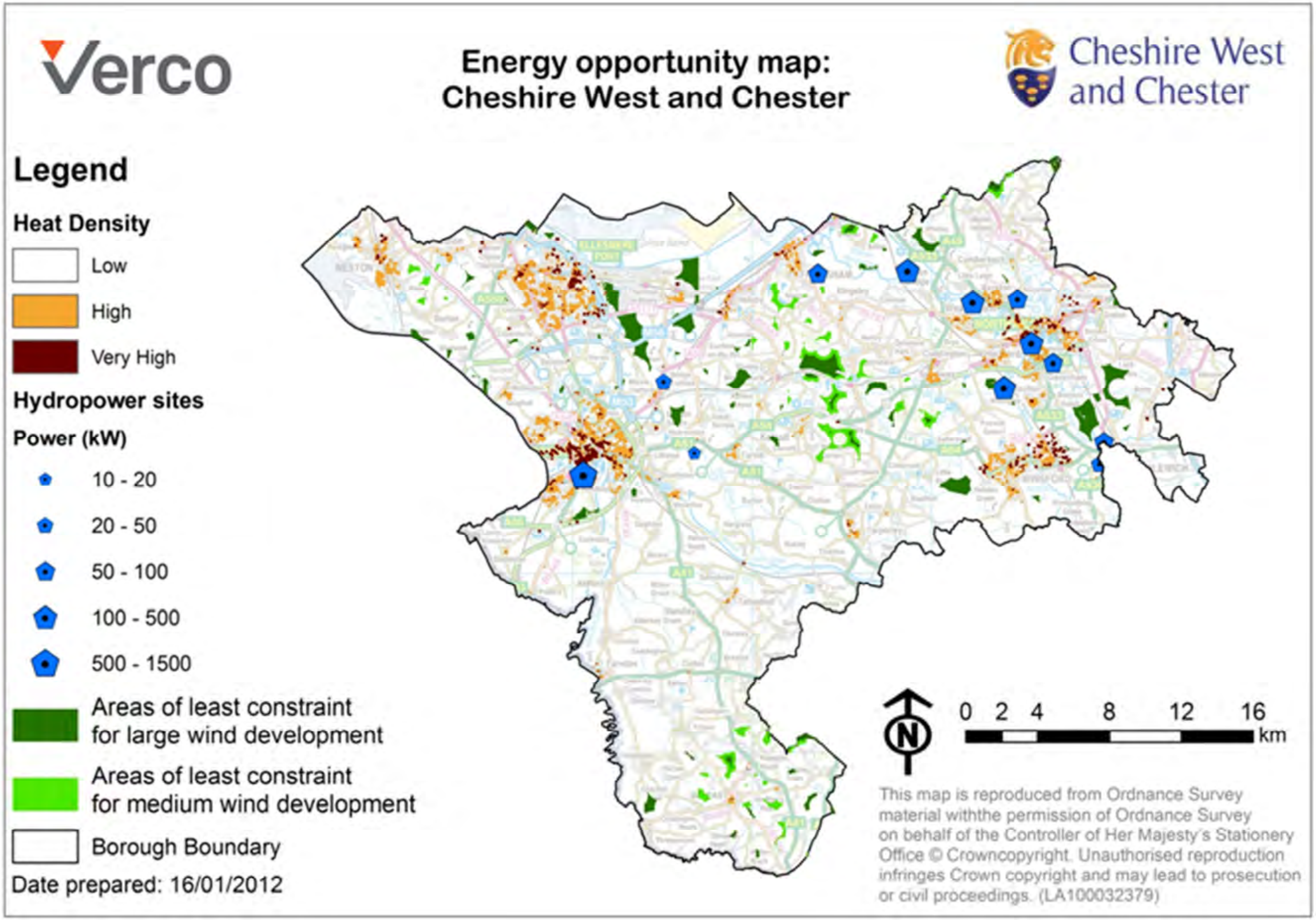


**Figure 12-2: Energy opportunity map for Cheshire West and Chester**

# 13. Target and Planning Policy Setting

## 13.1 Introduction

Our assessment of the Renewable and Low Carbon potential within the boundaries of Cheshire West and Chester has identified that wind energy, Coal Bed Methane (CBM), energy from waste (EfW) and biomass are likely to play the largest roles in contributing towards a reduction in greenhouse gas emissions.

It should be noted that CBM is not inherently a low carbon technology and is included on the basis that it offers the opportunity to use methane gas in CHP and district heating applications, which would result in carbon reduction compared against conventional fossil fuel used just for heat generation.

Collectively these technologies will be the main components of the Borough's contribution to national targets, which currently stand at generating 15% of the total energy consumption of the country by 2020 from renewable and low carbon sources. Our assessment also shows that microgeneration and district heating have the potential to play a significant role, not only in lowering carbon emissions but also increasing energy security.

Our analysis suggests that these technologies can deliver a **3.0% energy contribution from renewables and low carbon generation** in the borough, as based against the total baseline energy consumption for the Borough of 22,1866 GWh per annum (in 2020). This total baseline energy figure includes energy consumption from the Borough's industrial and commercial sectors, as well as energy use associated with transportation.

We contend it is important for the consumption baseline to account for this data, since national targets are based upon total energy consumption. However, the inclusion of industrial petroleum and industrial manufactured solid fuels in the Borough (which to a large extent are attributable to the Stanlow refinery) has a significant impact, resulting in a stated consumption of approximately 67MWh / per person per year, which is almost three times the national average. If we remove the consumption for these two fuel types in the Ellesmere Port area (as a proxy for the Stanlow refinery[1]), the consequence is to reduce the estimated energy consumption within the borough by over 50%. Using this as a consumption baseline, the deployable renewables potential highlighted within this study would contribute to around 6.3% of energy consumption.

A suite of national legislation and guidance has helped define the role of local authorities in delivering national targets for renewable and low carbon energy and the headline documents were summarised in section 2.

The evidence gathered through this study supports a number of policy approaches that the Council may wish to adopt through their emerging planning policy. It is important to note that while this study is considered to represent a substantial technical evidence base, the Council has a significant degree of flexibility with which it may approach policy development and implementation on these matters. This section therefore sets out the key messages that emerge from the evidence and highlights ways in which the Council could take these forward.

[1] *it was not possible for DECC to provide energy consumption data for individual commercial sites*

## 13.2 Setting Strategic Objectives and Outcomes

Planning legislation and national policy point to the need for local planning policy to address a number of renewable and low carbon energy related objectives:

1. Follow the principles of sustainable development in the location and design of all new and refurbished development,
2. Address the causes of climate change through reducing greenhouse gas emissions,
3. Adapt to the impacts of a changing climate on Cheshire West and Chester, through design measures,
4. Reduce the risks of relying on imported and centralised energy.

These objectives can be related to the following strategic outcomes:

1. New and existing power supplies will be used more efficiently so as to reduce the $CO_2$ emissions associated with new developments and existing buildings
2. Renewable and low carbon energy capacity will need to increase in all areas to assist meeting national targets for a 15% share of total energy consumption from low carbon and renewable sources by 2020, with further contributions potentially required throughout the lifetime of a plan, as national targets are amended by Government
3. New development is designed / delivered so as to reduce energy demand
4. Maximise the commercial, employment, energy security and community benefits, e.g. fuel poverty, that can be delivered through deployment of these technologies

These objectives and outcomes are related but are set out separately so as to illustrate the range of policy approaches that may be required in the local policy. It is also important to note that in accordance with the Government's Carbon Plan (2011), activity against each of these outcomes is required by many different sectors of the economy – not all of which will be influenced by decisions taken through planning application processes. Thus different functions within the local authority may seek to consider and align their actions on achieving the outcomes that are developed for the Plan.

These proposed strategic objectives and outcomes arise from the findings of the study and the current national policy context. They provide a framework for the Council's planning policies and the headline conclusions on these are:

- Contributing to meeting the national targets for carbon reduction should be a key objective
- A policy on stand-alone energy generation should be included
- A policy on renewable and low carbon energy in new and refurbished developments should be included which supports in principle the role that development will play in carbon reduction and describes how new development can help to contribute to the four strategic objectives
- All renewable and low carbon technologies should be encouraged with particular attention given to those with the greatest potential to deliver the borough's objectives. Consideration should be given to identifying location suitable for deployment
- The planning policies of the Borough should include reference to specific issues and criteria that will help determine proposals for energy development – these include: impacts on landscape, biodiversity, historic environment, residential amenity, highways, access and civil aviation.

## 13.3 Policy issues: low carbon generation

The technical elements of this study provide the Council with the means by which to weigh the relative importance of the identified potential of different technologies with wider local planning objectives. Several recommendations can be made for each technology as discussed in the following sections.

### 13.3.1 Wind energy

National guidance encourages local authorities to plan positively for renewable and low carbon energy, including wind.

The Draft NPPF states that local authorities should: "design their policies to maximise renewable and low-carbon energy development while ensuring that adverse impacts are addressed satisfactorily". It also notes that local authorities should "consider identifying suitable areas for renewable and low-carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources".

The Northwest Renewable Energy Potential and Deployment Study (SQW, 2010) noted that the Cheshire sub-region has a strategic role to play in the delivery of wind, with 20% of the region's total commercial wind resource and 35% (the largest share) of the small scale wind resource. However, this study has identified a substantially lower, but still significant, wind energy potential. It is recommended that further work is conducted to examine the full landscape and cumulative landscape constraint for wind energy deployment.

The study has identified that there is a significant overall potential for wind energy in the Borough and it is recommended that the Council prepare a planning policy that seeks to positively plan for its use. This will not only meet the strategic objective of addressing the causes of climate change through reducing greenhouse gas emissions, it will also reduce the risks of relying on imported and centralised energy.

It is recommended that the Council prepares a planning policy that's seeks to positively plan for the deployment of wind energy.

The main considerations of a Borough-wide policy that are raised by this study are:

**Spatial distribution**

- The opportunities identified by the study are relatively scattered and the only spatial patterns that would lend themselves to identification as areas of search lie to the north of the Borough around the Elsemere Port area. However, these are relatively small and it is recommended that the plan be limited to identifying that while there is some potential for larger, commercial scale wind turbines the pattern of development is likely to be one of single turbines and small clusters, scattered rather than being grouped in a particular part of the Borough.

**Large scale wind**

- There are few opportunities for the development of large scale commercial wind farms in the Borough due to the dispersed nature of the settlements and the need for a buffer between turbines and settlements.
- Those small pockets that have been identified would need to subject to further landscape analysis prior to identification as areas of search in a plan policy
- There are only likely to be opportunities for small clusters of large scale wind turbines for much of the Borough

**Medium scale wind**

- The potential for medium scale wind turbines which do not require as large a buffer is greater in the Borough and the evidence suggests that there are many opportunities for such schemes typically serving industrial, commercial or agricultural users or schools.
- Further landscape work would be needed to identify specific areas of search

**Target setting**

- Given that there are few strategic opportunities for wind turbines the setting of a target is not considered to be a key mechanism for positive planning.
- Current national policy encourages local authorities to establish positive spatial policies and incentives as opposed to targets for individual technologies

**Landscape**

- Landscape has been taken into account in identifying opportunity areas, but there is need for further assessment to examine the extent of landscape constraints. This may be done by the Council as part of the plan-making process, by applicants in association with planning proposals or a combination of both.
- It is considered that further work could be undertaken on relating the opportunity areas for wind identified in this study (i.e. the least constrained areas) with landscape character areas in order to provide further messages on the scale of wind farms that may be appropriate in these general locations.
- A policy on wind energy should ensure that landscape is a key criteria against which proposals will be assessed.
- Given that there are only a few limited areas where large commercial scale wind turbines may be located in the Borough any future landscape analysis could focus on the sensitivity of these areas to large and medium scale wind and assess the sensitivity of the remainder of the Borough's landscapes to medium scale turbines only

**Other criteria**

- It is recommended that this include specific reference to the following: ecology and biodiversity (including birds), heritage, airspace operation and communications. The Council may consider that policies elsewhere in the plan on noise, amenity, access and heritage would be sufficient to determine planning applications for standalone wind turbines.

**Community Schemes / Individual Turbines**

- Given that the dispersed nature of settlements is a constraint for wind power in the Borough the Council may wish to consider how the local policy might encourage turbines which are closer to settlements through community projects where residents are more willing to accommodate turbines in return for local energy benefits. The role of Neighbourhood Plans as a vehicle for identifying sites could be suggested, as described in the Draft NPPF.
- The Council may consider being supportive of small scale wind turbines in areas which are off-grid e.g. on farms and isolated dwellings in rural areas. This would provide plan users with in principle certainty. The Council may wish to consider how best to address landscape and nature conservation impacts through supplementary work or through any landscape assessment that takes into account the individual and cumulative effects of small scale turbines.

### 13.3.2 Biomass Resource

Biomass is encouraged as a fuel source along with other sources of renewable energy but there are few explicit references in the Draft NPPF.

Biomass presents a significant resource potential and therefore could provide a significant contribution to energy supply in future years.

The role of local planning policy in achieving the identified potential of biomass is largely one of stimulating demand and promoting the establishment of supply chains that will fulfil this demand.

It is recommended that the Council prepares a planning policy that seeks to positively plan for its use greenhouse gas emission reduction and improve energy security.

The Council should include reference to biomass within a policy for stand-alone renewable energy to address issues around biomass plant developments as well as policy on smaller decentralised scale energy generation.

The main considerations of a Borough-wide policy that are raised by this study are:

**Spatial distribution**

- The Borough has a significant potential for biomass use and it should be supported by the Council in general as a key energy source. However, the biomass resource is spread across the Borough and not limited to specific areas; therefore specific spatial policies will not be required.

**Biomass Plants**

- Opportunities to locate biomass plants which generate electricity close to potential users of heat outputs should be encouraged and where possible align with existing or potential future district heating networks.
- Biomass (both heat-only and combined heat and power) should be supported, especially where they replace gas or electricity heating and in particular for areas off the gas grid where oil may currently be used for heating

**Smaller Scale Development**

- Biomass (used in heat-only and combined heat and power) for individual or groups of buildings should be supported
- Farm scale anaerobic digestion and others forms of securing energy from biomass should be encouraged along with the sharing of biomass plant between farms
- Community-led development should be supported

**Criteria on sustainable sourcing of biomass**

- It is important that biomass is sustainably sourced and that developers are aware of their duties to demonstrate sustainability criteria. Information to support justification text may be drawn from Article 17 of the EU Renewable Energy Directive 2009, which requires users of biomass to demonstrate that biomass is not sourced from areas of primary forest, designated nature conservation areas or areas containing threatened species, bio-diverse grassland, areas of high carbon stock and peatland. In addition, if a plant receives ROCs there must be a report to Government on the sustainability of feedstock, including the distance it has travelled.

There are also restrictions on the fuel type to be used and on the quantity of biomass that can be delivered by road.

- To address these points the Council should consider requesting information from prospective developers on the type and source of the biomass proposed to be used in biomass plants and the wider implications of this.

**Production of biomass**

- It is important that the growing of biomass crops does not impact negatively upon water, soils, landscape, archaeology, ecology and landscape. DECC has established a methodology to support the protection of land that can otherwise be used to grow food, however, policies may usefully note that biomass crop production should avoid Best and Most Versatile agricultural land within the Borough
- It is recommended that general development management policies ensure that they are relevant to biomass production and energy generation

**Biomass supply chains**

- Some authorities have developed links with the biomass industry, especially around woodfuels (see for example the Barnsley http://www.wood-fuel.org.uk/who.php) and its is recommended that the Council explores similar action
- The Council may also consider exploring with its neighbouring authorities a cross-boundary sustainable approach to the growth and processing of biomass and supply chain implications which ensures that biomass is grown and processed in as efficient a manner as possible.

### 13.3.3 Hydro Power

Hydropower is encouraged along with other sources of renewable energy but there are few explicit references in the Draft NPPF.

The assessment of the hydro resource suggests that small scale hydropower has a limited but important role to play in renewable energy generation.

The study has revealed a small potential for hydro power. While small, it should be encouraged to support the borough’s objectives. Hydro schemes are not particularly cost-effective (relative to some other generation technologies) but can play a valuable role in increasing awareness of renewables and maintaining the power generation heritage of some areas and communities.

The Council should include reference to hydro power within a policy for stand-alone renewable energy. The main considerations of a Borough-wide policy that are raised by this study are:

- The Council should ensure that hydro schemes do not impact rivers and river habitats negatively. Small-scale schemes do not typically involve the use of dams or reservoirs and are fairly minimal in terms of impact.
- The Council should consider whether hydro-schemes can be a catalyst for wider ecological improvements of river networks and ecology through wider consultation with the Environment Agency.
- Policy justification on this issue should refer to the need to consult early with the Environment Agency and ensure that the various consents, construction licenses, river consents and fish pass consents are secured.
- General development management policies covering impacts to ecology, heritage, landscape and amenity will be important in determining applications for hydro-power schemes. In

addition, references to water abstraction, pollution and run-off will be important.

#### 13.3.4 Coal Bed Methane

The extraction of CBM would meet Government's ambitions to provide for a local and secure energy supply and the Draft NPPF notes that local authorities should encourage capture and use of methane from coal mines in coalfield areas.

The study has revealed that there are areas of Cheshire West and Chester where there is potential to extract Coal Bed Methane gas.

There is a need for the planning policy to recognise this potential energy resource and support its sustainable extraction. The policy should ensure that:

- The extraction of CBM is supported in principle
- Any extraction should also capture carbon where feasible and viable to the operation
- Any extraction should fully maximise the use the heat generated as a low carbon energy source
- The Council and the Local Enterprise Partnership work with key bodies to co-ordinate the investment and long timescales required to extract CBM
- Local impacts are assessed in the same way as for mineral workings and that conditions are placed on the development where appropriate to secure positive and beneficial restoration

Coal Bed Methane is derived from coal and is their neither renewable or low carbon in nature. In order that CBM can make an important contribution to carbon reduction within the borough, it is recommended that the council considers a policy only allowing the implementation of schemes that efficiently use CBM fuel for both heat and power. The council should also consider enabling development with significant heat demand adjacent to CBM development sites, e.g. horticultural, leisure, relevant industrial activities.

#### 13.3.5 Community-led generation

It is important to recognise and support the contribution of community-led and farm scale renewable and low carbon solutions and the Draft NPPF supports the development of community-led energy schemes. Small scale wind turbines, anaerobic digestion, biomass boilers and other forms of energy and heat generation which serve more than one building may be supported through plan policies.

Community-owned schemes have proven to be one of the most effective means of pulling communities together in raising capital and sharing the financial returns and re-investing into other energy and carbon saving initiatives. Within the Borough, Ashton Heyes exists as a good local example of what is achievable through community collaboration.

The most likely schemes to be developed by community groups will be wind turbine clusters and hydro-electricity schemes, although it is recommended that policy supporting community-owned energy is left open to support all forms of renewable energy where suitable.

### 13.4 Policy issues: Built environment

The Draft NPPF states that local planning authorities should plan for new development in locations and ways which reduce greenhouse gas emissions. They should actively support energy efficiency improvements to new dwellings and when setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards. Opportunities where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems should be identified.

The Government's Zero Carbon Homes policy is summarised in section **Error! Reference source not found.**. It should also be noted that consultation on Building Regulations Part L suggests that progress towards mandatory Code Level 4 for all new homes will not now occur in 2013.

The Government recognise that there are circumstances where local authorities could drive progress on sustainable buildings further and faster, in particular where they can demonstrate that there are clear local opportunities to use renewable or low carbon energy through decentralised systems.

It is important to reflect that the role for local planning policy is likely to diminish as Building Regulations are tightened (towards the zero carbon standard in 2016).

The Borough's planning policy has a much longer life span and therefore it is important that policy on this area does not become quickly out of date.

The study has revealed broad capacity for renewable and low carbon energy in association with new development and specifically, through heat mapping, potential for district heat networks within the larger settlements. Realising this small but significant potential will help meet the strategic objectives of: following the principles of sustainable development in the location and design of all new and refurbished development, addressing the causes of climate change through reducing greenhouse gas emissions, adapting to the impacts of a changing climate on Cheshire West and Chester, through design measures and reducing the risks of relying on imported and centralised energy.

It is considered that the Council should consider planning policies which contain the following messages:

### 13.4.1 Energy Hierarchy Approach

It is recommended that a clear structured process of decision making is set out that makes it easier to take decisions on new developments. One way of doing this is through requiring development to respond to the 'energy hierarchy'.

This will enable developers and development management officers to better assess the potential for the twin outcomes of carbon reduction and energy generation in both residential and commercial developments and "front-load" the process through the requirement to submit an energy opportunities statement with applications.

The 'energy hierarchy' requires that all new buildings:

1. have lower embodied energy through use of sustainable materials in design and construction, then,
2. are more energy efficient and have a lower energy demand e.g. through using more efficient appliances (where specified at development stage), includes high standards of energy performance within the building 'fabric', and, incorporate passive design elements such as south facing windows and overhangs to capture solar energy efficiently and natural shading to avoid the need for summer cooling, then,
3. ensure that any remaining energy is efficiently used through e.g. high performance boilers

and lighting systems, and then

4. generate heat and power from on-site renewable and/or low carbon sources, i.e. on-site microgeneration, site-wide energy technologies or off-site energy sources including district heating networks, and then
5. encourage building users to reduce their energy use, e.g. through providing building operation information, energy efficiency advice and enabling / encouraging use of energy monitoring.

The chief benefit of the energy hierarchy is that it enables the Council to raise the issue of planning for renewable and low carbon development at the earliest stage in the process where the developer is more able to offset costs and where significant gains can be made at no or low cost.

The application of the energy hierarchy can more easily be ensured by the Council requiring that developers prepare an "energy opportunities assessment" shows how design (and construction) addresses the 'energy hierachy'.

### 13.4.2 Alignment with Building Regulations and Standards

Government standards are driving this agenda forward and Building Regulations are ensuring that the fabric of new residential and non-residential buildings is improved so that buildings emit lower carbon emissions. This "fabric first" approach means that carbon savings are "locked in".

The Government looks to other standards such as the Code for Sustainable Homes and the BREEAM (for on-residential buildings) to deliver carbon savings that are greater than those delivered through Building Regulations. These set the standard for best practice in sustainable design and have become the de facto measures used to describe a building's environmental performance. The Borough's planning policies should refer to these standards and encourage developers to assess their compliance with these in their energy opportunities assessments.

In addition, it is recommended that supplementary planning guidance be developed to provide design and construction guidance to help developers make elementary decisions on location, layout and use of site characteristics as well as requirements under the 'energy hierachy'.

### 13.4.3 Energy generation for new development

Building regulations do not currently automatically ensure that decentralised energy will be delivered and the Government's proposals for Part L in 2013 are unlikely to ensure this. However, the Government is committed to delivering zero carbon homes by 2016 and zero-carbon buildings by 2019 which will increasingly require carbon reduction from decentralised generation and 'Allowable Solutions[2]'. The Borough's planning policies should refer to this ambition and detail that Building Regulations and the national standards will be the main drivers for this in the long term and that as they change development decisions will be taken in line with them. It is recommended that the Council also considers the establishment of a local carbon fund to enable the delivery of 'Allowable Solutions' compliant projects that will maximise the benefits to the borough, by delivering against local priorities.

The study highlights that there is potential for District Heat within the main settlements of the Borough (see next bullet below) and the study provides evidence to require that in particular locations developments should address level 4 of the energy hierarchy through assessment and provision of

[2] *A scheme proposed to enable the implementation of carbon reductions to be displaced from development to 'off-site' initiatives.*

District Heat networks.

For all other locations outside of areas of District Heat opportunity it is considered that there is insufficient evidence available to require that developers deliver on-site renewable energy generation between the current time and 2016. This is because nationally available viability testing by the Zero Carbon Hub has not been endorsed by the Government and local viability testing has not been undertaken for development within the borough. In order to establish a policy that goes beyond national standards the Council should undertake specific viability testing to explore the potential of development in the Borough to deliver on-site energy generation across development typologies and for earmarked for major development.

**13.4.4 District heating networks**

This study identifies that there is potential for district heating networks in particular locations across the Borough (e.g. in Chester and Ellesmere Port). The Council may wish to identify these areas within its planning policy as defined 'Areas for Potential for Heat Networks'.

A policy may stipulate that new developments in 'Areas for Potential for Heat Networks' should contribute to the objective of delivering district heating infrastructure. It is suggested that this may be achieved by ensuring that in Chester and Ellsemere Port developers consider district heating as their first option for meeting the energy hierarchy on-site renewables objective. Clearly once building regulations are tightened further and an element of decentralised generation is required through this mechanism, the policy could usefully help direct the capital that developers would need to spend on this element towards district heating infrastructure development rather than microgeneration, e.g. solar PV. Developments should give consideration to connection to neighbouring existing and planned heat loads and heat sources as this may improve viability, whilst improve the likelihood connecting heat networks.

Where District Heating is determined as non-viable developments should include design features to enable connection to a heat network at later date.

The planning policy should identify that there may be potential for smaller heat networks in other areas such as Northwich and Winsford and that this will be explored through any further site allocation plan making,

The policy should establish the strategic potential for District Heat Networks in the Borough and signal that further site allocations plan-making will be informed by the potential for these.

The Council may wish to consider stating that large and mixed-use developments should install a district heating network to serve the site.

The Council should also consider the operational needs of such networks and ensure that developments provide sufficient land, buildings and/or equipment for an energy centre to serve existing or new development.

The Council may wish to consider initially the potential role that public buildings can have in providing an anchor load within a decentralised energy network.

It is recommended that the Council acknowledges the strategic importance of DHN within the Core Strategy in order to influence the setting of the Community Infrastructure Levy (CIL).

It is recommended that the conducts a more detailed strategic appraisal of District Heating Networks, including those areas identified in this study as “Areas for Potential Heat Networks”. This would encourage the development of Heat networks and to provide, the Council, site developers and other stakeholders supporting evidence to enable a co-ordinated approach which is required to facilitate delivery.

### 13.4.5 Low carbon retrofit and renovation

It is widely acknowledged that a large proportion of $CO_2$ emissions associated with buildings arises from our existing building stock, much of which will still be around at the end of the Core Strategy period. It is therefore recommended that the Council seeks to promote the reduction of energy and carbon emissions for existing buildings, through retrofit and low carbon renovation as encouraged by the Draft NPPF.

The study did not specifically address the issue of refurbishment and retrofit and there are few mechanisms within planning policy to enforce energy efficiency improvements within existing properties, however, there are precedents across the UK where policies have been adopted to support the implementation of energy efficiency improvements where a property is extended or renovated. Uttlesford District Council led the way with this approach nationally and, more locally, Stockport MBC have adopted a similar policy within their adopted Core Strategy. The Council may wish to consider a similar approach, taking account of the following issues:

- **Extensions**: Where a property is proposed to be extended, the Council will expect cost effective energy efficiency measures to be carried out on the existing property. Applicants could be asked to complete and submit a home energy assessment form and are then notified of energy savings measures that the Council require as part of the conditions of granting planning permission for the extension.
- **Replacement dwellings:** if the replacement is bigger than the existing house then the Council could seek an "as built" dwelling emission rate 10% lower than the target emissions rate calculated to comply with Part L1A of the Building Regulations.

The Uttlesford Council implementation of policy for existing buildings provides a proven example on how these policies can be applied and assessed. Uttlesford have devised a checklist of carbon reduction measures that are most typically cost-effective for domestic properties. The checklist approach is relatively simple and mirrors the intentions of national Building Regulations Part L1B and Part L2B – if any of the measures on the list are applicable, they are likely to pay for themselves in energy cost savings in less than seven years, and their combined cost does not exceed 10% of the cost of the building works, they are required. If none of the measures on the list are suitable, no implementation is required.

All proposed conversions that are deemed to need to comply with Part L of the Building Regulations will need to be rigorously checked against the criteria as part of the policy implementation. With such policy in place the Council could also make use of supporting financial schemes such as the Green Deal to reduce the upfront capital cost of required improvement measures. This could be simply a supporting and promoting role, or the Council may choose to become a Green Deal provider to directly support the delivery of this policy.

In addition, as discussed in the discussion above around new development, the Council should consider establishing a local Carbon Fund able to leverage developer receipts to support energy efficiency implementation in existing property compliant with the ‘Allowable Solutions’ scheme but, crucially, supporting local delivery priorities.

**Viability**

In order for Core Strategy policies to be sound they have to be effective, justified and consistent with national policy. Increasingly, these tests of soundness encompass a need to demonstrate that what the Core Strategy is seeking to deliver is viable for the development industry. This means identifying, understanding and acknowledging the financial challenges on renewable energy and on the development industry in general to include excessively expensive LZC technologies in association with new homes and other developments. The Draft National Planning Policy Framework covers the issue of viability specifically and states that, for housing, local authorities must ensure that sites are deliverable including "in particular that development of the site is viable i.e. that it would provide acceptable returns to a willing landowner and a willing developer based on current values and taking account of all likely infrastructure, standards and other costs."

The draft policies presented in this study have been assessed against two levels of viability:

- So as to ensure that industry can deliver standalone renewable and low carbon technologies without excessive additional contribution, and
- So as to ensure that developers can build homes and commercial properties that enables them to achieve an acceptable level of financial return.

Evidence for these assessments of viability is available nationally and it is not considered necessary to engage in further local viability assessments of the sort that local authorities do for affordable housing.

The viability of standalone wind farms will vary depending on size, location and wind speed. Factors such as distance from the nearest sub-station will also be an issue. Profitability depends on wind speed, cost and performance of a wind turbine installation, as well as energy prices.

Large turbines selling power to the grid can be financially viable where the average wind speed is high. They are likely to become attractive to more businesses in future, as technology continues to improve and the deregulated energy market develops.

Small turbines may be viable with lower average wind speeds, particularly where other renewable energy alternatives are limited and where mains gas and electricity may not be available.

It is not for the Core Strategy to determine the viability of choices made by the wind energy industry but the policy should ensure that it does not impose unnecessary costs to development.

The viability of decentralised energy in association with new development has been well documented nationally by the Zero Carbon Hub. Further information can be found in the document "Zero Carbon Hub, Carbon Compliance: Setting an appropriate limit for zero carbon new homes - Findings and Recommendations (2011)". This concluded that tightening carbon compliance through Building Regulations will only have a minor impact on scheme viability.

# 14. Monitoring and enforcement

Once key elements of the Council's planning policy is drafted, the Council should develop clear arrangements for monitoring and reporting to ensure that the policies continue to remain effective in their implementation. The following section highlights activities that are ongoing at national level and suggests ways that the local authority may align with these.

## 14.1 National monitoring

There are two main national databases which monitor the status of renewable energy projects for the Department of Energy and Climate Change (DECC).

RESTATS[3] presents data on national energy use and supply, including renewable and low carbon energy, is gathered by the Renewable Energy Statistics Database monitoring programme from four principal sources:

- a review of existing databases
- an annual survey of renewable energy developers
- estimates of the uptake of small scale renewable energy technologies
- gap analysis technology surveys – to verify the accuracy of the data.

The results of the database are currently provided at a national level published in the Digest of UK Energy Statistics (DUKES) and via the RESTATS website. There are future plans to make the data available at a county and district level.

Renewable Energy Planning Database (REPD)[4] works in conjunction with the RESTATS database, DECC also monitors the progress of renewable energy projects through the planning system through the REPD. This monitoring programme collects information from local planning authorities and renewable energy developers on the status of all renewable energy projects at each stage of the planning process - from intended applications through to construction and commissioning. Details on key planning and environmental issues are also recorded.

The information is collected via a review of planning applications posted on local authorities' planning portals and by contacting planning officers and developers direct. The data is made publicly available in the form of excel spreadsheets via the RESTATS website and are updated on a monthly basis. Data is provided on each individual renewable energy project and can be easily disaggregated to a regional, county and/or district level.

There are several other national databases which provide information on renewable energy projects. As outlined above, most of the information from these sources is drawn together within the RESTATS database.

[3] *https://restats.decc.gov.uk/cms/welcome-to-the-restats-web-site/*
[4] *https://restats.decc.gov.uk/cms/planning-database/*

- NFFO Database - provides information on all schemes operating under Non Fossil Fuel Obligation contracts (e.g. the contracts that were awarded to eligible renewable energy projects prior to the introduction of the Renewables Obligation)
- CHAPSTATS - the Combined Heat and Power statistics database
- Ofgem Renewables and CHP Register (formerly known as the ROC's Register) - lists certificates issued on a month-by-month basis to each accredited generating station.
- ROC's Database of Accredited Generating Stations - contains information on all schemes currently claiming ROC's certificates.
- DECC's Major Power Producers (MPP) Survey – covers large-scale hydro, co-firing and poultry litter combustion
- BWEA – UK Wind Energy Database - provides information on all wind farm applications and projects within the UK.
- Renewable Energy Association (REA) database - includes information on both renewable heat and electricity projects.

## 14.2 Local monitoring

The Department for Communities and Local Government announced in October 2010 that it was decentralising Local Area Agreements (LAAs) and replacing the National Indicator Set with a single comprehensive data list from April 2011. The single data list is a catalogue of all the datasets that local government must submit to central government in a given year. This includes "Emissions from local authority own estate and operations" (former NI 185). It does not include former NI186 - Carbon dioxide emissions within the scope of influence of local authorities. The Council may wish to consider monitoring these emissions themselves subject to resource implications.

There are three main reasons why it is considered important to monitor renewable energy projects within the Borough:

- To provide a mechanism for reviewing the success or otherwise of policies especially given that decentralised energy policies are likely to change throughout the lifetime of the plan
- To understand the Borough's contribution to national targets
- To provide information on the planning and commissioning status of renewable energy applications on a quarterly basis to the REPD

Most local authorities do not have a formal data monitoring system set up to identify renewable energy projects. Local authorities are no longer required to report on core output indicators related to renewable energy capacity but are requested to provide information to DECC on the planning and commissioning status of renewable energy projects as part of the Renewable Energy Planning Database (REPD).

The establishment of a formal data-gathering system at the local authority level would help this reporting process. It could be linked to existing development control databases and the DECC Renewable Energy Planning Database. It is recommended that the Council explores ways of aligning and managing data from all relevant departments within the local authority.

A summary of data that should be gathered by local authorities to meet the requirements of the DECC REPD is as follows:

- Planning application number
- Technology type – reported in line with the RESTATS classifications [Digest of UK Energy Statistics 2008]
- Applicant and/or developer
- Project name
- Site address (including, County, Country, Region, Local Authority, Postal Code)
- Grid reference
- Installed capacity of application in megawatts
- Installed capacity in megawatts of operational renewable energy development
- Application status (e.g. approved, refused, submitted, withdrawn, scoping)
- Reasons for refusal (if relevant)
- Post consent status – (awaiting construction, under construction, operational, abandoned)
- Planning application dates (submitted, determined, operational (if relevant)
- Planning officer recommendation
- Appeal details and dates (if relevant)
- Planning and/or environmental designations on or near site

Data should be gathered on both renewable electricity and renewable heat projects.

Many renewable energy installations are carried out under Permitted Development Rights and the local authority is not required to report on these. This information is notoriously difficult to obtain as installers are not required to notify local authorities of small-scale renewable energy installation that fall under PDR. It is suggested that if DECC wishes to understand the contribution these smaller installations make they will quantify the combined output of all these small or medium-scale installations through the Renewables Heat Incentive and the Feed-In Tariffs initiatives.

Further information is expected from DECC and DEFRA on the responsibilities of local authorities in monitoring on greenhouse gases. However, some initial requests are available on the DECC web-site and include:

- Homepage for local authority statistics
  http://www.decc.gov.uk/en/content/cms/statistics/local_auth/local_auth.aspx
- Sharing information on greenhouse gas emissions from council own estate and operations – further guidance is provided at:
  http://www.decc.gov.uk/assets/decc/Statistics/nationalindicators/1693-sharing-information-ghg-emissions-council.pdf

Furthermore DEFRA provides guidance for all organistions, including public sector, on how to monitoring green house gas emissions from their own activities. This can be found at:

http://www.defra.gov.uk/environment/economy/business-efficiency/reporting/

## 15. Recommendations and Next Steps

Below is a summary of the next steps that are recommended to Cheshire West and Chester Council as a means of taking the information within this study and combining this with other forms of evidence to develop draft planning policies.

- The Council steering group should review the evidence base and policy commentary within this report to ensure that the recommendations align with the Council's intentions. The information contained within this report has been developed in consultation with the project steering group, as well as the officer-led stakeholder workshop in November 2011.
- The Council should promote the work done within this study and other related studies in supporting developers to achieve cost-effective low carbon development, making Cheshire West and Chester an attractive place for sustainable new development.
- The Council should maintain close engagement with local developers and community groups, providing training and communication sessions as necessary to prepare a local platform for low carbon development and the development of local renewable energy.
- The Council should ensure that the many different teams and Council officers involved in planning and enforcing development are aligned and engaged in promoting sustainable development for the benefit of the local community.
- The Council should continue to monitor and review the sustainable credentials of new development to ensure that standards are upheld within the Borough, to ensure that the Borough contributes to national low and zero carbon energy generation targets, in proportion to the resources available.
- Council members and officers should understand and promote the delivery of the Energy Opportunities Map to maximise the development of renewable energy and sustainable development within the Borough.
- The Council should consider promoting the formation of community-owned energy groups and support their work in developing renewable energy schemes and implementing retrofit improvements within their local communities. The Council should support such groups with guidance, in-house skills, knowledge transfer and linking to grants and funding opportunities where possible.
- The Council should maintain its awareness of upcoming schemes being developed at a national level, which will impact on the requirements and ability of local residents and developers to implement the opportunities identified in this report. Such schemes include the Green Deal, Energy Company Obligation (ECO) and updates to national building Regulation standards and related schemes such as the Community Infrastructure Levy (CIL) and allowable solutions.
- In order to present leadership through example, the Council should consider developing those energy efficiency and renewable energy / low carbon opportunities that arise within and in the proximity of assets within its estate, either directly or via third party developer. Key opportunities included energy efficiency and renewable energy retrofit programmes within council owned buildings, developing decentralised generation on council owned land, and, co-ordinating development of district heating where council can be an 'anchor heat consumer' or can facilitate the implementation of infrastructure.
- The Council should work alongside neighbouring Local Authorities to deliver energy opportunities that exist across borough boundaries, as well as sharing expertise and best practice.

- The Council should consider to investing in identifying renewable energy opportunities to enhance and maintain the Energy Opportunities Map. It is also recommended that a number of further study areas are investigated to refine outline proposals for potential opportunities highlighted within this study, including:
    - Exploration of the potential for district energy within those areas highlighted as having the greatest potential within the Borough
    - Preparation of outline energy strategy feasibility studies for specific strategic sites
    - Exploration of the development of a borough-wide low carbon fund that could be introduced to substitute on-site implementation of low carbon and renewable energy generation, with implementation elsewhere in the district on a larger scale, where it can prove to be more carbon and cost-effective to do so. This fund could provide the framework for the delivery of a locally driven "allowable solutions" option to enable development to achieve carbon standards under the zero carbon regime from 2016 onwards.
    - Exploration of the specific viability of establishing low carbon targets for new development going beyond national requirements established in forthcoming Building Regulations.
    - Educating and informing local community energy groups.
    - Providing training for Council members and officers.