Wolverhampton City Council

Renewable Energy and Carbon Reduction Study

Final Report

AMEC Environment & Infrastructure UK Limited

December 2011

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Report for

Michele Ross
Senior Planning Policy Officer
Wolverhampton City Council
St Peter's Square
Wolverhampton
WV1 1RG

Main Contributors

David Fovargue
Robert Deanwood
Steven Wood
Gareth Oakley
Tom Jennings

Issued by

....
David Fovargue

Approved by

....
Claire Barnett

AMEC Environment & Infrastructure UK Limited

Gables House, Kenilworth Road, Leamington Spa,
Warwickshire CV32 6JX, United Kingdom
Tel +44 (0) 1926 439 000
Fax +44 (0) 1926 439 010

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Key stakeholders who have helped to inform the Study findings include: Steve North and Stuart Hobbs from Wolverhampton Homes; Dave Webb and Keith Daw Wolverhampton City Council, Jane Holmes, Cenex; Sam Hollis, Thomas Vale; Richard Baines, Black Country Housing Group; Reg Crockett, Energy & Resource Recovery Ltd; Nick Abson, Cygnus Atratus; Bill Whitehouse, Express Power; and Steven Cocks, University of Wolverhampton. A full review of stakeholders engaged as part of the Study is included in Appendix D.

Front cover photographs show developments in Wolverhampton, including: Cross Street South, a 30 dwelling scheme incorporating biomass heating (left), Unity, a 205 dwelling scheme incorporating solar thermal technology (centre) and St Luke's Primary School (right) incorporating a biomass boiler. Photographs courtesy of Tom Winckley, Wolverhampton City Council.

Executive Summary

A. Purpose of this Report

AMEC Environment and Infrastructure UK Ltd (AMEC) was appointed by Wolverhampton City Council to assess the opportunities for renewable and low carbon energy generation across Wolverhampton. The Study will inform the City Council's strategy for renewable and low carbon energy, support the implementation of the Black Country Core Strategy and provide the context for the energy-related policy and proposals of the emerging City Centre, Bilston Corridor and Stafford Road Corridor Area Action Plans (AAP).

This executive and non-technical summary is intended to provide an overview of the scope and purpose of the Study and its key findings.

B. Who is the Study for?

The Study has been written for the City Council but is intended for a wider audience, including businesses, developers and local communities. These different actors will all have an important role to play in the delivery of renewable and low carbon energy in Wolverhampton.

C. Why is renewable and low carbon energy important for Wolverhampton?

Wolverhampton's households and businesses spend around £160M on their energy bills each year, and the energy used to heat and power buildings produces more than one million tonnes of CO_2 emissions per year. A clear ambition for the City Council is to reduce energy bills and emissions, and the introduction of more renewable and low carbon energy is one of the key ways to achieve this.

Specifically, renewable and low carbon energy is important to Wolverhampton for the following reasons:

1. **Economic growth: exploiting opportunities for inward investment and new jobs.**
2. **Community benefits: helping to reduce energy bills, addressing fuel poverty and providing greater energy security.**
3. **Reducing CO_2 emissions: delivering the City Council's commitments in response to climate change and sustainability.**

The aim of this report is to present how these opportunities might be realised, focusing on recommendations for activity by the City Council, private sector and local communities.

D. What are the key findings from the Study?

At present existing renewable technologies contribute approximately 2% of Wolverhampton's current energy demands per annum (approximately 53 Gigawatt hours [GWh] per annum against a total energy demand of 3,218GWh per annum). This Study demonstrates the potential that exists to increase the proportion of the City's energy supply which comes from renewable and low carbon energy sources, drawing on a range of technologies, from micro-generation (solar panels for example) to a city-centre wide heating network fuelled by biomass.

Figure A summarises the overall findings from the Study with respect to what could be achieved via a mix of different technologies and the proportion of renewable and low carbon energy supply that could be achieved. Figure A demonstrates that:

- **Energy mix 1:** a strategy based on micro-generation and some wind turbine development could increase renewable and low carbon energy supply from 2% to around 3%.
- **Energy mix 2:** investing in infrastructure such as a city centre heating network and planting biomass on previously developed land - in parallel to energy mix 1 - could increase renewable and low carbon energy supply to around 5%.
- **Energy mix 3:** taking energy mix 2 and considering the impact that a further energy from waste plant could have given the clear private sector interest in this type of facility in Wolverhampton. As an example a $30MW_e$ energy from waste plant could increase renewable energy supply to around 12%.
- **Energy mix 4:** fully exploiting Wolverhampton's waste resource alongside energy mix 1 could increase supply to around 20%.

These figures are intended simply to demonstrate the order of magnitude of what could be achieved, and it may of course be possible to go much further. The figures should therefore not be seen as a ceiling or maximum but as a guide to what potential exists, to be used to inform the Council's future decision-making and as a baseline from which to monitor progress.

It is important to recognise that there are a number of possible barriers that will need to be overcome to support the delivery of renewable and low carbon energy projects, not least securing the up front capital investment, ensuring wider support within the City Council and developing the mechanisms for delivery.

E. What are the implications for the Area Action Plans?

The Study identifies the specific potential for renewable and low carbon energy generation alongside planned new development in the City Centre, Stafford Road Corridor and Bilston Corridor Area Actions Plans (AAPs). This will help the Council and developers understand what technologies could be viable in these areas and help to support the implementation of Black Country Core Strategy Policy ENV7 which requires 10% on-site renewables.

In addition, the Study recommends that new developments within the AAPs (and across the City) are ‘future proofed’ *now* to achieve the government’s target for zero carbon homes from 2016 and zero carbon non-residential development from 2019. The potential impacts for the design and viability of schemes means that zero carbon development should be considered at the outset of the planning process and will need to be demonstrated by developers submitting applications in the next few years.

F. What happens next?

This Study is a *starting point* and a key priority for the City Council will be to disseminate the findings and promote the benefits associated with renewable and low carbon energy generation to local communities, businesses and developers. Links will also need to be made to the City Council’s wider objectives in delivering a low carbon economy.

The Study presents a number of recommendations for the City Council and its partners, together with an action plan for delivery. The Study recommendations and supporting action plan identify the measures that the City Council and others will need to take to drive the take-up and realise the significant benefits associated with renewable and low carbon energy in Wolverhampton.

The Study also forms the evidence base for the energy-related aspects of the City Centre, Stafford Road Corridor and Bilston Corridor AAPs and other plans.

Study Recommendations

Recommendation 1: this Study is just the starting point and the Council needs to work with public and private sector partners to disseminate the Study findings and actively promote the benefits presented by renewable and low carbon energy, and more widely a low carbon economy, across the City. Securing buy-in from the different departments within the Council is also considered essential (Officers, Members and those within the Council's finance/accounting department).

Recommendation 2: identify the significant potential for 'allowable solutions' in the AAP areas to offset emissions within the existing built environment. Whilst the Council could set up its own Carbon Reduction Fund, it is recommended that, at this stage, the Council waits on Government proposals for an allowable solutions mechanism which could ultimately supersede any locally adopted approach. This may need to be supported by an SPD in the future, or make use of the Community Infrastructure Levy (CIL) as a mechanism.

Recommendation 3: continue to promote measures to reduce emissions within the existing built environment, such as affordable warmth, linked to national mechanisms such as the Green Deal.

Recommendation 4: require developers of new renewable and low carbon energy schemes to facilitate connections to existing and proposed households and businesses, so that energy generated can be used locally. This can be achieved via the development control process, though a stronger policy basis could also be provided for this through the AAPs.

Recommendation 5: continue to support waste-related energy projects given the significant potential that they have as a main supplier of low-carbon/renewable energy in Wolverhampton, and their potential contribution to delivering the waste management capacity requirements of the Core Strategy. However, there is a need to ensure that local benefits can be realised in accordance with Recommendation 4 (connections to surrounding development) via planning conditions and Section 106.

Recommendation 6: carry out further feasibility work to examine the significant potential presented by a City Centre district heating network in line with previous studies.

Recommendation 7: consider the opportunities to help support supply chains for both biomass and waste, utilising the potential of Council-owned land (e.g. for the storage and sorting of fuel and planting of biomass crops).

Recommendation 8: identify land ownership and Council interest in progressing wind-related development on the four sites identified.

Recommendation 9: identify a pilot scheme for a Council-led ESCO to promote both renewable/low-carbon energy and cheaper local energy supplies.

Recommendation 10: engage with existing authorities such as Woking and Birmingham City Council at both Officer and Member level to share experience.

Recommendation 11: establish monitoring to understand the installed capacity and annual energy supplied via operational renewable and low carbon energy schemes, using the information presented in section 2 of this study as the baseline.

Recommendation 12: engage with the developers of sites within the AAP areas as early as possible (linked to Recommendation 1 - dissemination of Study findings) to ensure that they are considering the need to plan for zero carbon homes from 2016, and non-residential schemes from 2019.

Recommendation 13: develop AAP policies which specifically require developers to demonstrate how their schemes can be future proofed to achieve zero carbon performance and which provide locally-specific guidance on appropriate technologies where possible.

Figure A – Increasing Wolverhampton's Renewable Energy Supply

Baseline: ~2% renewable energy supply (53 GWh/annum, 1 million tonnes CO_2) see section 3.2 in the main report

Energy mix 1

i. Wolverhampton Homes Retrofit

11.5 GWh per annum with a 50:50 split between solar PV and solar thermal

CO_2 savings of 3,800 tonnes per annum

See Box 5, section 4.3 in main report

Ii. Private housing solar thermal retrofit

5 GWh_{th} per annum (5,000 homes)

CO_2 savings: 1,025 tonnes per annum

See Box 5, section 4.3 in main report

Iii. Wind Turbines:

1.2 GWh_e per annum

CO_2 savings: 650 tonnes per annum

See section 4.4 (wind) in the main report

iv. Area Action Plans Solar PV

13 GWh_e per annum

CO_2 savings: 3,600 tonnes per annum

See section 7.2 in the main report

iv. Area Action Plans Solar Thermal

8 GWh_{th} per annum

CO_2 savings: 1,700 tonnes per annum

See section 7.2 in the main report

Circa. 3%

Additional 41 GWh per annum, taking total supply to 92 GWh per annum

Total CO_2 savings of 1.1M tonnes per annum

Energy mix 2

vi. Investment in City Centre Heating Network (Core Network)

50 GWh_{th} per annum

CO_2 savings 4,700 tonnes per annum

See section 4.5 in the main report

vii. Everything included as part of Energy Mix 1

41 GWh per annum

CO_2 savings 1.1M tonnes per annum

See Energy mix 1

Circa. 5%

Additional 111 GWh per annum, taking total supply to 164 GWh per annum

Total CO_2 savings of 1.1M tonnes per annum

Energy mix 3

viii. Biomass crops grown on previously developed land

20 GWh_e per annum

CO_2 savings 11,000 tonnes per annum

See section 4.4 (biomass) in the main report

ix. Additional energy from waste plant (e.g. 30MW_e scheme)

100 GWh_e per annum (indicative)

CO_2 savings 54,000 tonnes per annum

Circa. 12%

Additional 211 GWh per annum, taking total supply to 264 GWh per annum

CO_2 savings of 1.2M tonnes per annum

Energy mix 4

x. Theoretical maximum from waste resource

545 GWh per annum

CO_2 savings 172,000 tonnes per annum

See section 4.4 (energy from waste) in the main report

Circa. 20%

Additional 586 GWh per annum, taking total supply to 639 GWh per annum

Total CO_2 savings of 1.3M tonnes per annum

Note: The aim of this figure is simply to demonstrate the order of magnitude with respect to the potential from different technologies. The figures presented are indicative and should not be seen as a ceiling for what could be achieved. Different mixes of technologies may also be appropriate.

Contents

PART 1: INTRODUCTION AND CONTEXT

1. Introduction

1.1 Purpose and scope

AMEC Environment and Infrastructure UK Ltd (AMEC) was appointed by Wolverhampton City Council (the City Council) in August 2011 to assess the opportunities for renewable and low carbon energy generation across Wolverhampton, building on the findings of the Renewable Energy Capacity Study for the West Midlands[1]. Covering all land within the administrative boundaries of the City Council, this desk-based study will inform the City Council's strategy for renewable and low carbon energy, support the implementation of the Black Country Core Strategy and provide the context for the energy-related proposals of the emerging City Centre, Bilston Corridor and Stafford Road Corridor Area Action Plans (AAP).

The Study has been written for the City Council but is intended for a wider audience, including businesses, developers and local community groups. These different actors will all have an important role to play in the delivery of renewable and low carbon energy in Wolverhampton. Informed by the findings of the Study, a key priority for the Council should be to disseminate the findings and promote the benefits presented by renewable and low carbon energy. It is expected that the Study will lead to a range of local initiatives and pilot projects to help the City Council exploit the social, economic and environmental opportunities associated with a low carbon Wolverhampton.

This Study has been written at a time of significant national economic uncertainty and organisational and policy change via the Localism Bill[2] and the planning system through the National Planning Policy Framework (NPPF)[3]. However, this changing context should be seen as an *opportunity* for the City and the Study demonstrates how attention paid to local renewable and low carbon energy generation can help to deliver local economic benefits, including jobs and inward investment and cheaper and more secure energy supplies. Greater autonomy from national government in terms of planning and finance could give the City Council the flexibility it needs to move towards the delivery of a low carbon Wolverhampton.

In considering the findings of this Study it is also crucial to note that Government policy regarding renewable energy and climate change is continually evolving. Updates to the Study's key conclusions and recommendations may need to be made to reflect this. For example, emerging policy and legislation which will need to be taken into account once enacted includes: revisions to the Feed-in-Tariff (current consultation on reducing the rate which is

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[1] Renewable Energy Capacity Study for the West Midlands, produced by SQW, CO_2 Sense and Maslan Environmental for West Midlands authorities, March 2011.

[2] See Localism Bill, Department for Communities and Local Government, December 2010.

[3] See draft National Planning Policy Framework (NPPF), Department for Communities and Local Government, July 2011.

payable for solar PV[4]), recent introduction of the Renewable Heat Incentive (RHI)[5], implementation of the Green Deal (under consultation[6]) and finalised definitions of 'zero carbon' development for both residential and non-residential development (including approach to 'allowable solutions').

1.2 Report structure

The report is structured in four parts.

- **Part 1** sets the context for the Study, setting out why renewable and low carbon energy generation is important for Wolverhampton (section 2) and what has been achieved to date in terms of delivery of renewable and low carbon energy schemes (section 3).
- **Part 2** explores the opportunities to increase the take-up of renewable and low carbon energy projects in Wolverhampton, with an appraisal of the feasibility and viability of different technologies (section 4) and an appraisal of factors affecting delivery (section 5).
- **Part 3** identifies how low and zero carbon developments can be delivered alongside planned growth in the Black Country Core Strategy. The need to plan for 'zero carbon' developments is set out (section 6), the suitability of different technologies considered for each AAP (section 7) and conclusions are made regarding the role for planning (section 8).
- **Part 4** presents overall conclusions and recommendations arising from the study (section 9) and an accompanying action plan for delivery (section 10).

1.3 Overarching context for the Study

Local and national commitments

The City Council has made a number of commitments in response to climate change, including the Wolverhampton Declaration on Climate Change and their Climate Change Strategy and Action Plan 2009-2012. The City Council is also a signatory to the Nottingham Declaration on Climate Change[7] and 10:10 initiative[8]. Alongside other

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[4] http://www.decc.gov.uk/en/content/cms/consultations/fits_comp_rev1/fits_comp_rev1.aspx (last accessed December 2011).

5 http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/incentive/incentive.aspx (last accessed December 2011).

6 http://www.decc.gov.uk/en/content/cms/consultations/green_deal/green_deal.aspx (last accessed December 2011).

7 http://www.energysavingtrust.org.uk/nottingham (last accessed September 2011).

8 http://www.1010global.org/uk (last accessed September 2011).

measures - such as sustainable transport - the development of renewable and low carbon energy schemes in the City will have a fundamental role to play as part of the Council's overall response to these commitments.

In parallel, the City Council needs to consider how it can contribute towards national priorities and targets for renewable energy, delivery of a low carbon economy and reducing CO_2 emissions in response to climate change. These priorities are summarised in the Government's 2011 Carbon Plan[9]:

- Restructuring the UK's energy supply, moving away from fossil fuels and towards low carbon alternatives. In parallel to the Carbon Plan the Government has published the National Renewable Energy Roadmap (July 2011). The 2009 Renewable Energy Directive sets a target for the UK to achieve "*15% of its energy consumption from renewable sources by 2020*". This compares to a baseline of 3% in 2009.

- Working towards a more efficient use of energy within homes and businesses, including better insulation and the use of micro-generation such as solar technologies. National initiatives such as the Green Deal (see Glossary) are intended to support this together with the national Micro-generation Strategy[10].

- The UK Government has made a number of commitments to reduce greenhouse gas emissions (particularly CO_2) in order to mitigate future climate change. Under the Climate Change Act 2008 the Government is required to cut emissions by at least 34% by 2020 and 80% by 2050 below the 1990 baseline.

The City Council's role as local planning authority

As the local planning authority the City Council will have a significant role to play in promoting the installation of renewable and low carbon energy schemes. Through planning policy (e.g. the AAPs), requirements can be set for new developments to connect to locally supplied renewable energy and achieve particular levels of sustainability (e.g. Code for Sustainable Homes or BREEAM standards - see Glossary). The 2007 Climate Change PPS[11] allows for local planning authorities to set these targets and standards where supported by robust evidence. Via the development control process the Council is in a position to reject proposals which do not achieve policy standards. The development control process will also be influential where decisions are made on specific proposals for renewable and low carbon energy schemes, such as new biomass plants or wind turbines, within the context of national policies including PPS22: *Renewable Energy*[12].

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[9] Department for Energy and Climate Change, March 2011.

[10] Department for Energy and Climate Change, June 2011.

[11] Planning Policy Statement: Planning and Climate Change, Supplement to Planning Policy Statement 1, DCLG, December 2007.

[12] Planning Policy Statement 22: Renewable Energy, ODPM, August 2004.

Adopted local planning policy for the development of renewables in Wolverhampton is centred on the Black Country Core Strategy and the policy areas of economy, environment and waste. Together these create a framework for the analysis of how renewable energy might simultaneously contribute to delivering the aspirations sought for Wolverhampton and the Black Country more widely (see Box 1). New planning policy documents adopted in the City - i.e. AAPs and Neighbourhood Plans - will need to accord with the Core Strategy, but can extent and modify policy where appropriate and justified.

Box 1 Key Policies in the Black Country Core Strategy

The Economy, Employment and Centres

Policy EMP1 envisages a significant increase in the number of jobs and provision of associated employment land, as part of the ongoing restructuring of the Black Country economy. Amongst the priority market sectors identified are green industries, including environmental technologies, waste management and research.

Environmental Infrastructure

Policy ENV7 Renewable Energy is the focus for the transforming the City's energy economy onto a more sustainable basis. This '10% policy' provides for the new approach to development that will directly contribute to City, Regional and National carbon emission targets and by default renewable energy generation targets. The policy is a reference point for new development, pragmatically caveated with tests on deliverability, viability and direct contribution to the Core Strategy, with all development proposals to be treated on their merits.

Waste

Securing 'equivalent self-sufficiency' in waste management across the Black Country drives the approach and targets established in **policies WM1-5**. With regard to the potential contribution of waste to renewable energy, Policy WM4 Locational Considerations for New Waste Management Facilities is of particular importance, identifying employment land as suitable for EfW and Biomass/CHP schemes. This study makes a direct contribution to understanding how this might be realised in practice.

Given the importance of land use planning to the delivery of renewable and low carbon energy in Wolverhampton it is afforded significant attention in this Study, particularly in terms of informing policies for the AAPs (City Centre, Stafford Road Corridor and Bilston Corridor) and the role for Neighbourhood Plans (plans being prepared for Tettenhall and Heathfield Park). The links are also made with the development control process with respect to the treatment of planning applications for renewable and low carbon energy schemes.

2. Why is Renewable and Low Carbon Energy Important for Wolverhampton?

2.1 Overview

Renewable and low carbon energy is considered important to Wolverhampton for the following reasons:

- Economic growth: exploiting opportunities for inward investment and new jobs in a low carbon economy.
- Community benefits: helping to reduce energy bills, addressing fuel poverty and providing greater energy security.
- Climate change mitigation: delivering the City Council's local commitments and helping to meet national targets.

These three reasons should be used by the City Council to 'sell' the importance and potential of renewable and low carbon energy - and more widely aspirations for a low carbon economy - to public sector partners, businesses, developers and local communities. In establishing the framework for a low carbon economy AMEC identifies the role that this Study can play and the wider links to national and other local initiatives (see Figure 2.1).

Figure 2.2 summarises the key messages from this section of the report, identifying the wider links that can be made between realising these benefits with national and local policy.

Figure 2.1 Developing a low carbon economy: commitments and opportunities by sector

Wolverhampton City Council's Corporate Commitments, including Wolverhampton Declaration on Climate Change				
	Energy Supply	**Built environment**	**Economy and communities**	**Transport**
Opportunities assessed within AMEC's Study	Identifying priority projects for renewable and low carbon energy schemes, across a range of technologies, including: - wind turbines - heat pumps - solar thermal and solar PV - combined heat and power (CHP) networks supplied with biomass or waste - Anaerobic digestion (AD) - Hydro electric schemes - Energy from Waste (EfW)	Retrofitting micro-generation to existing & new development Connecting locally generated renewable and low carbon energy schemes to existing and proposed development Assisting with implementation of Policy ENV7 Planning policy and targets for the three AAPs Potential for 'Wolverhampton Carbon Reduction Fund'	Priority projects/opportunities for investment in renewable and low carbon energy schemes and infrastructure Identifying the economic benefits associated with renewable energy schemes (no. jobs, inward investment etc) Providing a return on capital investment in schemes, drawing on Government incentives (e.g. FiT, RHI and ROCs) Community-led schemes	Infrastructure for electric/hybrid vehicles (linked to 'Plugged-in-Places') Renewable energy schemes directly connected to vehicle charging points Renewable resource used for fuel (e.g. biogas)
Wider links, including national & local initiatives	Renewable Energy Roadmap (2011) 2009 Renewable Energy Directive (15% of the UK's energy consumption from renewable sources by 2020) Black Country Core Strategy	Green Deal Revisions to Building Regulations, including timetable for zero carbon development (homes from 2016) Affordable Warmth Strategy Action Plan 10:10 Commitment Carbon Management Plan Energy & Water Management Plan Black Country Core Strategy	Green Investment Bank Neighbourhood Planning & Localism Black Country Core Strategy	Black Country Core Strategy (spatial planning: balance between homes, jobs and sustainable travel) Local Transport Plan Climate Change Strategy & Action Plan

2.2 Economic growth

Helping to recover from the recession

Whilst the UK is technically out of recession is clear that the country is continuing to face uncertain economic times. Wolverhampton's Economic Development Strategy[13], written during the recession, identified the challenges facing the City:

> *"Wolverhampton faces a storm of deep seated problems compounded by the impacts of the recession. The percentage of working age people employed in Wolverhampton with no qualifications increased between 2003 and 2007. In 2007 the figure stood at just below 25%. This single stark statistic neatly summarises the challenges facing the communities of the City.* ***The current recession is biting deep into Wolverhampton; unemployment is increasing, businesses are contracting, and opportunities for expanding the wealth generating sector seem to be thin on the ground. Action is required.****"* (Emphasis added)

[13] The Wolverhampton Economic Development Strategy (2009-2026): A Road-Map, GHK Consulting Ltd, April 2009.

Both the public and private sector in Wolverhampton are focussing on opportunities to support local economic growth, inward investment and new jobs, and renewable and low carbon energy generation is seen by the City Council as a fundamental part of this. This also reflects the priorities in the Black Country Core Strategy and West Midlands Regional Economic Strategy[14]:

- Black Country Core Strategy Policy EMP1 identifies green industries, including environmental technologies, waste management and research as a priority market sector.
- Connecting to Success - the West Midlands Regional Economic Strategy - emphasises the importance of using the region's strengths in engineering, science and technology to deliver low carbon solutions to national and international markets: "*For Business this means fully capturing the opportunities for both existing industries and new enterprise to ensure the West Midlands region secures a reputation for profitable low carbon enterprise. For People this means up-skilling to secure the benefits from new employment opportunities emerging from a low carbon economy, along with behavioural change, to enhance quality of life…*"

Nationally, renewable energy is seen as a significant growth market which will have an ever increasing role to play: "*Renewable energy already employs more than a quarter of a million people; by 2020, it could be over half a million. The creation of jobs in the renewable energy sector, investment in new manufacturing capability, and the consequent direct and indirect benefits will support our transition to a green economy.*" (UK Renewable Energy Roadmap[15]).

Adapting Wolverhampton's economic base

A recent review[16] of the low carbon economy in Wolverhampton examined its sectoral structure, its relative strengths and the specific manufacturing and employment opportunities associated with this character. The report identified that absence of low-carbon infrastructure could constrain the transition to a low carbon economy and a potential local authority action to "*support development of low carbon infrastructure via long term development plan for Local Authority including key infrastructure e.g. waste, transport, energy*" (page 20). The Report is an important reference point for identifying how the general profile and specific clusters of activity might best take advantage of low carbon opportunities such as localised energy supplies, energy infrastructure and building technologies.

One of the key priorities will also to be to ensure that the necessary skills are in place. DEFRA's Skills for Low Carbon and Resource Efficient Economy[17] sets out the 'green skills' that are likely to be required in a low carbon economy (note that these skills are not solely for renewable and low carbon energy):

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[14] Regional Economic Strategy for the West Midlands: Connecting to Success, Advantage West Midlands, 2007.

[15] http://www.decc.gov.uk/en/content/cms/meeting_energy/renewable_ener/re_roadmap/re_roadmap.aspx (last accessed December 2012).

[16]Opportunities in the Low Carbon Economy: Wolverhampton, Wolverhampton City Council, May 2010.

[17] Skills for a Low Carbon and Resource Efficient Economy, Pro Enviro for DEFRA.

- Design skills: eco-design, green manufacturing, materials specification, lifecycle assessment.
- Waste skills: quantification and monitoring, process studies, management systems and minimisation technologies.
- Energy skills: energy minimisation, management systems, monitoring, costs and trading, renewable energy technologies, non-renewable energy technologies.
- Building skills: building energy management, integration of renewable energy, energy efficient construction, facilities management, calculating building energy, efficiency and carbon ratings.
- Transport skills: transport impact minimisation.
- Materials: sourcing, procurement and selection.
- Financial skills: investment models and new financial models.
- Management skills: impact assessments, business planning and risk management.
- Policy and planning skills: masterplanning, strategy development and implementation.

With respect to transport, the potential for electric and hybrid vehicles and supporting infrastructure is considered in Appendix C to this Study. Fundamentally, it is concluded that in the short-medium term (next 10-15 years) the opportunities will be limited in Wolverhampton until costs reduce and economies of scale and technology exert an influence. However, there may be opportunities to link to a wider project associated with the Black Country and Birmingham.

Creating jobs in renewable and low carbon energy

Investment in renewable and low carbon technologies will also have an important contribution to economic growth; developing jobs in renewable and low carbon energy through the manufacturing of components, construction and operation of schemes and supporting the wider supply chain (see Box 2 for an example of job opportunities associated with renewable and low carbon energy projects). Ensuring that the necessary skills are also in place will also be important (see previous section).

Box 2	Creating jobs in renewable and low carbon energy

Waste related schemes

Planned and potential schemes in Wolverhampton (see section 3 and Figure 3.1) such as the gasification plant at Purbrook Road and Greenpower.54 will create jobs. It is estimated that the Purbrook Road scheme will create circa 20 jobs[18] alongside a £5M investment in the site (benefits from European funding) and the Greenpower.54 scheme with up to 40 people involved in plant operation and a further 30 in the fuel preparation/sorting process[19]. Jobs will also be created during construction of such schemes.

The Government has published a report specifically into waste-related energy projects. In relation to Anaerobic Digestion (AD) this suggests that a 5,000 tonne per annum plant (occupying around 0.15ha) could employ up to 3 people (site manager plus 2 others) and a centralised 40,000 tonne per annum plant (occupying 0.6ha) up to 5 people (site manager, foreman, plus 3 others)[20].

Biomass

Biomass plants will create jobs not only in construction and operation of the facility, but also in the wider supply chain for growing, collecting/harvesting and transporting the fuel. Where biomass can be sourced locally this will have benefits for Wolverhampton's economy.

Micro-generation

There will be jobs associated with the installation and maintenance of micro-generation schemes (e.g. solar PV), with some potential in terms of the manufacturing of components.

Wind

The European Wind Energy Association (EWEA) reports that across the EU circa 15 jobs are created per MW installed capacity[21].

Supporting new renewable and low carbon energy projects and realising the benefits

Supporting the development of new renewable and low carbon energy projects will also be important for the City Council given the jobs and investment that these can bring (e.g. see Box 2). In addition the Council can make use of planning conditions and Section 106 Agreements to deliver wider economic, social and environmental benefits. With respect to jobs, this is something that the Council is already leading on through the implementation of Black Country Core Strategy Policy EMP5 Improving Access to the Labour Market: *"Planning obligations will be negotiated with the developers and occupiers of major new job creating development to secure initiatives and/or contributions towards the recruitment and training of local people. The training schemes should offer help particularly to disadvantaged groups, so that they may obtain the necessary skills to increase their access to job opportunities."* For a proposed energy project at Purbrook Road (see section 3 for details) this is being dealt with via condition, requiring the developer to ensure targeted recruitment and training. Policy EMP5 could therefore have a key role to play in realising the economic benefits from new renewable energy projects in Wolverhampton.

[18] See Planning Committee Report - 28 June 2011, Wolverhampton City Council (application ref: 11/00530/FUL).

[19] Greenpower.54, Wolverhampton, Renewable Energy Generating Plan, EIA Scoping Report, SKM Enviros Ltd on behalf of Express Power Limited, September 2011.

[20] Planning for Waste Management Facilities, A Research Project, Office for the Deputy Prime Minister, 2004.

[21] http://www.ewea.org/index.php?id=1638 (last accessed December 2012).

Providing an attractive location for businesses

The ability to provide a more secure supply of local energy which is more resilient to national increases in energy bills is considered an important opportunity, and something that could be attractive to businesses wishing to locate and invest in Wolverhampton. In addition, the ability to connect to a source of renewable and low carbon energy will also be important in terms of particular businesses delivering on the Carbon Reduction Commitment Energy Efficiency Scheme or any corporate commitments that they have (e.g. Corporate Social Responsibility [CSR]). The availability of renewable and low carbon energy could therefore form a key part of Wolverhampton's competitiveness as a location for investment.

2.3 Community benefits

AMEC has estimated that households and businesses in Wolverhampton spend circa £160M per year on energy. The average household is spending over £1,000 per annum on heating and power, with this expected to increase as energy companies increase prices further[22]. Rising prices are likely to be an increasing concern for households and businesses. For the most vulnerable and poorer members of society there is the risk of 'fuel poverty'. "*The latest projections suggest that* ***there were around 4.6 million fuel poor households in England in 2009***"[23].

Locally provided energy from renewable and low carbon energy can have an important role to play in reducing bills and providing resilience to future national price increases, particularly public sector led schemes such as a community based Energy Services Company (ESCO) where profit is not the sole driver. The role for ESCOs in delivering community based energy schemes is something that is explored in section 5 of this Study.

Linked to fuel poverty is 'energy security' given the global depletion of fossil fuels. It makes sense for Wolverhampton to consider how its energy security can be enhanced in the longer term. The UK Renewable Energy Roadmap notes that "*Getting more renewable energy across the UK can give us much more security and a greater degree of energy independence - helping to shield us from global fossil fuel price fluctuation.*"

It should of course be recognised that renewable and low carbon energy is just one part of the overall response to fuel poverty. This will need to be complemented by national and local measures for energy efficiency, reducing the amount of energy that households and businesses waste. The City Council's Affordable Warmth Strategy Action Plan and national schemes including the Community Energy Saving Programme (CESP)[24] and Green Deal[25] will all have a key role to play here.

[22] Taking the energy demand associated with homes and businesses in Wolverhampton (Appendix A) and multiplying this by the average price of electricity and gas based on DECC Quarterly Energy Prices (September 2011). The following assumptions have been taken from the DECC figures: Electricity, 12p per kWh residential and 7.5p per kWh commercial & industrial. Gas, 3.6p per kW residential and 2p per kW commercial & industrial.

[23] Annual Energy Statement, Department for Energy and Climate Change, 2010.

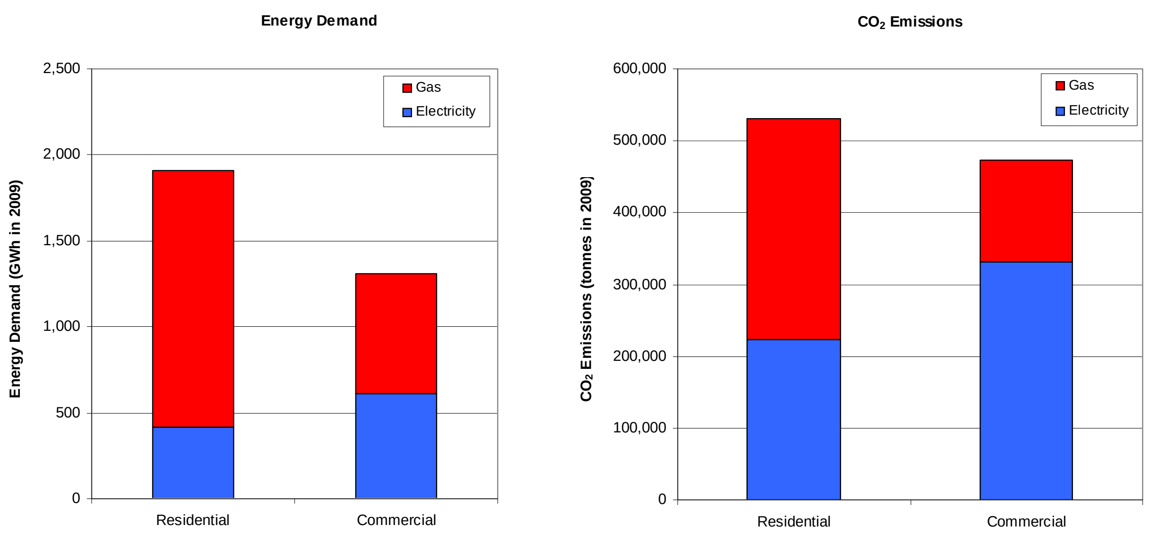
[24] http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/cesp/Pages/cesp.aspx (last accessed October 2011).

2.4 Climate change

The Government has identified climate changes as "***one of the greatest threats** to both UK and global security and prosperity*".[26] (Carbon Plan, 2011, emphasis added). The City Council has also recognised the importance of responding: "*Climate change is the single greatest challenge that we are faced with today and Wolverhampton City Council acknowledges the importance of taking action on climate change now in order to reduce harmful CO_2 emissions and to ensure that the city is well equipped to cope with inevitable climate change in years to come.*"[27] The City Council's commitments are also formalised in the Wolverhampton Declaration on Climate Change.

DECC figures show that the City's households and business require over 3,200GWh energy per annum, equivalent to 1 million tonnes of CO_2[28] Figure 2.3 illustrates the breakdown.

Figure 2.3 Energy demand and CO_2 emissions (2009 base)



2008/09 Energy Demand (GWh/annum)		CO_2 emissions per annum (tonnes/annum)
Heat	2,189	448,745
Electricity	1,029	554,631
Total energy demand (2008/09)	3,218	1,003,376

Source: AMEC, based on DECC 2009 Figures

[25] http://www.decc.gov.uk/en/content/cms/tackling/green_deal/green_deal.aspx (last accessed October 2011).

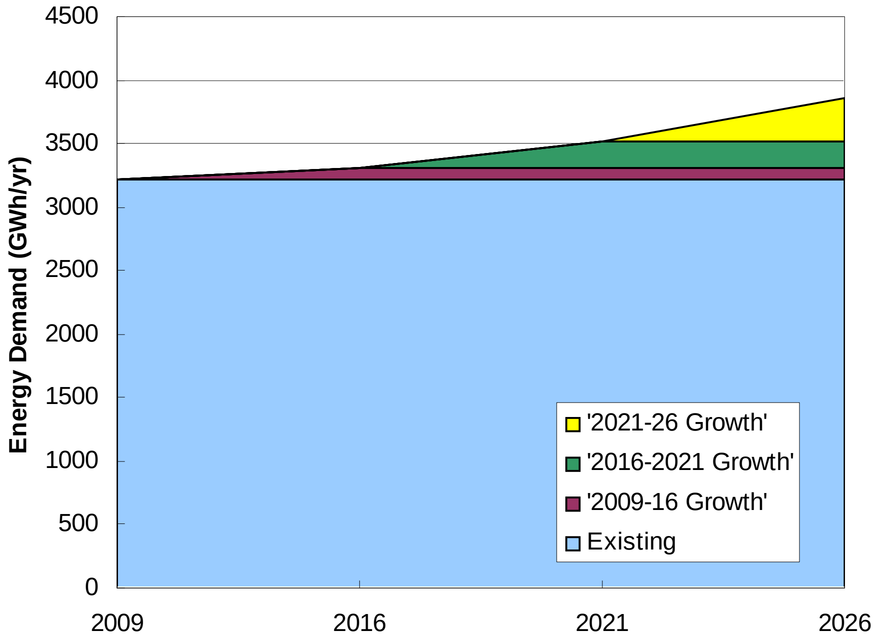
[26] Page 5, Carbon Plan, HM Government, 2011.

[27] Wolverhampton Climate Change Strategy and Action Plan 2009-2012, Wolverhampton City Council, 2009.

[28] Sub-national sales figures, Department for Energy and Climate Change, 2009 (the latest figures that are available).

In addition, new growth and development through to 2026 planned in the Black Country Core Strategy (circa 12,000 dwellings and new employment) will have an impact on total energy demand and CO_2 emissions. However, as Figure 2.4 shows this new development will not have a significant impact on the City's overall energy demands.

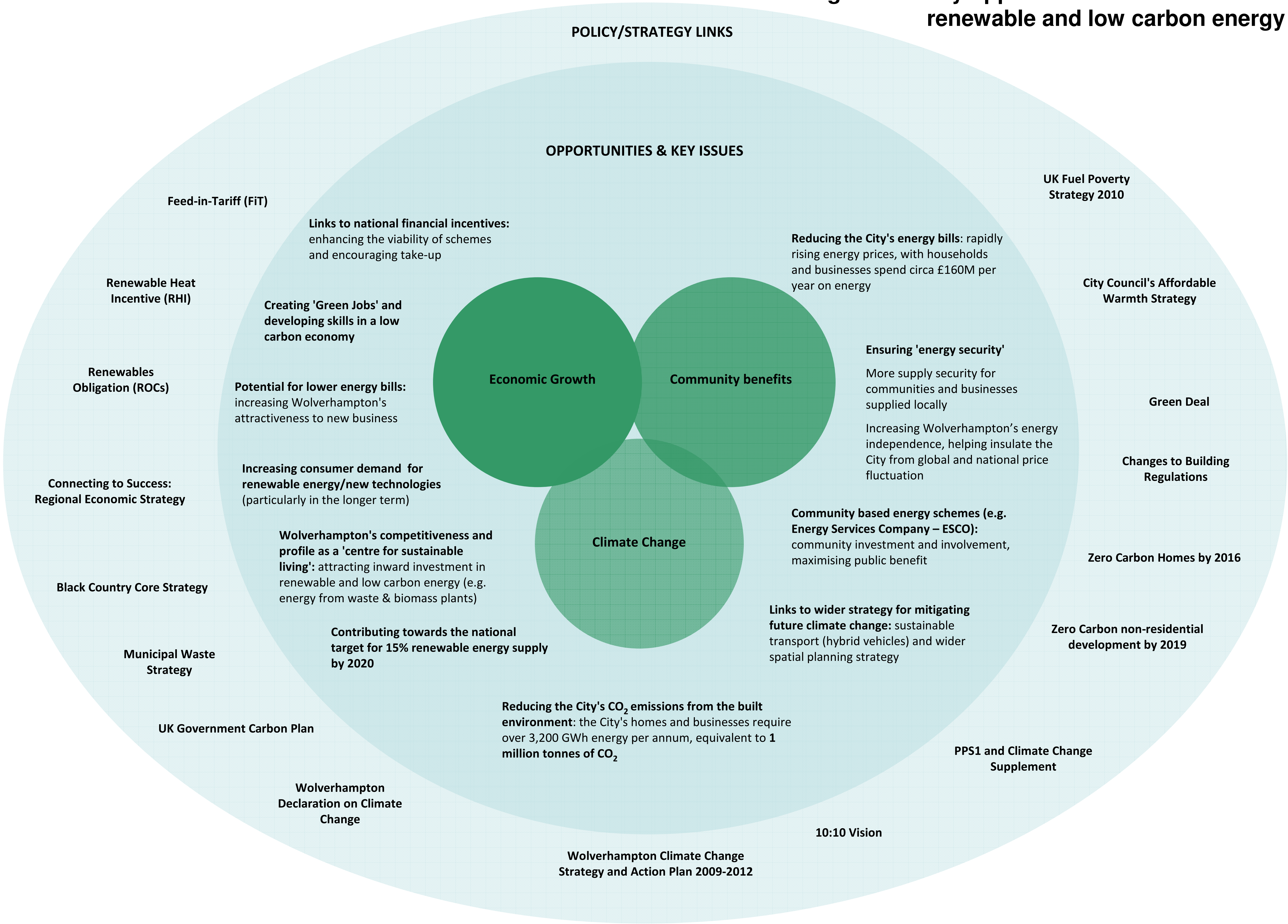
Figure 2.4 Energy demand associated with Core Strategy growth through to 2026



Source: AMEC

The City Council needs to look at the opportunities to reduce these emissions, with renewable and low carbon technologies having a significant role to play alongside energy efficiency. What the figures do show, particularly Figure 2.4, is that is that a significant focus for the Council's attention should be the *existing* built environment, i.e. the 1M tonnes CO_2 per annum associated with the City's current energy demand. The opportunities to respond will be through connecting new renewable energy schemes to existing households and businesses, via planning policy measures (explored in section 6) and national schemes energy savings schemes such as the Green Deal and CESP (see Glossary).

Figure 2.2: key opportunities associated with renewable and low carbon energy



3. Wolverhampton's Renewable and Low Carbon Energy Supply

3.1 Introduction

The City Council, private sector and others have already made progress in bringing forward renewable and low carbon energy schemes in Wolverhampton. The aim of this section is to identify key projects as context to help inform the assessment of further opportunities in Part 2 of this Study.

3.2 Current renewable and low carbon energy supply

Figure 3.1 provides an overview of existing and planned renewable and low carbon energy projects in Wolverhampton. This includes stand-alone schemes which are predominantly commercial operations with energy exported to the grid and schemes supplying specific buildings or developments. Particular schemes of note include:

- The City Council's existing Energy from Waste Plant at Crown Street (8MW_e installed capacity, supplying circa 56GWh_e per year. 28GWh_e of this considered renewable[29]).
- A planned gasification plant at Purbrook Road. Consent was granted for this scheme June 2011[30] (4-5MW_e installed capacity, potentially supplying circa 40GWh_e per year. 20GWh_e considered renewable).
- Wolverhampton Homes' scheme at All Saints (12 dwellings), which piloted a mix of micro-generation technologies (solar thermal, micro-CHP and air source heat pumps for example). The scheme was funded via the New Deal for Communities and the City Council's Decent Homes budget.
- Planned solar PV schemes, including the City Council's proposals for the Civic Centre where the tender process is now complete and Kia have been awarded the contract. Start on-site is imminent (49kW installation, which could supply circa 35,000kWh_e per annum).
- Dwellings across the City having installed solar thermal panels following receipt of solar thermal grant (22 locations, assuming each installation could supply 1,000kWh_{th} per annum then this could total 0.22GWh per annum).
- Biomass heating scheme planned at Heath Town to supply 1,123 properties (1MW boiler, which could supply circa 5GWh_{th} per annum once operational).

[29] Rule of thumb of 50% of total waste stream being renewable resource (i.e. wood, biomass etc.).

[30] Planning application reference: 11/00530/FUL.

- Small-scale biomass schemes alongside housing developments (e.g. Cross Street South, 30 dwellings with solar thermal technology) and schools (St. Luke's Primary School, incorporating a biomass boiler), for example.

Together, existing and planned renewable energy schemes - within Wolverhampton's administrative boundary - make a contribution of approximately 2% to the City's current energy demands, as set out in Table 3.1.

Table 3.1 Current contribution from renewable energy to the City's energy supply (existing and consented schemes)

	Baseline GWh/year (indicative)	CO_2 savings (tonnes per annum)	Assumptions
MICRO-GENERATION			
Civic Centre Solar PV (under construction)	0.04	19	Assuming 49kw solar PV installation, producing 35,000kWh per annum based on typical 700kWh/kWp/y
Solar thermal grant locations (22)	0.22	45	Assumes each installation could supply 1,000kWh per annum
Residential schemes	<0.1	<20	Unity, Lunt, Blakenhall Gardens etc (no exact figures on what is supplied over the course of year from these schemes)
COMMERCIAL SCALE			
Energy from waste			
City Centre existing EfW	28	15,092	Existing City Centre EfW. 28GWh$_e$ per year considered renewable out of total output of 56GWh$_e$ per year
Purbrook Road (Energy & Resource Recovery Ltd)	20	10,780	4-5MW electrical output. Assuming 8,000 hours per year operation = 40 GWh per year total with 50% renewable is equivalent to 20 GWh
Biomass heating/CHP			
St Lukes Primary School	<0.1	<20	
Cross Street South	<0.1	<20	
Heath Town Boiler House	5	1,025	Indicative estimate to demonstrate order of magnitude. 1MW boiler operating at full output for 5,000 hours per year, 100% renewable (once operational)
Total energy supply	53		
Energy Requirement (GWh/annum)	3,218		
Contribution	2%		
	CO_2 savings (tonnes per annum)	26,961	

2008/09 Energy Demand (GWh/annum)		CO_2 emissions per annum (tonnes/annum)
Heat	2,189	448,745
Electricity	1,029	554,631
Total energy demand (2008/09)	3,218	1,003,376

Source: AMEC

Please note that the figures provided in Table 3.1 are indicative and should be used simply to understand the relative contribution from different renewable energy sources. It is not intended to be a comprehensive audit of existing installed renewable energy capacity within the City. There may be small renewable energy schemes which are not included (e.g. domestic scale PV or wind installations), however they would be unlikely to have a significant impact on the *overall* figures.

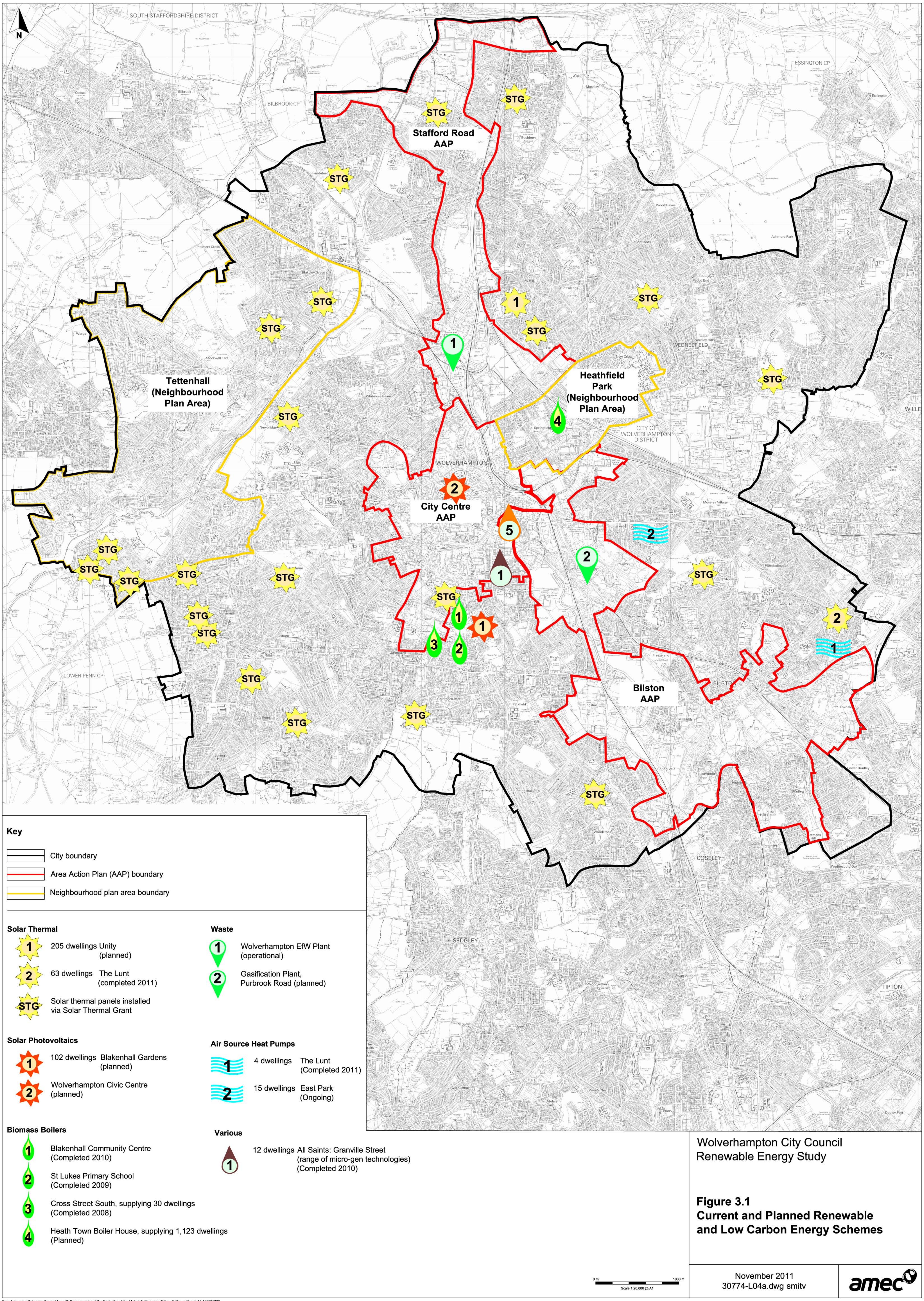
In addition to existing and consented schemes, it is important to highlight other schemes at pre-planning application stage, such as proposals for a 30MW_e energy from waste facility to the north of the City close to i54 ('Greenpower.54'[31]).

3.3 Increasing Wolverhampton's renewable energy supply

One of the fundamental aims of this Study is to understand how the proportion of the City's renewable energy supply - which currently stands at a baseline of circa 2% (circa 53GWh per annum, see Table 3.1) - can be increased. If the Council wanted to deliver a proportion of say 10% renewable energy supply then this would equate to provision of 322GWh per annum, an additional 269GWh per annum to the baseline position. To achieve 15% supply, commensurate with what the Government is trying to achieve nationally[32], would equate to an increase to 483GWh per annum (an additional 430GWh per annum on top of the baseline). The ability to increase the supply from renewable energy schemes is addressed in Part 2 of this Study, with the results summarised in Figure A which illustrates different potential energy mixes.

[31] http://www.express-energy.com/greenpower54-c14.html (last accessed October 2011).

[32] At a national level the Government is committed to delivering 15% renewable energy supply by 2020. Based on a projected energy demand of 1,557 Terawatt hours (TWh) at 2020, the Renewable Energy Roadmap[32] sets out how 234TWh can be delivered.



Wolverhampton City Council
Renewable Energy Study

Figure 3.1
Current and Planned Renewable and Low Carbon Energy Schemes

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PART 2: OPPORTUNITIES TO INCREASE THE TAKE-UP OF RENEWABLE AND LOW CARBON ENERGY

4. Assessment of Potential for Renewable and Low Carbon Energy Schemes

4.1 Introduction

This section provides an assessment of the potential for new renewable and low carbon energy projects in Wolverhampton. It builds on the findings of the Regional Study, the key findings from which are summarised in Box 3.

Box 3	Key findings from the West Midlands Renewable Energy Capacity Study

The West Midlands Study makes the following conclusions for Wolverhampton.

- Wolverhampton has a potential renewable energy capacity of **600MW**, which is around 1% of the total capacity identified for the West Midlands.
- 97% of this capacity is from micro-generation, with 3% from waste.
- The potential from wind and biomass is seen as limited given the nature of Wolverhampton as an urban area.
- With respect to waste, municipal solid waste is seen to provide the largest opportunity, as well as commercial and industrial waste.
- Hydropower potential is seen as limited.
- In terms of micro-generation, 68% of total capacity could come via air source heat pumps, 17% from ground source heat pumps, 7% from solar hot water heating and 8% from solar PV.
- The potential for CHP networks is identified given the City's heat demand (7% of the West Midlands total heat demand).
- In terms of grid capacity, it is noted that Wolverhampton has good access with planned extensions in the future.

This section is supported by a detailed technical appendix (Appendix B) which provides more detail on the methodology and assumptions underpinning AMEC's assessment.

4.2 Technologies considered

The following technologies are considered, based on the City Council's project brief:

Building integrated micro-generation

- Solar technologies, including solar thermal (heating and hot water) and solar PV (electricity).
- Heat pumps (ground source, air source and water source).
- Micro-wind.

Commercial-scale generation

- Wind turbines, focussing attention on the potential for smaller scale turbines given Wolverhampton's urban nature.
- Hydro electric schemes.
- Energy from waste, which will need to include an assessment of the available waste resource (commercial and industrial, construction/demolition and household waste).
- Biomass heating/CHP, including an assessment of the biomass supply chain (waste wood, coppicing, arboriculture, food and green waste). The potential for smaller scale biomass boilers is also considered in this section.
- Anaerobic Digestion (AD).
- Biogas, including an assessment of pyrolysis, gasification, methane from landfill and mine workings.
- Peak lopping (using small scale standby generators to meet peaks in demand on the electricity network). Not considered a renewable technology, but can provide a back-up to renewable energy schemes such as wind turbines for example.

Heating and power networks

- Considering the potential to link existing communities and businesses to existing commercial scale generation (e.g. Crown Street Energy from Waste Plant) or other facilities with potential.

4.3 Building integrated micro-generation

Overview

As demonstrated in Figure 3.1 there are a number of schemes where micro-generation, including solar PV and solar thermal systems, have been installed. Projects include Wolverhampton Homes' All Saints scheme, which piloted the use of a range of technologies, and homes which have installed solar thermal panels across the city.

The aim of this section is to consider the potential for micro-generation to be retrofitted to *existing* buildings and to be delivered alongside planned developments through to 2026. The opportunities are considered city-wide and in relation to the three AAP areas.

Solar PV

Economically, the availability of Feed-in-Tariffs (FiT) assists in making solar PV an attractive proposition. Whilst there have been changes to the FiT in response to the proliferation of large scale 'solar farms', the support still exists for smaller scale schemes retrofitted to existing homes and businesses. It is for these reasons that the City Council is already considering a solar PV scheme retrofit scheme for the Civic Centre, which is currently going through a procurement process.

AMEC has considered the potential for solar PV based on a review of the levels of roof space across the city (review of aerial mapping). The review has focussed on non-domestic buildings, specifically those within the AAP areas of the City Centre, Bilston Corridor and Stafford Road Corridor. The review has highlighted a number of specific buildings with potential, which are identified in section 7 of this Study. Together with other sites these could deliver in excess of 13,000MWh$_e$ per annum and abate almost 4,000 tonnes of CO_2.

There is also good potential to retrofit domestic properties, both social housing and private housing. In terms of supporting installation the Council's greatest role to play will be with the social housing stock, via Wolverhampton Homes, though there are barriers that will need to be overcome, particularly in relation to the City Council's approach to borrowing (see section 5). As an example, however, Birmingham City Council has rolled out a solar PV retrofit scheme on its existing social housing stock (Box 4).

Box 4 Solar installations in Birmingham properties

Proposal: to fit solar panels to 10,000 council owned properties in Birmingham. It is seen as the biggest proposal for retrofitting in the UK to date.

"*The plan - Birmingham Energy Savers - will be jointly funded by Birmingham council and investment from energy suppliers and commercial banks, and follows two successful pilot schemes conducted in Europe's biggest local authority. Paul Tilsley, deputy leader of Birmingham city council, said: "Birmingham Energy Savers offers a fantastic opportunity for residents and businesses to cut carbon pollution, and save themselves thousands of pounds by reducing future bills. This scheme will significantly improve the lives of people in Birmingham, setting a green standard beyond that of any city in the world."*

Under the scheme, the commercial banks will provide half the up-front investment, supplemented by £25M from the energy companies and £25M borrowed by the council. Consumers will pay a levy on their energy bills to repay the loans but Sandy Taylor, head of the city's climate change unit, said households would still be paying lower bills after the retrofit. The council, run by a Conservative-Liberal Democrat coalition, has been working on the idea of a Birmingham "green new deal" for the past year following the commitment made in 2006 to cut carbon emissions by 60% by 2026. With high levels of unemployment, councillors hope the project to improve the council's housing stock will also create and provide training and protect jobs, and support the growth of green industry in a city still heavily dependent on manufacturing.

The next phase of the programme will involve using the proceeds from the first 10,000 retrofits for a refinancing of the scheme that will deliver funding of £2bn, enough to refurbish 200,000 homes. Taylor said that the council would begin by targeting those households with the greatest social need, singling out people living in fuel poverty or who were particularly vulnerable. Eventually, he added, the plan was to upgrade all 420,000 homes in the city, which would mean moving on from publicly owned homes to those currently owner-occupied or in the private rented sector."

Guardian, 03 October 2010 - http://www.guardian.co.uk/environment/2010/oct/03/birmingham-solar-panel-council-proposal (last accessed October 2011)

Solar thermal

Solar thermal systems have similar siting requirements to those discussed in the case of solar PV. In addition, there needs to be a significant hot water demand at the site, which remains reasonably constant throughout the calendar year. Whilst this is typically the case for residential properties, it limits the impact of such systems in non-domestic premises. Swimming pools, hospitals and schools, as well as residential care homes typically provide suitable sources of hot water demand. As with solar PV there is also good potential to retrofit domestic properties with Figure 3.1 showing how popular it has been to date with installations across the city.

As with solar PV AMEC has considered the potential that exists within the AAP areas (specific buildings are identified in section 7). It is estimated that solar thermal could generate over 8,000MWh$_{th}$ per year and abate over 1,600 tonnes CO_2 per annum.

Heat pumps

Air source heat pumps will have potential in Wolverhampton, as noted in the Regional Study however it is important to note that they will not have a significant role to play in reducing CO_2 emissions. It is recommended that air source heat pumps are only considered for off-grid properties which are electrically heated.

Ground source heat pumps will have a much greater role to play in reducing emissions and it is estimated that these systems could produce circa 70,000MWh_{th} per annum and reduce the city's baseline by between 21,000-26,000 tonnes of CO_2 per annum (however it is important to note that there will be a demand of circa 20,000MWh_e per annum to drive the heat pumps).

Water source heat pumps could also be used, linked to the existing canal network for example. The opportunity to use the existing canal network to provide heating and cooling for buildings is something that has been previously highlighted to Wolverhampton City Council by British Waterways[33]. The feasibility and viability of using this resource would need to be considered at a project specific level, for example where new development is proposed adjacent to a canal. Depending on the scale of uptake this could have a helpful contribution towards the City's renewable and low carbon energy supply.

Micro-wind

Micro-wind (i.e. building mounted turbines) will not have significant potential in Wolverhampton, given that as an urban area the wind resource is generally poor at rooftop level with high levels of turbulence.

Opportunities for retrofitting existing housing in Wolverhampton

Box 5 sets out the opportunity to retrofit existing houses in Wolverhampton within both the public and private sector stock. The focus is on solar PV and solar thermal given that they are renewable technologies which could deliver the most in terms of emissions savings.

[33] http://www.britishwaterways.co.uk/media/documents/SustainableCoolingSolutionForCanalsideProperties.pdf (last accessed December 2011).

Box 5	Retrofitting Wolverhampton's existing housing stock (summary)

Wolverhampton Homes

Considering Wolverhampton Homes' total housing stock (23,705 dwellings) the potential to retrofit solar PV and solar thermal has been assessed. It is estimated that the total potential is as follows:

- $9GWh_e$ per annum solar PV; **or**
- $14GWh_{th}$ per annum solar thermal.

For the purposes of understanding the potential energy mix in Figure A we assume a 50:50 split between solar PV and solar thermal, so $4.5GWh_e$ from PV and $7GWh_{th}$ from solar thermal. In total this could offset circa 3,800 tonnes of CO_2 per annum.

Private sector stock

Based on a simple rule of thumb of a domestic scale solar thermal installation providing 1,000kWh per annum, the retrofit of 5,000 dwellings in Wolverhampton could supply $5GWh_{th}$ per annum and offset annual CO_2 emissions by circa 1,025 tonnes.

Source: AMEC

4.4 Commercial scale projects

Wind turbines

As an almost entirely urban area, Wolverhampton has limited potential for wind energy. There may be some potential for medium scale turbines (125kW rated with a hub height of up to 35m). Based on an initial constraints mapping exercise[34] four potential sites have been identified and are illustrated in Figure 4.1 (Bushbury Hill, Planetary Industrial Estate, Goldthorn Park and Land near Dunstall Park Racecourse). If just one of these sites came forward, a single 125kW rated turbine could produce in the region of $300MWh_e$ per annum. If a single turbine at each location was developed then this could deliver around $1.2GWh_e$ per annum, equivalent to demand from approximately 450 homes. This could offset up to 650 tonnes of CO_2 per annum.

It is important to note that AMEC is not recommending these sites as necessarily suitability for wind development, simply that based on an assessment of wind speeds and environmental constraints there is an accessible wind resource across four key sites which could be assessed further via detailed site screenings. Taking forward any proposals for wind development would require the detailed application of planning policy, development control, Environmental Impact Assessment (EIA) where applicable as well as engagement with key stakeholders (e.g. MOD and NATS En Route Radar Ltd) and local communities.

[34] Constraints considered include a noise buffer of 300m to residential properties, local nature reserves, Registered Parks and Gardens and Listed Buildings.

The small scale of the system may suit a community ownership model, whereby a nearby residential area has a share in the turbine(s). Local people would buy shares in the scheme and receive discounted energy bills and income where surplus energy is sold to the grid. There are examples of this type of project across the country[35].

Hydro

The potential for hydro electric schemes in the city is negligible. There are no major rivers in Wolverhampton, and though a number of small rivers and tributaries rise in the City (e.g. Watershead Brook, a tributary of the River Penk, and Smestow Brook, a tributary of the River Stour), these small watercourses are not considered likely to support a commercially viable hydropower scheme due to the low (and variable) flow rates.

Energy from waste

Energy from waste has definite potential to provide low carbon heat and electricity in Wolverhampton, as demonstrated by the level of interest in new projects (e.g. Purbrook Road gasification plant and Greenpower.54). Considering the different waste arisings by type it is estimated that there is sufficient material within the city to provide an annual electrical output of up to 360MWh and thermal output of up to 730GWh[36]. This equates to an installed electrical capacity of some 45MW, which could be met either by a single energy from waste plant or a number of smaller facilities. As a rule of thumb, 50% of this resource would be considered renewable (i.e. wood waste, biomass etc.) and so equate to 180,000MWh_e and 365,000MWh_{th}, equivalent to the offset of 172,000 tonnes of CO_2 per annum if fully exploited.

Energy from waste (including biomass from waste sources) therefore has a significant role to play in the energy mix of Wolverhampton for the following reasons:

- good availability of waste given high volume of arisings in a compact area, and good transport links within the City and beyond; and
- good opportunities to recover energy and provide low carbon heat and electricity to local homes and businesses to private wire/district heating networks.

However, although there are definite benefits there is a need to carefully consider impact of numerous EfW/ biomass plants on air quality and other planning and environmental measures. Although the emissions from modern combustion plant are very low, the cumulative impact in an urban area must be considered especially as the city falls within an Air Quality Management Area.

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35 For example: http://www.corecoop.net/index.php?option=com_content&task=view&id=32&Itemid=46 (last accessed October 2011).

36 See calculations at **Appendix B** Table B.7 p.12.

A further possibility for the Council is to make use of existing vacant and underused land, in appropriate locations, to help support the supply chain for waste (i.e. for the collection and sorting of waste to supply existing and planned EfW plants).

Biomass

Biomass differs from other sources of renewable energy in that it can be transported, stored and used at a wide variety of scales, giving significant advantages over variable sources such as solar and wind energy. However, there are also a number of potential barriers, such as the requirement for space and access for deliveries, air quality concerns in urban areas and increased complexity and maintenance requirements.

As covered in the energy from waste section there is a substantial source of waste wood in Wolverhampton. There are no substantial woodland areas, so arisings from forestry management activities can be considered negligible. There will be small, but not negligible, resource from arboriculture activities (e.g. tree surgery, parks and garden management), but this is often difficult to collect centrally and exploit as a fuel. Despite the limited resource within the City boundary, there are considerable arisings in the neighbouring rural areas of Staffordshire and Shropshire. Biomass can be reasonably transported for approximately 30 miles without incurring major additional costs or CO_2 emissions, and there are a number of existing suppliers within this distance[37]. One of the key suppliers of both wood pellets and chip, Midlands Wood Fuel Ltd, has a depot in nearby Pattingham.

Box 6 provides an example of an authority setting up its own biomass supply chain (Staffordshire County Council). This is something that the City Council could attempt to set up.

Box 6	**Biomass case study: Staffordshire County Council**
Staffordshire County Council has set up their own wood fuel company[38] which supplies fuel to numerous public and private buildings. There may be a similar opportunity for WCC to help establish the supply chain, giving confidence to developers considering installing biomass plant from both the point of view of fuel availability and a clear endorsement from the authority. Such a scheme would be limited by the available resource, with a likely focus on waste wood and/or arisings from arboriculture. A scheme to help the segregation, collection and processing of clean waste wood (i.e. material that will not require Waste Incineration Directive compliant boiler plant) could be particularly beneficial as it requires a coordinated approach working in partnership with numerous waste contractors. See http://www.staffordshire.gov.uk/environment/woodfuel/home.aspx (last accessed October 2011).	

The City Council has recently had discussions with E.ON regarding opportunities to grow crops on brownfield land to use as feedstock for an AD plant (specifically maize, but other crops may be suitable). The potential for the use of disused brownfield land to grow energy crops in the Wolverhampton city area was assessed by considering vacant brownfield land registered on the 2009 NLUD. Only areas of land greater than four hectares were considered as it was assumed that it would be economically impractical to cultivate the large number of small plots within the city area.

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[37] http://www.biomassenergycentre.org.uk/portal/page?_pageid=77,241242&_dad=portal&_schema=PORTAL (last accessed October 2011).

[38] http://www.staffordshire.gov.uk/environment/woodfuel/home.aspx (last accessed October 2011).

Information supplied by E.ON suggests that five hectares of energy crops would be enough to supply electricity for 200 average homes. The 120 hectares would therefore have the potential to meet the electrical demand of approximately 5,000 homes in the Wolverhampton area (equivalent to around 20GWh per year).

Anaerobic Digestion (AD)

Linked to both waste and biomass is the potential for the anaerobic digestion of food and green waste, farm waste and certain types of industrial effluent (especially associated with the production of food and drink). With respect to potential in Wolverhampton it is estimated that there is a resource of circa 60,000 tonnes per year of food and green waste from commercial and industrial sources that could be treated via AD, which would be sufficient to supply a plant with an electrical output of approximately 3MW. In practice it is difficult to collect this material so the true potential may be less than this but nevertheless represents a significant and underused resource.

Effluent from industrial processing is often rich in organic matter that is well suited to treatment via AD. This can give considerable long-term economic and environmental benefits of using a waste by-product to produce biogas to contribute to heating and/or powering the plant. Identifying and, where necessary, educating suitable industries of the potential to benefit from an AD plant may help to increase the uptake. Industries in Wolverhampton that may be suitable for AD include breweries (Marston's in particular) food and drink manufacturers and dairies. There is some limited potential to use farm waste, but as the City is predominantly urban it is not suggested that this be a focus since the contribution to energy supply from farm arisings would be very small even if fully exploited.

Peak lopping

Peak lopping refers to the practice of using small scale standby generators to meet transient peaks in demand on the electricity network (note that it can also refer to the shedding of load at peak times). The potential to contribute to Wolverhampton's electricity supply is small, and there is certainly little or no benefit in terms of CO_2 emissions due to the use of diesel or other fossil fuels, and even the use of biofuels would result in minimal benefits due to the very low proportion of the time such plant would operate.

Fuel cells

Exhaust emissions from fuel cell systems are much lower than those from 'conventionally' fuelled systems (virtually zero). However, all fuel cell systems require a suitable fuel input source of hydrogen which must be produced using energy from renewable sources if the fuel cell is to result in substantial CO_2 emissions reductions. Additionally fuel cells are an emerging technology and are currently expensive, requiring substantial subsidies to compete with conventional technologies. This is the case with all new technologies, but does therefore mean the focus in the short to medium term should be on increasing the supply of renewable energy (especially biogas) such that when fuel cells become more established and cost competitive, there is a potential source of low carbon hydrogen fuel. Fundamentally, without a source of renewable hydrogen, fuel cells will have minimal impact on CO_2 emissions reductions. They should be seen as a highly efficient technology with a potentially important role in the long term (especially in low carbon transport), but require an expansion to renewable energy to happen initially.

However despite the limited potential in the short to medium term, it would be worthwhile attracting fuel cell technology suppliers to be based in the City and encouraging the trialling of demonstration systems in Wolverhampton, as there is likely to be a substantial opportunity in future for the City to become a key hub of fuel cell development.

Considerable effort is presently being expended in developing commercial applications for fuel cells, which may well result in an expanding market for such products in the next 5-10 years.

Mine workings

Based on current available evidence mine gas is unlikely to have any potential in Wolverhampton, though there may be potential to use mine water for heating but this would require detailed site investigations to identify specific projects for further testing.

4.5 Opportunity for combined heat and power networks

AMEC has identified the opportunity for a CHP district heating network which in the first instance would connect buildings within the city centre (Figure 4.2), though there are opportunities to extend this into neighbouring areas (Figure 4.3). The core network could supply some 50GWh$_{th}$ per annum (see Appendix B for further details).

Table 4.1 summarises the costs and likely payback from the core network serving the city centre.

Table 4.1 Overview of district heating network (core network only, serving the City Centre)

	Value	Unit
Technical		
Gas CHP Capacity	2.6	MW$_e$
Gas Boilers Capacity	17.0	MW$_{th}$
Pipework Length	3.8	km
Financial		
Capital Cost	£5,800,000	
Annual Income (energy sales)	£2,300,000	per year
Expenditure (fuel and maintenance)	£1,900,000	per year
Simple Payback	12	years
Environmental		
CO_2 Savings	4,700	tonnes per year

Source: AMEC

It is recommended that the network is supplied with heat from gas CHP plant initially, with the potential for it to be biomass in the future.

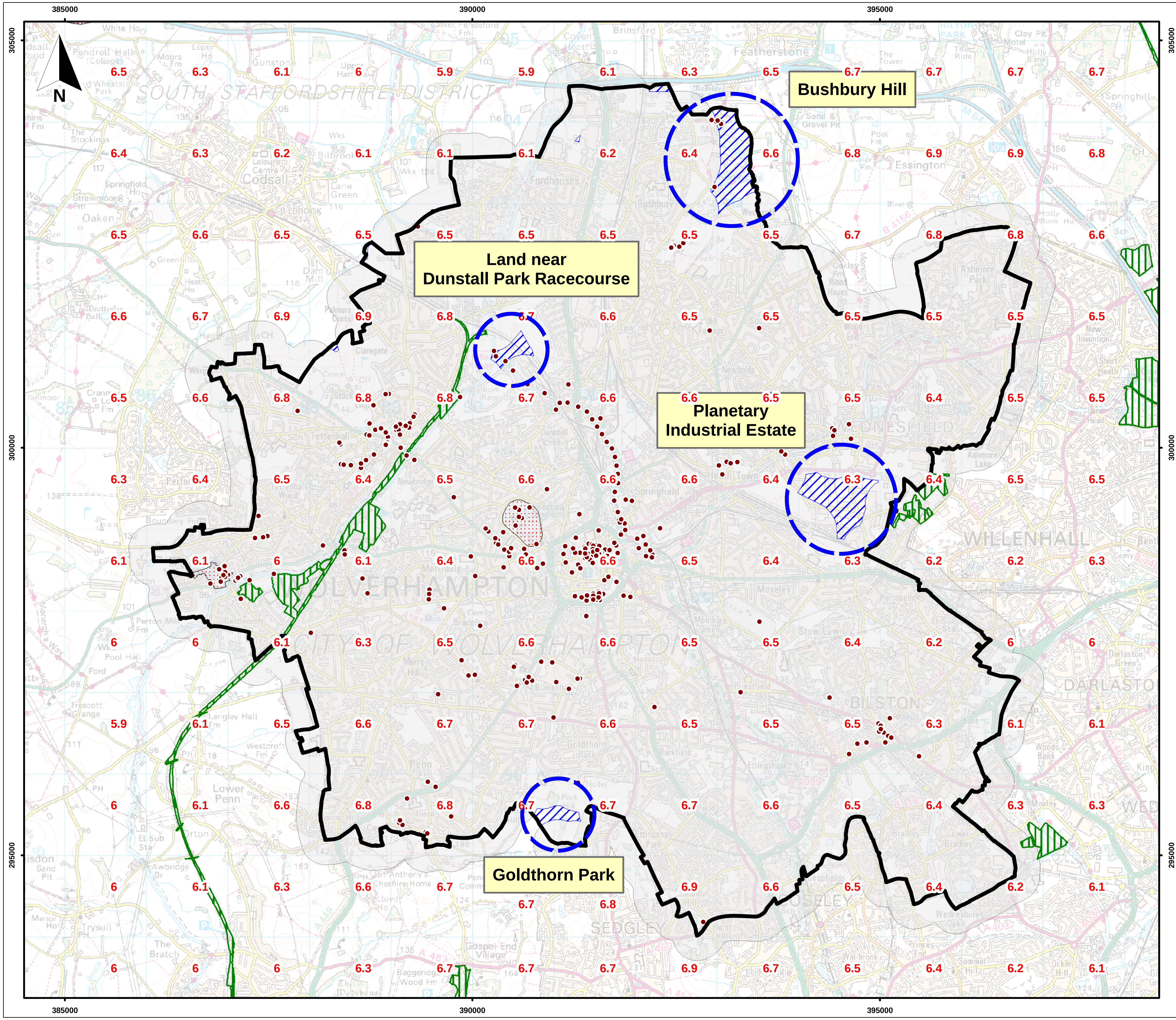
Box 7 provides a case study of Birmingham City Council's district heating network on Broad Street.

Box 7 Birmingham District Heating Network
Birmingham City Council has aspirations to reduce CO_2 emissions by 60% by 2025. This is an ambitious aim, and the effective delivery of decentralised district energy schemes across the whole city will be one of the key mechanisms to achieve this. One part of the City Council's strategy was to develop a district heating network along Broad Street, supplying a number of users including the Children's Hospital, Aston University and Council buildings. The network will be connected to a 1.5MW gas CHP plant. Birmingham District Energy Company Ltd (BDEC) was formed by Utilicom Ltd to deliver the scheme and is: ▪ a wholly owned subsidiary of the Utilicom Group; ▪ owned and operated by Utilicom in partnership with Birmingham City Council (BCC) as a commercial venture; and ▪ an Energy Services Company (ESCo) which will design, build, finance, own and operate sustainable district energy schemes across Birmingham. The City Council expects that as well as emissions savings (up to 3,000 tonnes of carbon in the first year), the scheme will reduce energy bills for the organisations involved. http://www.climate-change-solutions.co.uk/pictures/content121/bdec_brochure_21_11_07.pdf (last accessed October 2011). http://society.guardian.co.uk/carbonmanagement/story/0,,2217767,00.html (last accessed October 2011).

4.6 Summary of renewable resource potential

Figure A in the Executive Summary provides an overview of the potential from the different renewable energy sources considered in this section. In summary this shows the following:

- **Energy mix 1:** a strategy based on micro-generation and some wind turbine development could increase renewable energy supply from 2% to around 3%.
- **Energy mix 2:** investing in infrastructure such as a city centre heating network and planting biomass on previously developed land - in parallel to energy mix 1 - could increase renewable energy supply to around 5%.
- **Energy mix 3:** taking energy mix 2 and considering the impact of a proposed energy from waste scheme (Greenpower.54) could increase supply to around 12%.
- **Energy mix 4:** fully exploiting Wolverhampton's waste resource alongside energy mix 1 could increase supply to around 20%.



Key:

- Wolverhampton City Boundary
- Potential areas for further investigation
- Residential areas with 300m buffers
- Registered Park and Garden
- Local Nature Reserve
- 6.3 NOABL Database wind speed at 45m above ground level
- Listed buildings

Please note:

The potential areas for further investigation represent what is considered the "accessible" wind resource.

AMEC is not recommending these sites as necessarily suitable. Individual "site screenings" would need to be undertaken assessing planning and environmental factors in more detail to determine potential (see report for details)

0 250 500 1,000 1,500 2,000 2,500 Metres

Scale: 1:45000 @ A3

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Renewable Energy and Carbon Reduction Study

Figure 4.1
Wind Energy Constraints Map

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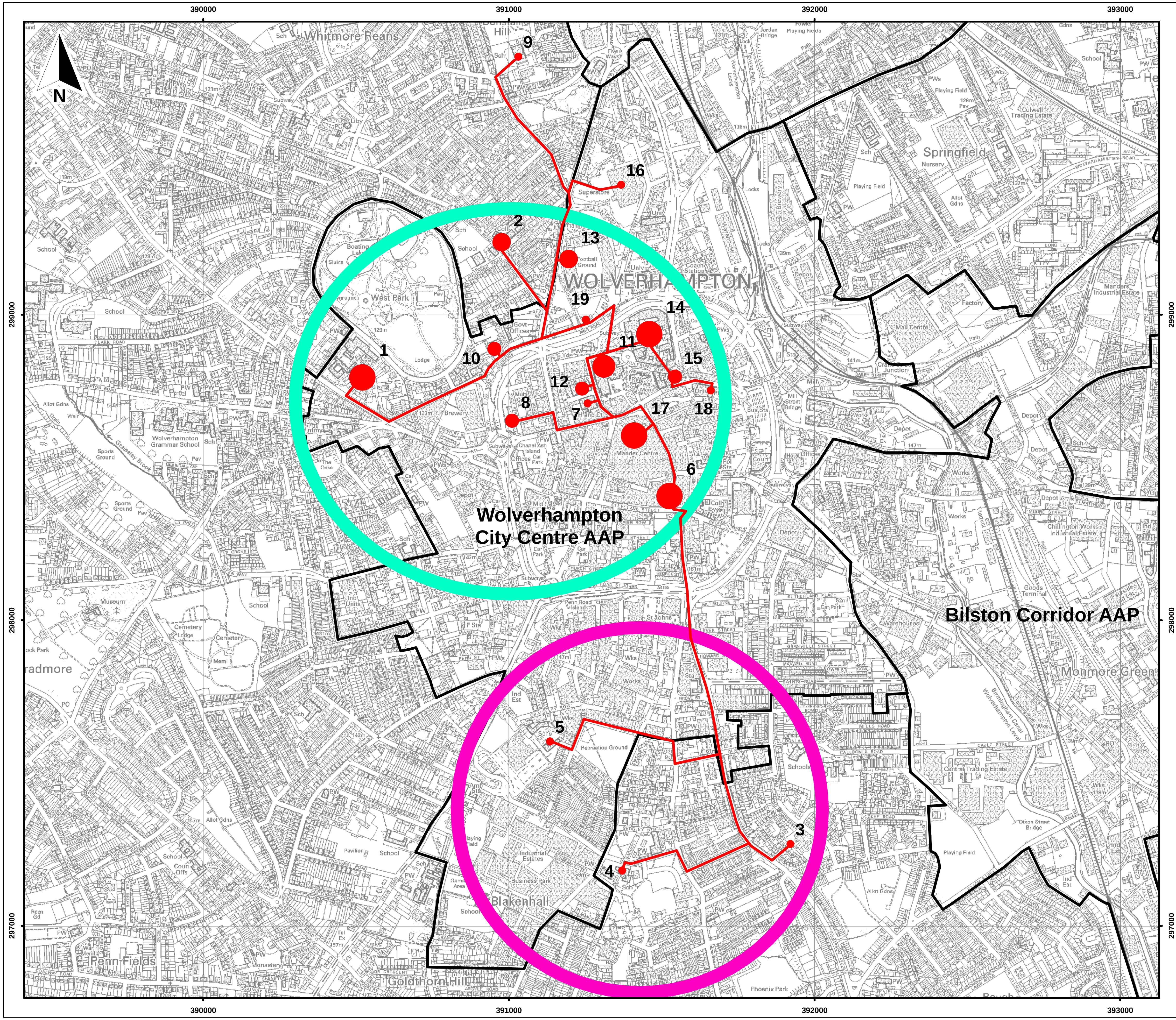

Key:

- Core network
- Potential extension network
- Possible pipeline route

Building heat demand (MWh per year)

- 0 - 1000
- 1000 - 2000
- 2000 - 3000
- 3000 - 7000
- 7000 - 22000

0 50 100 200 300 400 500 Metres

Scale: 1:12000 @ A3

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Renewable Energy and Carbon Reduction Study

Figure 4.2
City Centre Heating Network

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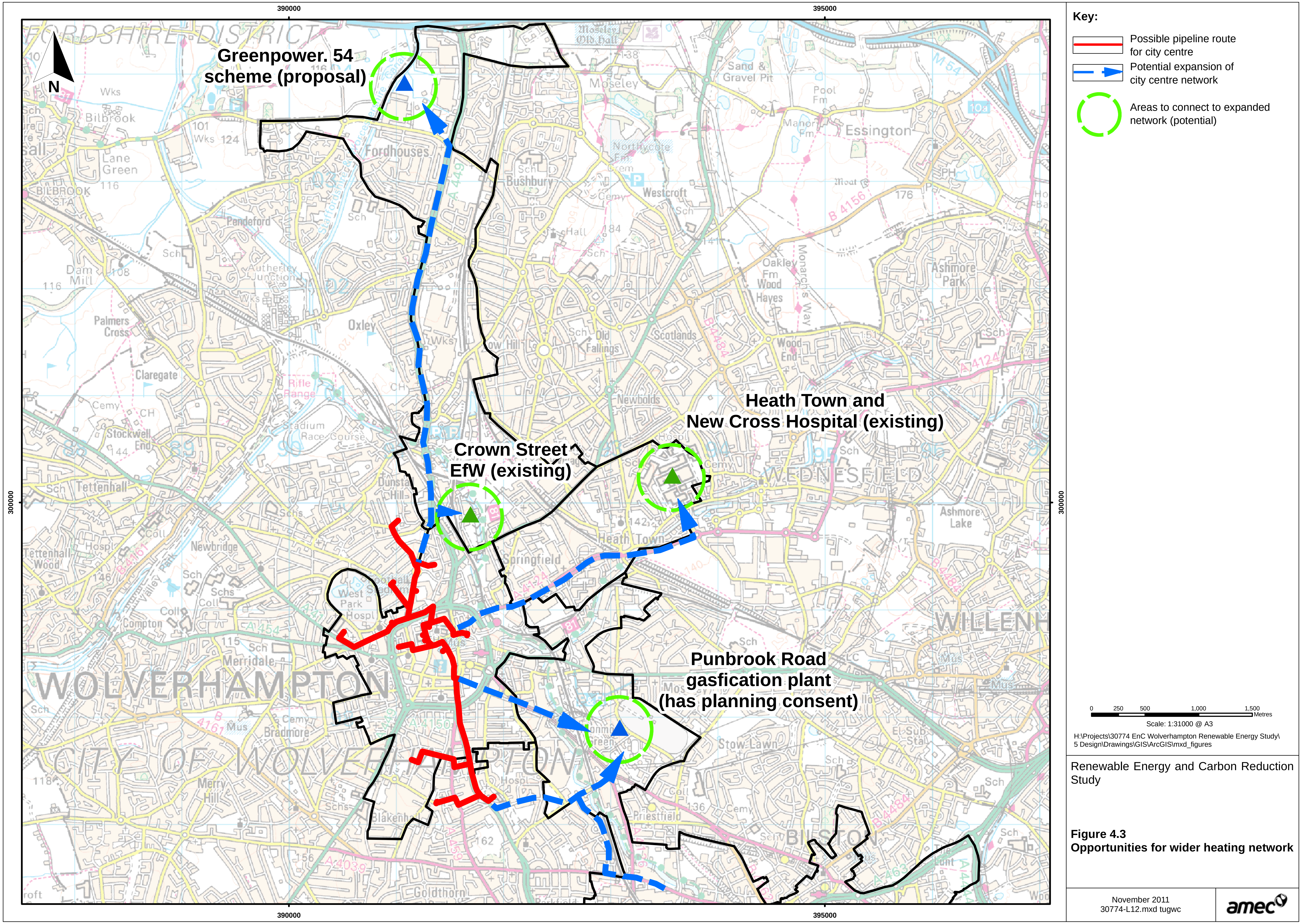

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Renewable Energy and Carbon Reduction Study

Figure 4.3
Opportunities for wider heating network

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5. Approaches to Delivery

5.1 Overview

The Council needs to consider the approach to the delivery of renewable and low carbon energy projects in Wolverhampton: is it all to be Council led, private sector led or something in between? This section considers a range of different approaches and consequences, drawing on case studies from other local planning authorities. In this section the potential barriers to delivery are also set out, considering the role of different stakeholders involved in delivery including developers, landowners and local communities.

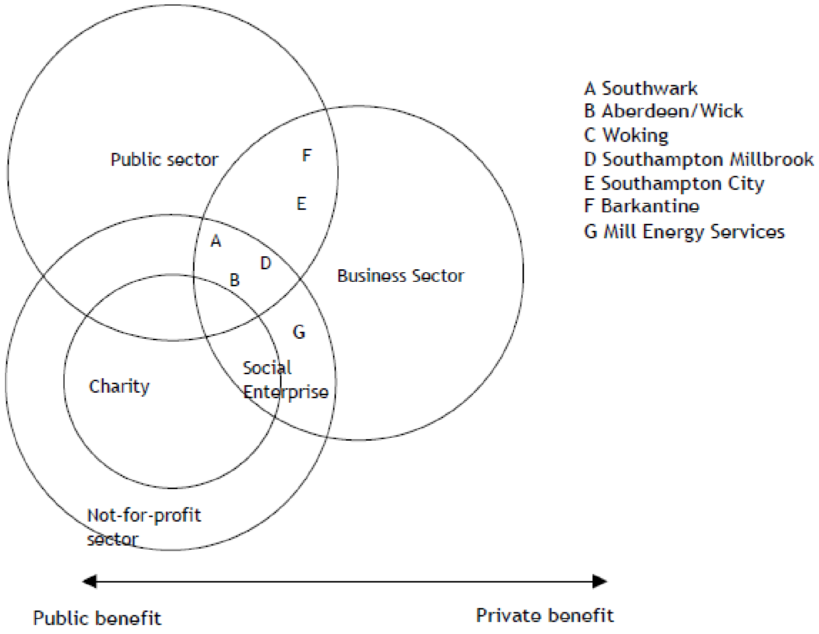
5.2 Energy Services Companies (ESCO)

An ESCO could be established to deliver the renewable energy schemes identified in section 4, be it a district heating scheme, wind turbine or community based micro-generation. There is no standard ESCO model, but a good starting point for information is a report produced for the London Energy Partnership - Making ESCOs Work: Guidance and Advice on Setting up and Delivering an ESCO[39]. The London Energy Partnership's report identifies the range of different models that exist which fundamentally relate to different levels of public and private sector involvement. In principle, an ESCO can be expanded to meet changing demands and opportunities, as has occurred with the Southampton CHP listed in Table 5.1.

The main distinction is that a public sector driven ESCO can deliver wider community benefits since profit is not the sole driver, though that the scheme makes money will still be an important consideration in terms of viability. Figure 5.1 looks at different models, with supporting case studies presented in Table 5.1.

[39] As set out in Making ESCOs Work: Guidance and Advice on Setting up & Delivering an ESCO, Brodies LLP for London Energy Partnership, February 2007 http://www.lep.org.uk/uploads/lep_making_escos_work.pdf .

Figure 5.1 ESCO models: public and private sector benefits



Source: London Energy Partnership (2007) Making ESCOs Work: Guidance and Advice on Setting Up and Delivering an ESCO

Table 5.1 ESCO characteristics

Project	Focus/Character	Advantages	Disadvantages
Aberdeen CHP Scheme	Public Sector-led, arms-length ESCO Supply to four multi-storey blocks Not-for-profit model Focus on mitigating fuel poverty Tenant and community participation	Straightforward contractual structure Community involvement/social housing Trust between the ESCO and sponsoring local authorities Retention of public sector character	Limited private sector involvement - risk retained by the public sector Contractual structure not robust enough for significant private sector involvement
Millbrook CHP, Southampton	Public Sector-led, arms-length ESCO 3,500 properties and 15 public buildings connected to a 50MW plant ESCO manages contracts for the design, build & operation of plant and network	Transfer of risk to the private sector via the ESCO Community involvement Possible use of Renewables Obligations Certificates	Complex structure with attendant contracts Management of public/private sector interfaces
Southampton Geothermal Heating Company/Barkantine Heat and Power Company (Tower Hamlets)	Company with share issue and profit-share PFI tender process	Significant transfer of risk to the private sector PFI model enable optimum allocation of risk between public and private sectors	Lengthy procurement process PFI approach may not be appropriate to the energy sector Risk of limited public sector involvement

Project	Focus/Character	Advantages	Disadvantages
Woking energy system	Companies set up by the local authority to generate and supply energy to hotels, conference centre and civic offices in the town centre 80 island generation sites supplying domestic properties through CHP and photovoltaics Electricity traded between island sites via a private wire system	Balance between the interests of the public and private sectors Self-sufficient network Limited public sector exposure	More complex than traditional CHP schemes because includes direct sale to consumers Legislative restrictions on the amount of electricity that can be supplied via private wire networks (c.1,000 dwellings) Upfront construction costs
Titanic Mill, West Yorkshire	Photovoltaics and biomass CHP Not-for-profit limited company with share issue owned by the building's management company which is in turn owned by the residents	Strong links between the energy generation and supply systems and the end-user Tariff structure determined by end-users Provision for asset maintenance and replacement via the ESCO Capacity to incorporate additional technologies e.g. fuel cells	Need for retention of specialist advice to operate the ESCO Robust operating procedures need to be established to ensure effective management of the ESCO

Source: London Energy Partnership (2007) Making ESCOs Work: Guidance and Advice on Setting Up and Delivering an ESCO

Discussions with the City Council indicate that they would prefer a public sector and community based ESCO model rather than a private sector led approach. The advantages of a public sector led ESCO are that the community benefits can be given greater consideration and it will not just be profit driven. The risk is of course establishing the necessary finance and investment necessary to deliver a scheme. It will also be taking the City Council into a new field.

If the City Council is to lead an ESCO in Wolverhampton there are a number of considerations:

- If it is to be a City Council led scheme (e.g. like the Woking model) there will need to be considerable support from Members given the significant levels of investment that will be required.
- Securing the upfront capital to deliver a scheme is a potential barrier, particularly at a time of financial austerity and a strain on public sector spending. However, changes to local government as part of the Localism Bill could provide the Council with the flexibility it needs to implement such a scheme. Making the business case will of course be crucial. Even with a public sector led scheme some level of private sector involvement will of course be crucial.
- The City Council will need to be prepared to take a long term view (i.e. 25 years or more) in terms of the return on an initial investment.
- A 'pilot' community based ESCO may be worth pursuing in the shorter term to help the Council establish the initial framework to do so and learn lessons which will help the future delivery of larger scale projects. A scheme linked to existing social housing, working in partnership with Wolverhampton Homes or a Housing Association, may be the best approach initially, where communities may already be familiar with some form of communal billing and metering.

- Talking to other local authorities who have led ESCOs will be crucial (e.g. Woking - see Box 8), at both Member and Officer level. The City Council needs to draw on the lessons learnt from other projects, what works and what does not.

- The Black Country Local Enterprise Partnership (LEP)[40] could have a role to play in setting up and coordinating an ESCO as part of its wider brief to encourage growth and economic development. More secure energy supplies for business and potentially cheaper fuel bills would be an important part of this.

Box 8 Case study: Woking Borough Council

Overview

Woking Borough Council has perhaps gone the furthest of any UK local authority in terms of supplying businesses and communities with locally sourced energy. Fundamentally, it is a public sector led ESCO (with private sector involvement) but to ensure greater flexibility and freedom from strict local governance regulations, Thamesway Ltd was established to provide energy services for Woking. Thamesway reports directly to the Council's Executive Committee.

Why was the ESCO established?

In the first instance Woking's main driver was saving money. The Council recognised the role that energy efficiency, and subsequently renewable and low carbon energy, could play in reducing the Council's energy bills. A positive spin-off from this was delivering reductions in CO_2 emissions, which has now led to Woking becoming one of the UK's leading authorities in reducing emissions. Energy consumption has been reduced by nearly 50% on 1990 levels and CO_2 emissions have been reduced by 77% on 1990 levels, equating to around £5m over 10 years.

Sources and useful references for further information:

http://www.woking.gov.uk/environment/climate/Greeninitiatives/sustainablewoking/thameswey (last accessed October 2011).

http://www.thamesweyenergy.co.uk/pages/about_us.php?id=12 (last accessed October 2011).

http://www.ideascentre.co.uk/download/file?ref=68 (last accessed October 2011).

5.3 Overcoming barriers to delivery

There are a number of potential barriers to the delivery of the renewable and low carbon energy potential identified in section 4. Some of the key considerations and barriers relating to different technologies are identified in Table 5.2.

[40] http://www.the-blackcountry.com/default.asp?PageID=322 (last accessed 30.11.11).

Table 5.2 Potential barriers to delivery of renewable and low carbon energy

Project (see section 4)	*Key* considerations and potential barriers to overcome
Micro-generation retrofitted to existing buildings (specifically solar thermal, solar PV and heat pumps)	**Funding and investment:** retro-fitting micro-generation within existing developments (e.g. solar panels on the roof space identified in section 4) could be led by the City Council, specialist energy companies or occupiers of the buildings themselves. In all cases the key consideration will be the payback period and the point at which the system starts saving the occupier money and generating revenue via sales to the grid. Typically the upfront capital will be secured via a loan, where the occupier does not have the capital to do so (e.g. a 5kW solar PV array for a non-domestic application could require investment in the region of up to £25,000). The government's proposed Green Investment Bank[41] could have an increasing role to play by providing loans at lower rates of interest. Helping the business case for such an investment by reducing the payback period is the FiT. At a larger scale, Birmingham City Council is currently retrofitting 10,000 Council-owned homes in the city with PV, which required the Council to take out a £25M loan supplemented by £25M from the energy companies. The FiT was crucial to the business case. It should be noted that whilst the FiT is already in place, it is an exhaustible fund and should therefore only be seen as a short term solution to driving the take-up of solar PV. For solar thermal and ground source heat pumps similar conclusions can be drawn, but the industry is still waiting on the introduction of the RHI to help drive the take-up. **Council buy-in:** discussions with the City Council and Wolverhampton Homes indicated that they have significant interest in the roll out of solar PV on the existing social housing stock given the ability to secure CO_2 emissions reductions and provide revenue in the longer term. One of the key barriers identified here however, is that if it is to be Council-led then a different approach to borrowing is required. The potential need for further borrowing may restrict scheme being taken forward. This is, of course, a much wider issue to consider, not just for micro-generation but the other schemes identified in section 4 if the City Council wishes to pursue them. **Planning and environmental considerations:** fundamentally micro-generation is unlikely to face significant barriers in terms of the planning process. The direction of national policy has been very much focussed on making it easier to install such technologies, including the introduction of permitted development rates for smaller scale domestic schemes.
City centre CHP heating network	**Environmental impacts (e.g. air quality, noise and visual effects):** air quality can be an issue with biomass and waste fuelled plants in an urban area such as Wolverhampton. Though emissions are low, the designation of Wolverhampton as an Air Quality Management Area means requirements are stringent, and where a number of plants are planned one of the key considerations will also be cumulative impact. This can usually be overcome by ensuring high standards gas clean-up equipment. Environmental impacts can be managed via the planning process and in many cases EIA is likely to be required, particularly for larger schemes e.g. an EIA is being prepared for the Greenpower.54 scheme. **Costs and delivery (who pays?):** the upfront capital costs associated with a heating network will be significant. As demonstrated in section 4 the core network serving the city centre could cost in the region of £5-10M, however there should be a return on the initial investment in the long term, in this case estimated to be around 10 years. **Council buy-in:** as with micro-generation one of the biggest barriers will be the availability of funding. It is likely that much of the work required to develop a district heating scheme would be outsourced to an ESCO, who may be able to fund the capital investment. This reduces the risk and initial outlay to the Council, though clearly under this scenario it will be the ESCO who benefits from the profits in future years. **Availability of fuel:** although there is locally available biomass and waste, larger scale projects may require fuel to be imported from other regions. The supply of biomass, waste or other fuel is not seen as an overall constraint to development however; in general where the demand exists the market will respond (be it locally or further afield). Fuel suppliers routinely source additional fuel in response to additional demand as they build up their customer base. **Public perception:** there may be issues relating to public perceptions of energy from waste projects that will need to be overcome through community engagement and consultation.

[41] http://www.bis.gov.uk/greeninvestmentbank (last accessed October 2011).

Project (see section 4)	*Key* considerations and potential barriers to overcome
Wind turbines	**Land ownership and developer interest:** availability of land and whether or not there is developer interest is crucial to understand at the outset. Sites owned by the City Council will be the most straightforward opportunities to pursue in the first instance. **Perceived community impacts/opposition to wind developments:** although the turbines considered as part of the assessment in section 4 are smaller scale (125kW rated, with a hub height of circa 35m, compared to larger scale 1MW+ rated turbines with hub heights of more than 70m), there could still be local opposition to a scheme. Typically, objections relate to impacts on property values, views, landscape impact and noise for example. It is possible to respond to local concerns via early engagement and education, as well as exploring opportunities for community ownership/shares in the turbines. **Grid connection and capacity:** unlikely to be a significant constraint given the scale of turbine proposed, though early liaison with Western Power Distribution (distribution network operator) and National Grid as part of a feasibility study would be helpful. Sites closest to existing substations will see reduced grid connection costs, as much of the cost is in the cabling. **Physical constraints, including highways, access and design (construction and operation):** undertake access feasibility studies when sites identified. Transport Assessment (TA) will be required at planning application stage. **Views of stakeholders (MOD, Nats En Route Radar Ltd, microwave link operators, HSE, National Grid - note, list not exhaustive):** early engagement as part of feasibility studies and pre-application discussions is essential. **Impacts on landscape, cultural heritage and biodiversity (including cumulative impacts):** likely to be addressed in detailed as part of Environmental Impact Assessment (EIA) process though early understanding of the issues essential. Discussions with Natural England and English Heritage encouraged at the outset and will help to understand the risks involved.

PART 3: DELIVERING LOW AND ZERO CARBON DEVELOPMENTS

6. Context for Delivering Low and Zero Carbon Developments

6.1 Introduction

Reflecting on the renewable and low carbon potential identified in Part 2 of the Study it needs to be considered how this can help to deliver low and zero carbon developments alongside the 12,317 dwellings and additional employment land proposed in the Black Country Core Strategy. Given that the majority of new growth and development is to be centred on the AAPs, which are to be areas of significant change over the plan period, this is the focus of our assessment. In turn this then informs recommendations for planning policy - including for the AAPs - in section 8. In turn, the principles could be applied to other areas which are the focus of development activity.

The key drivers behind planning for renewable and low carbon energy are Policy ENV7 and the national timetable for more sustainable buildings, principally zero carbon homes from 2016 and zero carbon non-residential from 2019 (see Figure 6.1). This section looks at expected energy demand and CO_2 emissions associated with future growth as the basis for further assessment.

Figure 6.1 National timetable for sustainable buildings

	Milestones	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	HOUSING: MANDATORY REQUIREMENTS (PRIVATE SECTOR)													
CODE FOR SUSTAINABLE HOMES	Code for Sustainable Homes replaces 'EcoHomes' as voluntary assessment rating for houses in England	April												
CODE FOR SUSTAINABLE HOMES	Rating against Code for Sustainable Homes becomes mandatory		May											
CODE FOR SUSTAINABLE HOMES	Period of Stamp Duty Land Tax Relief for Zero Carbon Homes	01 October 2007 – 30 September 2012												
CODE FOR SUSTAINABLE HOMES	Building Regulations (see Building a Greener Future, Policy Statement, 2007). Sets minimum energy standards, which can be related to energy standards in Code for Sustainable Homes (CSH). Note: no government timetable for achieving CSH Levels *overall*. Timetable just relates to energy standards.				25% reduction in carbon emissions from 2006 Building Regulations from October 2010 Energy standard *equivalent* to CSH3			44% reduction in carbon emissions from 2006 Building Regulations from 2013 Energy standard *equivalent* to CSH4			Zero carbon in relation to 2006 Building Regulations from 2016 Energy standard *equivalent* to CSH6			
	HOUSING: MANDATORY REQUIREMENTS (PUBLIC SECTOR – HOMES AND COMMUNITIES AGENCY [HCA] FUNDED[110]													
CODE FOR SUSTAINABLE HOMES	English Partnerships Quality Standards, 2007. Requires *whole* levels of CSH for all EP/HCA owned sites		Require CSH3 2008-2009		Require CSH4 2010-2012			Require CSH6 2013+						
CODE FOR SUSTAINABLE HOMES	Housing Corporation Design and Quality Strategy 2007. Requires *whole* levels of CSH to secure funding for affordable housing		Funding stream requires CSH3 2008-2010			Funding stream likely to require CSH4 2011-2013			Funding stream likely to require CSH4 2014+					
	NON-RESIDENTIAL													
BREEAM	2008 Budget Report. No equivalent BREEAM standard or targets set nationally. Cannot directly relate energy performance measures to BREEAM standards alone										Zero carbon schools & colleges		Zero carbon public sector buildings	Zero carbon non-domestic buildings
BREEAM	English Partnerships Quality Standards, 2007 (applicable to HCA schemes)	BREEAM 'Very Good' for offices and industrial buildings (no compulsory timetable for planned improvements, though note wider timetable for zero carbon non-domestic by 2019												
BREEAM	Department for Children, Schools and Families (DCSF)	BREEAM 'Very Good' for new schools (rating required to secure capital funding). Note timetable for zero carbon schools by 2016.												
BREEAM	Department of Health (DoH)	BREEAM 'Excellent' rating required for new buildings seeking Outline Business Case approval ('Very Good' required for refurbishment projects)												

6.2 Timetable for zero carbon development

Overview

It is helpful to consider the timetable for zero carbon development in more detail. As demonstrated in Figure 6.1 there are two key deadlines that the government is working towards:

- zero carbon homes from 2016; and
- zero carbon non-residential development from 2019.

At the outset it is important to note that work on the zero carbon homes target is much more advanced than for non-residential development. Clearly this is the because the homes target is much closer, but also there are added complexities for non-residential development given the range of possible building types that the target will need to encompass.

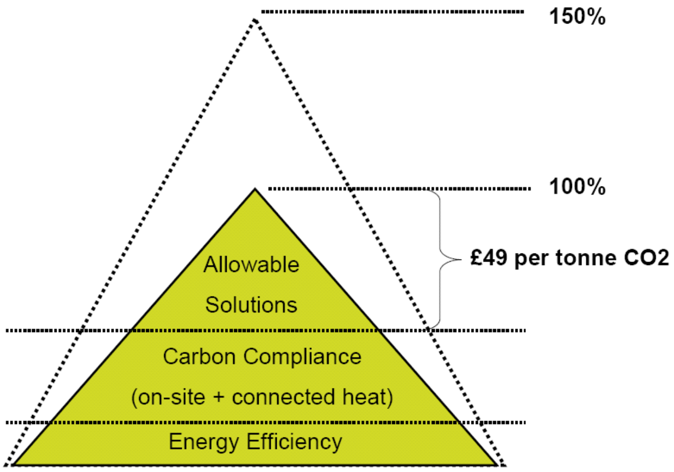
Zero carbon homes

The definition of what constitutes a zero carbon home has been the subject of significant debate within government and the property sector. The current definition was set out by Grant Shapps, Housing Minister, in May 2011[42]. Fundamentally, developers will need to offset emissions from all energy use regulated by Building Regulations (heating and power for fixed appliances, e.g. lighting). Any energy use and emissions associated with electrical appliances (laptops, washing machines and televisions for example) is unregulated and not covered by the definition; there is no requirement on developers to consider these emissions when trying to deliver zero carbon development.

As illustrated in Figure 6.2, there are three key elements to delivering zero carbon development:

- energy efficiency;
- carbon compliance via on-site/locally connected renewable and low carbon energy; and
- allowable solutions to offset residual emissions, likely to be in the form of a financial contribution towards local renewable energy infrastructure or towards retrofitting existing homes and businesses with efficiency measures.

Figure 6.2 Defining zero carbon homes (2011)



Note: *previously the government was seeking emissions reductions of up to 150% to meet the zero carbon standard which accounted for 'unregulated' energy use (televisions, laptops and other household appliances). This requirement has since been removed from the latest definition of zero carbon development, with the 100% relating solely to regulated emissions from space heating and fixed appliances within the home (e.g. lighting).*

Source: Homes and Communities Agency

It should be noted that the government is still considering the mechanism by which allowable solutions are to be secured - it could be a nationally set contribution (e.g. the £49 per tonne identified by the HCA), left to local planning authorities to set a contribution as part of a 'carbon reduction fund' or within their Community

[42] http://www.communities.gov.uk/news/corporate/1905491 (last accessed October 2011). See also the work of the Zero Carbon Hub: http://www.zerocarbonhub.org/ .

Infrastructure Levy (CIL). Milton Keynes Council established their own Carbon Offset Fund in 2008 which is, fundamentally, an allowable solutions model (see Box 9).

Box 9	**Milton Keynes Carbon Offset Fund**

With respect to a potential financial contribution to achieve zero carbon development, Milton Keynes Council was one of the first local planning authorities to do so in their Sustainable Construction Policy D4 and supporting SPD in 2007.

The Council's approach is to require financial contributions to the Milton Keynes 'carbon offset fund' where it is not possible to achieve zero carbon development on site.

Following the calculation of a development's likely CO_2 emissions (tonnes per annum) a contribution of £200 per tonne for net additional emissions via a Section 106 agreement or unilateral undertaking is required of developers.

The carbon offset fund is managed by the MK Energy Agency on behalf of and monitored by the Council.

http://www.milton-keynes.gov.uk/mklowcarbonliving/displayarticle.asp?ID=70509 (last access October 2011)

Whilst the Council could pursue a similar approach to Milton Keynes (i.e. a Wolverhampton Carbon Reduction Fund), it is suggested that it will be better to wait for further guidance from government on the national approach to allowable solutions. Investing time and resources in developing a local mechanism could be overtaken by a potentially simpler national model linked to Building Regulations for example.

Zero carbon non-residential development

Three phases of work have been produced in relation to delivery of zero carbon non-residential development focussing on the definition, technical and economic aspects[43]. There are, however, no recent statements from government regarding this target - the recent focus has been on the more immediate target of 2016 target for zero carbon homes. Whilst the homes-related target is important, planning for the 2019 target is also considered important. Renewable and low carbon technologies will clearly have a role to play, and this Study demonstrates the opportunities for existing and new businesses to connect to communal scale systems and retrofit micro-generation technologies such as solar PV.

6.3 Planning for zero carbon development *now*

In order to achieve the 2016 target in particular it is considered crucial for the local planning authority and developers to start planning for this level of performance now. The case for doing so is set out in Figure 6.3, with Box 9 setting out a worked example. The principles set out in Figure 6.3 and Box 10 apply to both residential and commercial development.

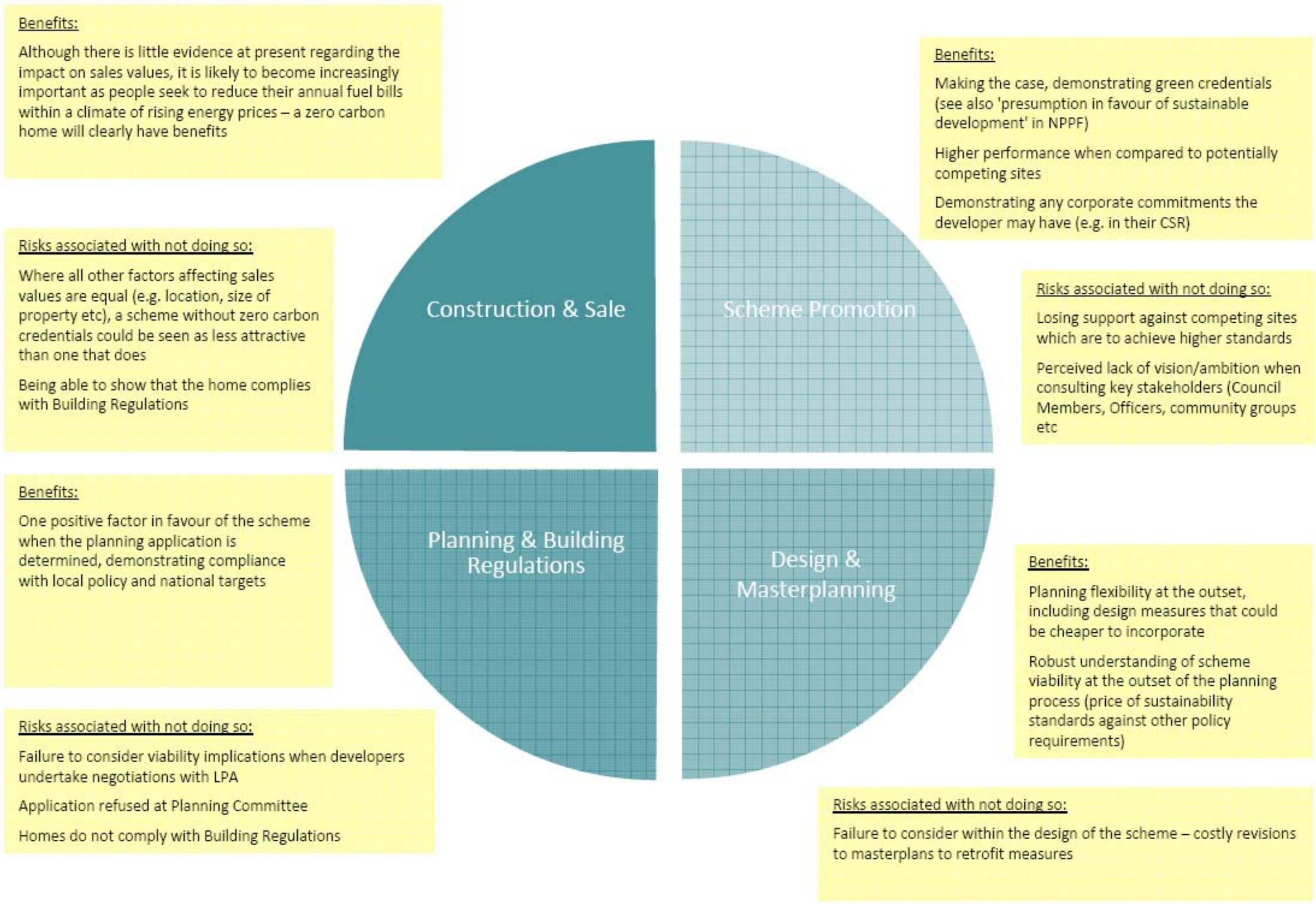
Further detail on what a developer needs to present can be set out as part of an SPD, but, fundamentally it will need to demonstrate the following, for example:

[43] http://www.communities.gov.uk/publications/planningandbuilding/zerocarbonnondomreport (last accessed October 2011).

- how the principles of the zero carbon energy hierarchy are to be addressed (i.e. the proportion of on-site measures vs. allowable solutions);
- the safeguarding of land within a masterplan to accommodate a future energy centre/CHP plant (for example) to build in flexibility to a scheme, particularly for larger mixed use developments;
- the ability to connect to nearby heating networks where established; and
- how zero carbon development has been taken into account as part of the viability modelling for a scheme (has sufficient consideration been given to the impact on development costs for example).

This would all need to be presented as part of the DAS or 'Sustainable Communities Checklist' submitted in support of a planning application. Early discussions between the developer and local planning authority should be encouraged.

Figure 6.3 Why plan for zero carbon development now?



Source: AMEC

Box 10 Worked example: planning for zero carbon development now

Example scheme

A mixed use scheme is proposed in Wolverhampton, involving the redevelopment of a 10ha former industrial site for circa 400 dwellings, community centre and 1,000m^2 employment workspace (B1a-c).

The scheme is at pre-planning stage, with the developer expecting to submit an outline application early 2012.

Assuming that detailed consent can be secured in 2013, construction will commence in 2014 with a build out over five years.

The need to plan for zero carbon

Planning the scheme in relation to standards at 2011 (i.e. 2010 Part L Building Regulations for the housing) will be insufficient: how will the homes built post 2016 achieve zero carbon performance? How will the homes build between 2013 and 2016 achieve higher levels of performance? (Amendments to Part L are to be introduced in 2013.)

Whilst enforced via Building Regulations, these higher standards will have spatial implications for the masterplanning and design of the scheme, requiring the use of on-site or locally connected renewable/low carbon sources of energy. The developer therefore needs to consider this at the outset of the design process. In addition it will help the developer to understand the potential impacts on scheme viability.

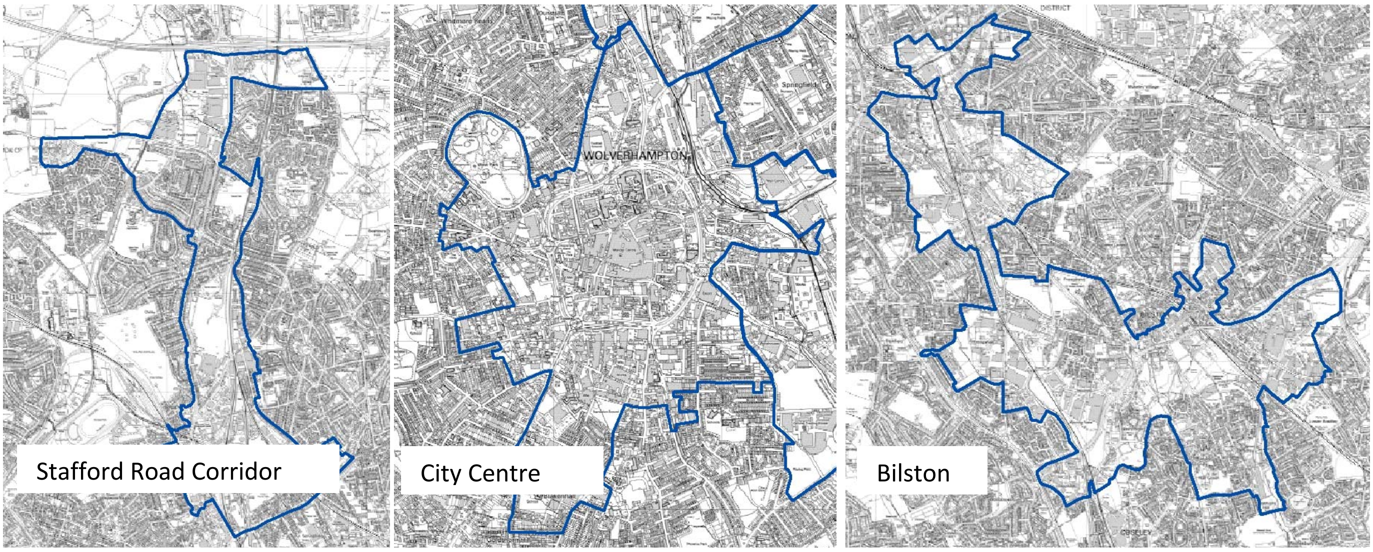
It should be noted that this is something that many developers are already doing in taking forward schemes to ensure that they are ‘future proofed’ against increasing national standards. It also has wider benefits, as set out in Figure 6.3.

7. Reducing CO_2 Emissions within the AAPs

7.1 Introduction

The focus of this section is to consider the opportunities and constraints associated with planning for renewable and low carbon energy and CO_2 reductions as part of the three AAPs (Figure 7.1). This section of the Study should be used to inform planning policies for the AAPs (explored in section 7) and help guide the local planning authority and developers on what technologies are likely to be suitable within these areas; this will assist with the implementation of Core Strategy Policy ENV7 in the short term.

Figure 7.1 Area Action Plans (AAPs)



Note: for a more detailed plan showing the Neighbourhood Plan boundaries see Figure 3.1.

7.2 Existing potential for renewable and low carbon energy generation

Overview

In the first instance it is important to consider the potential for accommodating renewable and low carbon technologies within the AAP areas as they stand at present (i.e. without planned growth through to 2026). Section

4 demonstrates the specific opportunity for a city centre heating network, with the potential for this to be expanded into the neighbouring Stafford Road Corridor and Bilston Corridor AAP areas.

In addition, particular buildings have been identified within each AAP for micro-generation, specifically solar PV and solar thermal being retrofitted to existing non-domestic properties.

Solar PV

Retrofitting solar PV to existing buildings within the three AAPs could generate over 13,000MWh$_e$ per annum, displacing over 3,500 tonnes of CO_2 per annum (Table 7.1). Table 7.2 identifies the largest five buildings within each AAP area with potential.

Table 7.1 Estimated Solar PV potential among existing buildings in each AAP

AAP	Energy Generation Potential (MWh/yr)	Carbon Impact (assuming displacement of grid electricity) tCO_{2e}/yr
Bilston	6,046	1,775
Wolverhampton City	618	166
Stafford Road Corridor	6,585	1,630

Note: applies to buildings **within or adjacent to the AAP boundaries given the opportunity for wider linkages**

Table 7.2 Individual potential Solar PV sites

Site	Energy Generation Potential (MWh/yr)	Comment
Bilston Corridor		
Retail Warehouses, Milfields Road	2,525	Large open roof, number of flat areas suitable for angled arrays, sky lights might be a problem.
Commercial Warehouses, Spring Vale Avenue	1,342	Large open apex roof, SW facing areas may be suitable, may be problem with skylights.
Wilcox Industrial Supply, Mount Pleasant	987	Number of buildings some new and old roof types. Some skylights and obstructions on roofs might be a problem. There are a number of SW facing roof areas.
Hill and Smith, Spring Vale Avenue	583	Large open apex roof, SE facing areas may be suitable, may be problem with skylights.

Site	Energy Generation Potential (MWh/yr)	Comment
Cullina Logistics, Spring Road	383	Complex apex roof, but large areas of SW facing roof space.
Wolverhampton City		
West Park Hospital, Park Road West	155	Most of the site, complex small buildings, most with tree shading issues. Main hospital building, large open roof space SW facing, some air vents.
Dunstall Primary School	105	Large flat roof spaces suitable for angled arrays, lots of air conditioning units on roof, plus complex structure, therefore only around half the roof space is suitable.
Blackenhall Community and Healthy Living Centre, Bromley Street	94	Complex set of buildings, but two areas of flat roof space suitable for angled arrays.
HM Revenue & Customs, Birch St	92	Large flat areas of roof, but complex roof structure, around two-thirds can be used for PV. SW facing.
Royal Wolverhampton Hospital, Compton Road	55	Complex site, most buildings shaded by trees, main hospital building has large flat roof area, facing SW.
Stafford Road Corridor		
Freshway Chilled Foods, Stafford Road Corridor	1,025	Large multi apex roof, half of apex's south facing, skylights all over.
Booker Cash & Carry, Stafford Road Corridor	880	Large apex roof half south facing, skylights might get in the way though.
Technopali UK, Headway Road	813	Large building, number of apex roofs, half with SW orientation.
Cargill Meats Europe, Wobaston Road	763	Large roof space, lots of air conditioning units on roof, whole roof SE facing.
EWS, Headway Road	665	Large roof, five areas only one SW facing.

Solar thermal

Retrofitting solar PV to existing buildings within the three AAPs could generate over 13,000MWh$_e$ per annum, displacing over 8,000 tonnes of CO_2 per annum (Table 7.3). Table 7.4 identifies the largest five buildings within each AAP area with potential.

Table 7.3 Estimated solar thermal potential among existing buildings in each AAP

AAP	Energy Generation Potential (MWh/yr)	Carbon Impact (assuming gas displacement) tCO_{2e}/yr
Bilston	1,684	312
Wolverhampton City	4,991	1,023
Stafford Road Corridor	1,524	345

Table 7.4 Potential individual solar thermal installations by AAP

Site	Potential Energy Generation (MWh/yr)	Comment
Bilston		
BIlston Leisure Centre	1,270	Complex roof structure, but a large section of SW roof space
South Wolverhampton & Bilston Academy	280	Complex roof structure some SE facing roof space
Green park School	72	Old complex roof structure, but some flat areas that are clear of obstructions for angled arrays
Hill Avenue Primary School	62	Complex roof structure but there may be some space for angled panels
Wolverhampton City		
Royal Wolverhampton Hospital	2,337	Complex site, most buildings shaded by trees, main hospital building has large flat roof area, facing SW
West park Hospital	1,810	Most of the site, complex small buildings, most with tree shading issues. Main hospital building, large open roof space SW facing, some air vents.
City of Wolverhampton College	458	Multiple apex roof, SE facing, some large areas for PV, skylights may be an issue though.
HM Revenue and Customs	159	Large flat apex roof, half facing SE
Graiseley Primary School	96	Complex roof structure but some SW facing roof space
Stafford Road Corridor		
North East Wolverhampton Academy	636	Large flat roof areas, suitable for angled arrays,
Pendeford Business Park	344	Lots of small buildings, some SW roof space.
Blackmore, The Development Centre	228	Multiple apex roof, SE facing,
Chart Energy and Chemicals	144	Large flat apex roof, half facing SE
Open College network of the West Midlands	96	Complex roof structure but some SW facing roof space

Figure 7.2 Solar PV and solar thermal potential: Stafford Road Corridor AAP

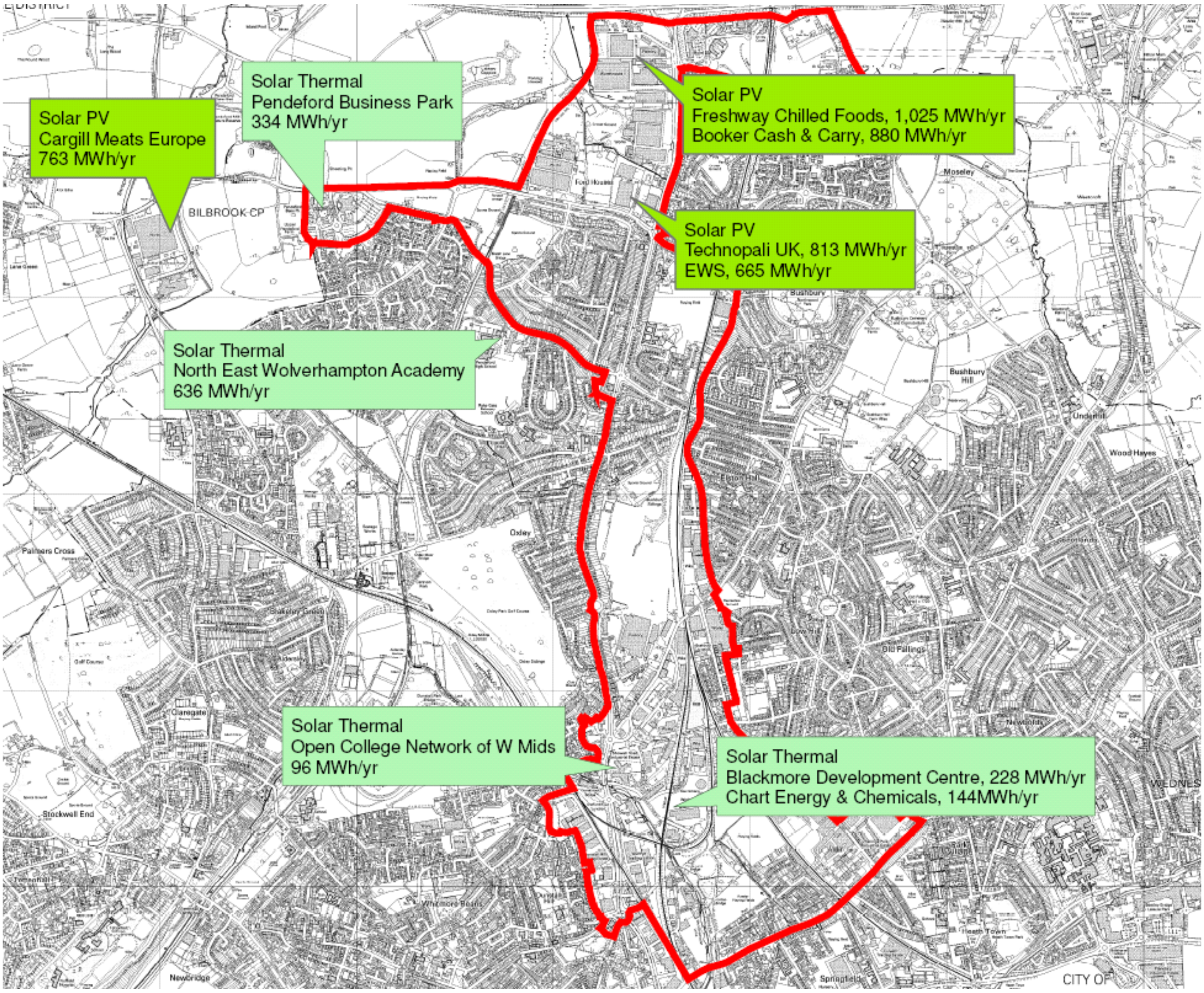


Figure 7.3 Solar PV and solar thermal potential: Bilston Corridor

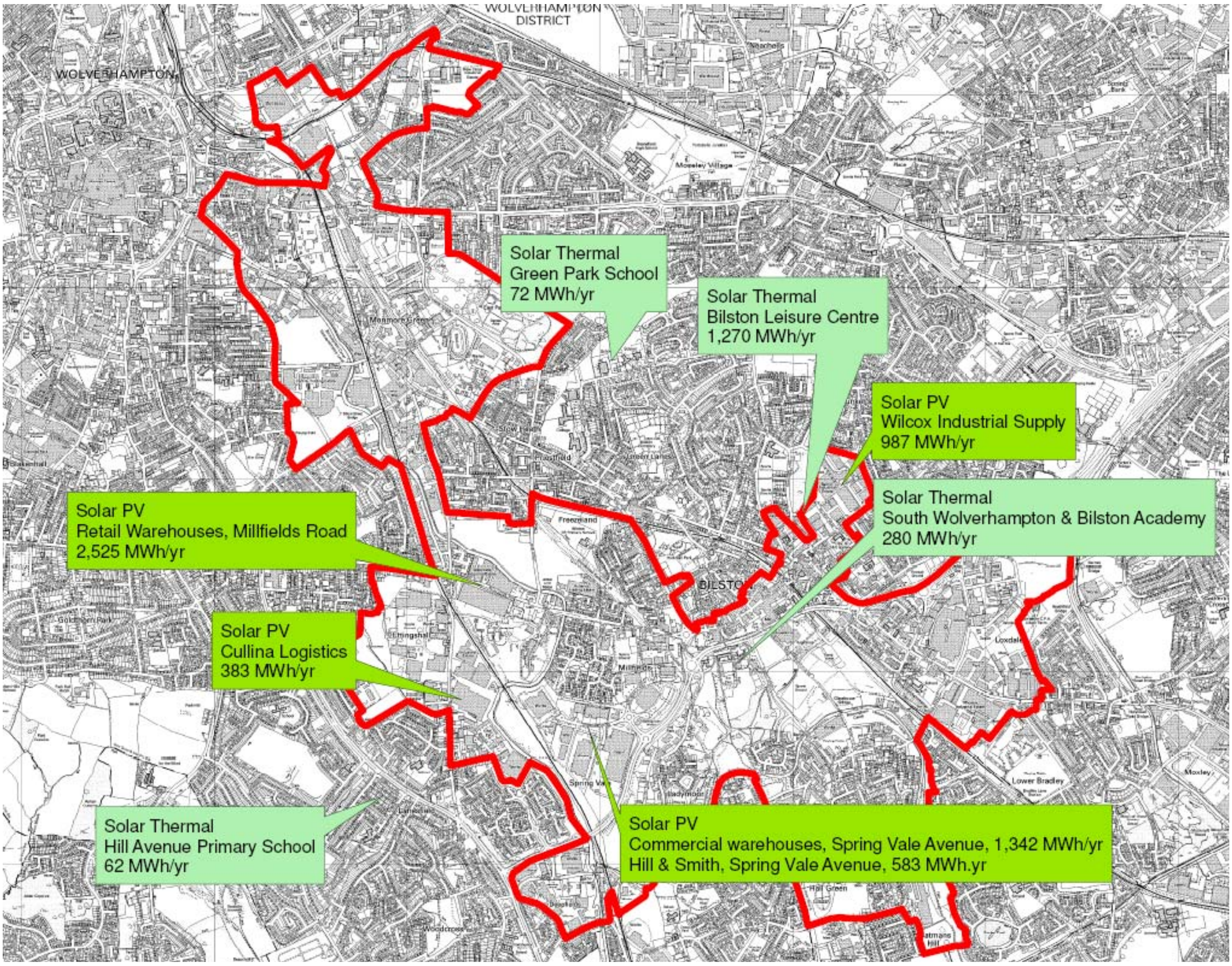
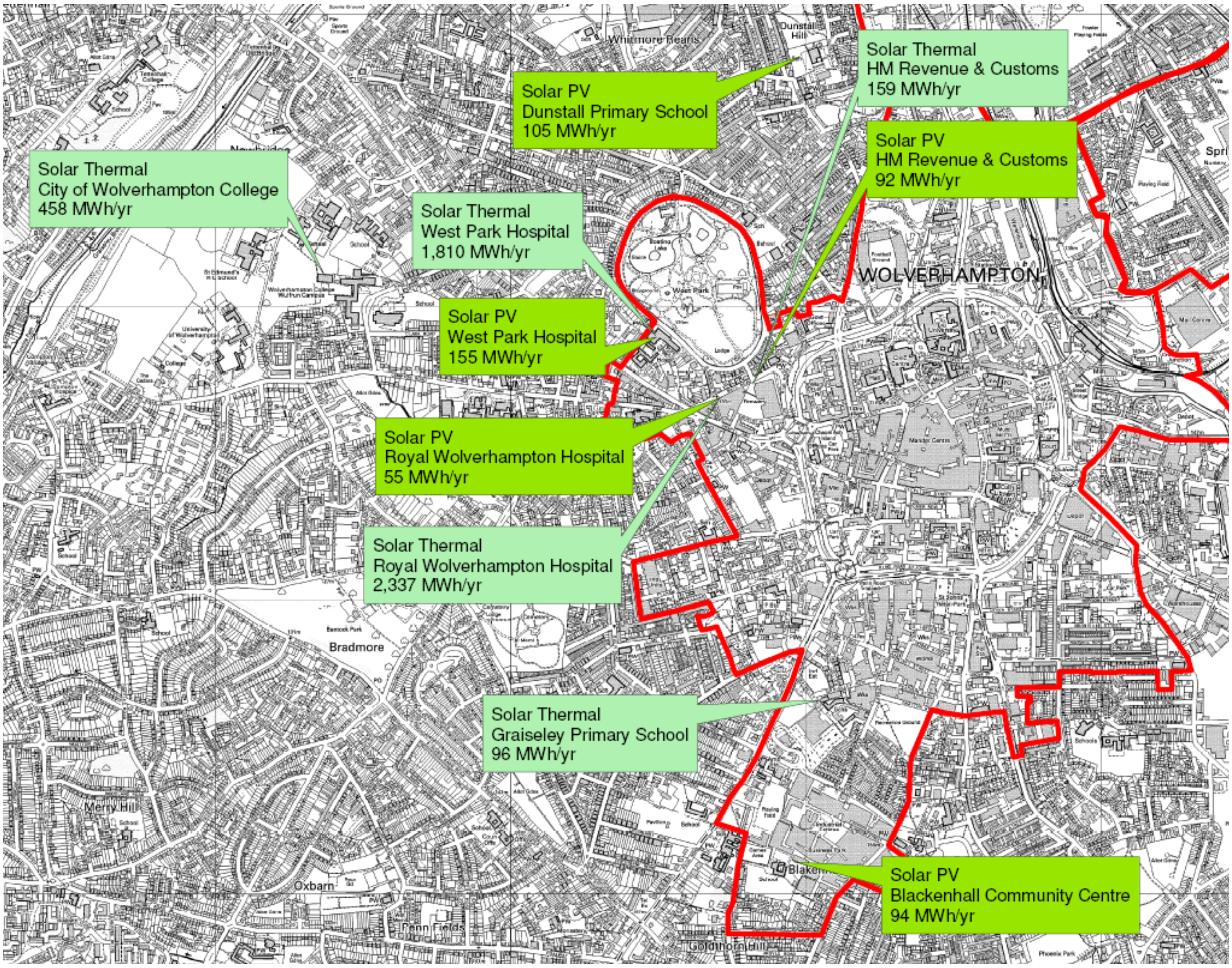


Figure 7.4 Solar PV and solar thermal potential: City Centre



7.3 Potential for renewable and low carbon energy alongside planned new development

City Centre AAP

Table 7.5 shows the potential level of development which could come forward within the City Centre AAP between 2011 and 2026.

Table 7.5 Summary of potential development: 2011-2026

Mix	2011-2016	2016-2026	Total
Residential	2,130	1,663	3,793
Retail (m^2)	50,000	50,000	100,000
B1 (m^2)	110,000	110,000	220,000
B2 (m^2)	-	-	
B8 (m^2)	-	-	

This level of development could result in an additional **57,000 tonnes of CO_2 per annum**. Over 70% of total emissions are associated with gas to heat and cool these new buildings with the remaining 30% for power (total electricity demand from this new development estimated at 77GWh per annum and 75GWh per annum for gas).

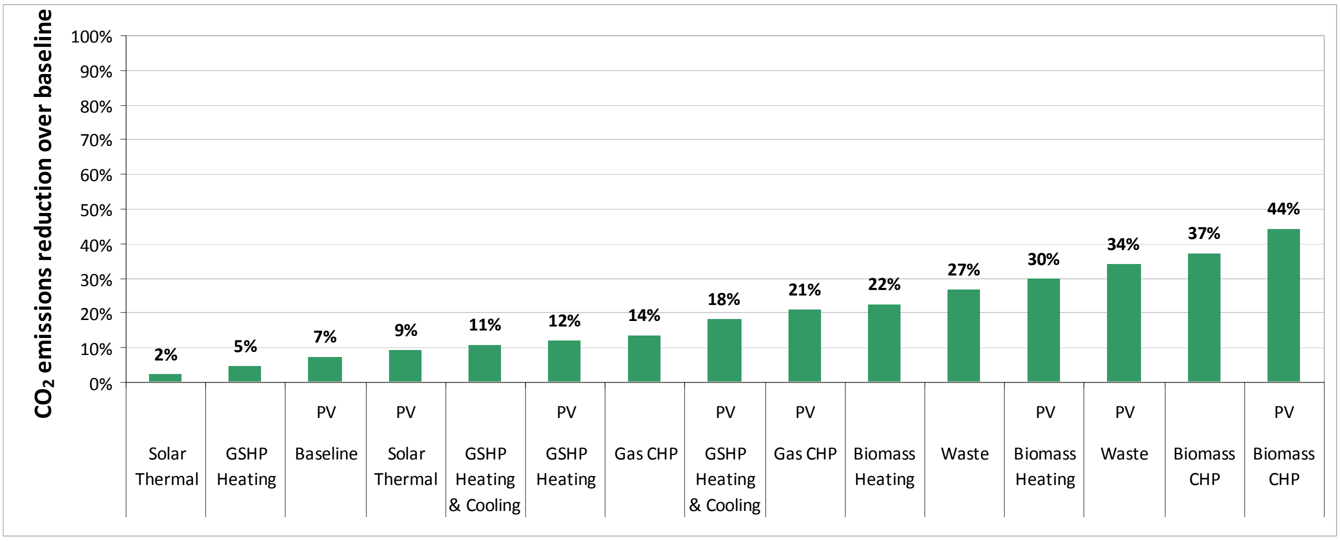
It needs to be considered how the 57,000 tonnes of CO_2 associated with this new growth can be reduced via the use of renewable and low carbon technologies. Table 7.6 appraises the different technologies, supported by Figure 7.2 which illustrates the level of savings that could technically be possible.

Table 7.6 Feasibility and viability of renewable and low carbon technologies for new development in the City Centre AAP

Technology	Potential CO_2 emissions reductions (Figure 7.2)*	Conclusions
Building integrated micro-generation		
Solar thermal	Minimal	Micro-generation is unlikely to deliver significant carbon savings alongside planned new development when considering growth proposed for the AAP as a whole. However, these technologies will have a role to play in individual developments achieving the policy requirements of ENV7
Solar PV	Marginal	
Heat pumps	Marginal	
Biomass boilers	Moderate	
Commercial-scale generation		
Energy from Waste	Moderate	Section 4 highlights the significant potential that exists in the city centre for a district heating network. It is proposed that this would be gas CHP in the first instance, but it is a network linked to waste or biomass would achieve much more in terms of CO_2 savings. Where established this could deliver greater carbon savings for new developments in the city centre than micro-generation technologies
Biomass heat/CHP	Significant	

***** Minimal (<10%) Marginal (10-25%) Moderate (25-50%) Significant (50-75%) Very Significant (>75%)

Figure 7.5 Potential CO_2 savings by renewable and low carbon technology



Source: AMEC

Bilston Corridor

Table 7.7 shows the potential level of development which could come forward within the Bilston Corridor AAP between 2011 and 2026.

Table 7.7 Summary of potential development: 2011-2026

Mix	2011-2016	2016-2026	Total
Residential	1,351	2,735	4,086
Retail (m^2)	-	-	-
B1 (m^2)	-	-	-
B2 (m^2)	98,000	215,000	313,000
B8 (m^2)	50,000	110,000	160,000

Source: WCC - see **Appendix F**

This level of development could result in an additional **58,000 tonnes of CO_2 per annum**. Circa 55% of total emissions are associated with gas to heat and cool these new buildings with the remaining 45% for power (total electricity demand from this new development estimated at 46GWh per annum and 164GWh per annum for gas).

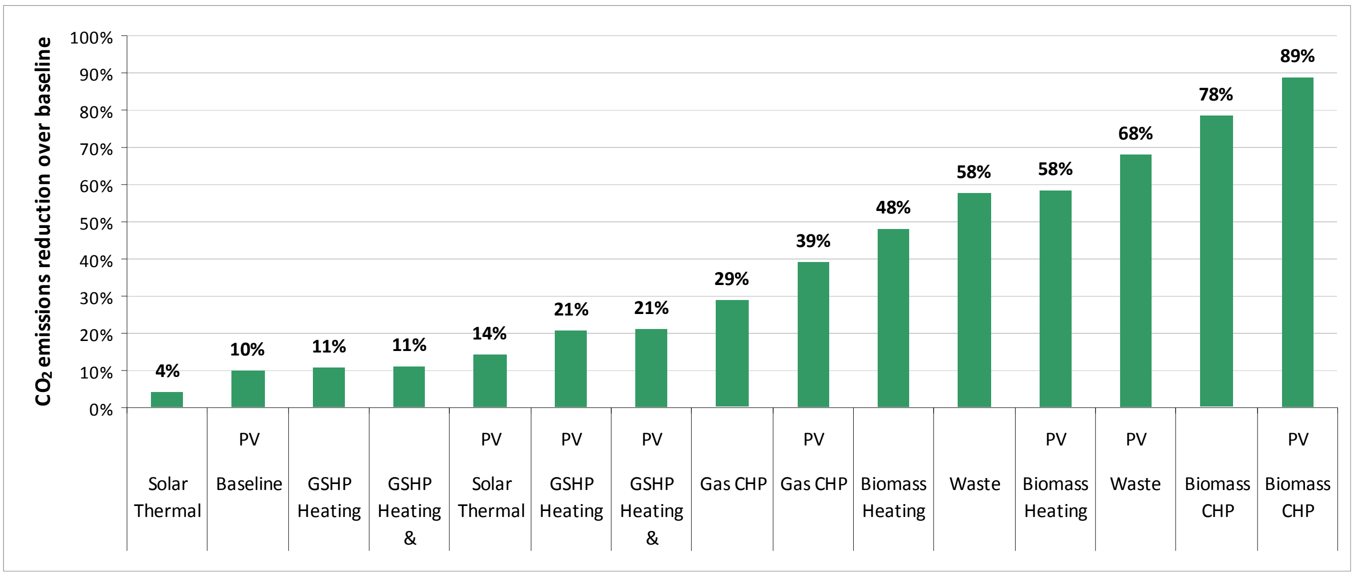
It needs to be considered how the 58,000 tonnes of CO_2 associated with this new growth can be reduced via the use of renewable and low carbon technologies. Table 7.8 appraises the different technologies, supported by Figure 7.3 which illustrates the level of savings that could technically be possible.

Table 7.8 Feasibility and viability of renewable and low carbon technologies for new development in the Bilston Corridor AAP

Technology	Potential CO_2 emissions reductions (Figure 7.3)*	Conclusions
Building integrated micro-generation		
Solar thermal	Minimal	Micro-generation is unlikely to deliver significant carbon savings alongside planned new development when considering growth proposed for the AAP as a whole. However, these technologies will have a role to play in individual developments achieving the policy requirements of ENV7
Solar PV	Marginal	
Heat pumps	Marginal	
Commercial-scale generation		
Energy from Waste	Significant	The potential for a stand alone heating network to serve new developments in the Bilston Corridor linked to gas CHP, EfW or biomass is considered limited at present. The viability of incorporating a network on schemes such as the proposed Bilston Urban Village will be challenging: lower density residential developments are not well suited to district heating schemes. However, section 4 highlights the potential for a city centre heating network to link into existing buildings within the Bilston Corridor (see Appendix B for existing buildings that could be suitable). Where such connections are made, there may be potential to link to proposed new development schemes given the carbon savings that could be achieved.
Biomass heat/CHP	Very Significant	

***** Minimal (<10%) Marginal (10-25%) Moderate (25-50%) Significant (50-75%) Very Significant (>75%)

Figure 7.6 Potential CO_2 savings by renewable and low carbon technology



Source: AMEC

Stafford Road Corridor

Table 7.9 shows the potential level of development which could come forward within the Stafford Road Corridor AAP between 2011 and 2026.

Table 7.9 Summary of potential development: 2011-2026

Mix	2011-2016	2016-2026	Total
Residential	92	1,555	1,647
Retail (m^2)	-	-	-
B1 (m^2)	-	-	-
B2 (m^2)	26,600	87,448	114,048
B8 (m^2)	26,600	87,448	114,048

Source: WCC – see **Appendix F**

This level of development could result in an additional **25,000 tonnes of CO_2 per annum**. Circa 56% of total emissions are associated with gas to heat and cool these new buildings with the remaining 44% for power (total electricity demand from this new development estimated at 19GWh per annum and 72GWh per annum for gas).

It needs to be considered how the 25,000 tonnes of CO_2 associated with this new growth can be reduced via the use of renewable and low carbon technologies. Table 7.10 appraises the different technologies, supported by Figure 7.4 which illustrates the level of savings that could technically be possible.

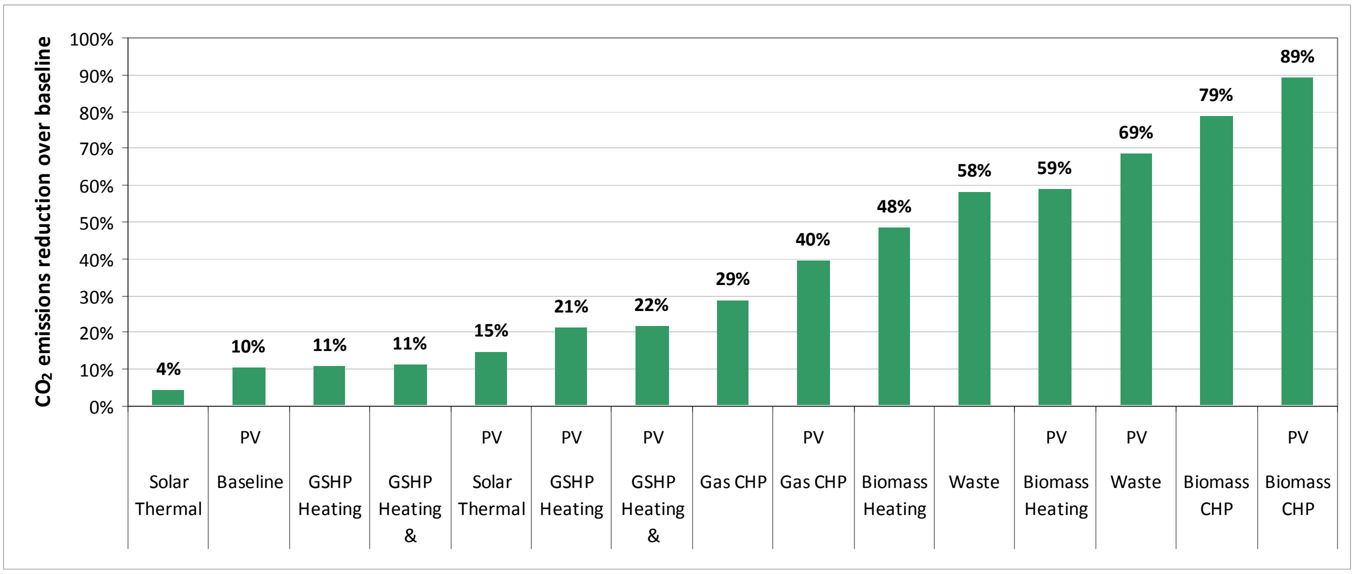
Table 7.10 Feasibility and viability of renewable and low carbon technologies for new development in the Stafford Road Corridor AAP

Technology	Potential CO_2 emissions reductions (Figure 7.4)*	Conclusions
Building integrated micro-generation		
Solar thermal	Minimal	Micro-generation is unlikely to deliver significant carbon savings alongside planned new development when considering growth proposed for the AAP as a whole. However, these technologies will have a role to play in individual developments achieving the policy requirements of ENV7
Solar PV	Marginal	
Heat pumps	Marginal	
Commercial-scale generation		
Energy from Waste	Significant	The potential for a stand alone heating network to serve new developments in the

Technology	Potential CO_2 emissions reductions (Figure 7.4)*	Conclusions
Biomass heat/CHP	Very Significant	Stafford Road Corridor linked to gas CHP, EfW or biomass is considered limited at present However, section 4 highlights the potential for a city centre heating network to link into existing buildings within Stafford Road Corridor (see Appendix B for existing buildings that could be suitable). Where such connections are made, there may be potential to link to proposed new development schemes given the carbon savings that could be achieved In addition, the City Council is also exploring the opportunity for connections to be made to the proposed Greenpower.54 scheme proposed by Express Power

* Minimal (<10%) Marginal (10-25%) Moderate (25-50%) Significant (50-75%) Very Significant (>75%)

Figure 7.7 Potential CO_2 savings by renewable and low carbon technology



Source: AMEC

7.4 Summary

There are two main aspects to consider in relation to renewable and low carbon energy generation within the AAPs:

- what technologies could be suitable alongside *existing* developments within these areas; and
- what technologies could be suitable alongside planned new growth and development through to 2026 (the time horizon of the Core Strategy and AAPs).

What is clear is that although micro-generation will have an important role to play, it is a district heating scheme that will achieve the most in terms of CO_2 emissions savings. If a district heating scheme is not taken forward in the City Centre AAP, or not deemed feasible within the Stafford Road Corridor and Bilston Corridor AAPs, then a strategy predicated on micro-generation and allowable solutions will be necessary to serve new developments. The latter could potentially involve the development of a district heating network, although significant co-ordination between developers, WCC and potentially third party investors would be required to realise such a significant scheme.

8. The Role for Planning

8.1 Introduction

As set out in section 1, planning will have a fundamental role to play in affecting the delivery of renewable and low carbon energy schemes, specifically:

- **Planning policy, comprising the Black Country Core Strategy, AAPs, Neighbourhood Plans and other Development Plan Documents:** within these policy documents the Council can set specific requirements for new developments to incorporate or connect to locally sourced renewable or low carbon energy. Linked to this the Council can seek particular levels of performance reflecting the Code for Sustainable Homes and BREEAM standards.

- **Development control decisions:** schemes which do not comply with policy (e.g. Black Country Policy ENV7 or AAP policy adopted in the future) can be refused by the Council. The Council will determine the suitability of new proposals for renewable and low carbon energy schemes, such as a biomass plant or a wind turbine, and planning conditions and Section 106 agreements can be used to maximise the social, economic and environmental benefits associated with a scheme.

8.2 Planning policy

Supporting the implementation of Core Strategy Policy ENV7

This Study should be used by the Council and developers to understand what opportunities exist for renewable and low carbon energy schemes within a particular area, as well as what technologies are most suitable and which ones are not. This will help to support the implementation of Core Strategy Policy ENV7 (Box 11).

Box 11	Black Country Core Strategy: Detailed Policy Wording of Policy ENV7

Policy

"Proposals involving the development of renewable energy sources will be permitted where the proposal accords with local, regional and national guidance and would not significantly harm the natural, historic or built environment or have a significant adverse effect on the amenity of those living or working nearby, in terms of visual, noise, odour, air pollution or other effects.

All non-residential developments of more than 1,000 square metres floor space and all residential developments of 10 units or more gross (whether new build or conversion) must incorporate generation of energy from renewable sources sufficient to off-set at least 10% of the estimated residual energy demand of the development on completion. The use of on-site sources, off-site sources or a combination of both should be considered. The use of combined heat and power facilities should be explored for larger development schemes. An energy assessment must be submitted with the planning application to demonstrate that these requirements have been met.

The renewable energy target may be reduced, or a commuted sum accepted in lieu of part or all of the requirement, only if it can be demonstrated that:

- *a variety of renewable energy sources and generation methods have been assessed and costed;*
- *achievement of the target would make the proposal unviable (through submission of an independently assessed financial viability appraisal); and*
- *the development proposal would contribute to achievement of the objectives, strategy and policies of the Core Strategy."*

Area Action Plans (AAPs)

This Study can be used to show what renewable and low carbon technologies are likely to be feasible and viable alongside planned new developments within the three AAP areas. In addition, the resource assessment that AMEC has undertaken is evidence from which the Council can set specific policy requirements in the AAPs.

Three main options have been identified, and will be tested further via the AAP consultation process:

- Option 1 - No AAP policy, rely on Core Strategy Policy ENV7.
- Option 2 - Set out preferred renewable and low carbon technologies for each development opportunity site, in line with current evidence.
- Option 3 - AAP to include a policy which adopts a positive approach to proposals for renewable and low carbon energy in appropriate locations and requires developers to demonstrate how they have planned for higher national standards, including zero carbon development, adopting a hierarchy approach.

Option 3 is the preferred policy approach because it requires developers to demonstrate the capacity for their schemes to achieve higher national building regulations standards, including zero carbon homes from 2016 and zero carbon non-residential development from 2019. It is expected that the majority of development opportunity sites identified in the AAP will begin construction after 2016.

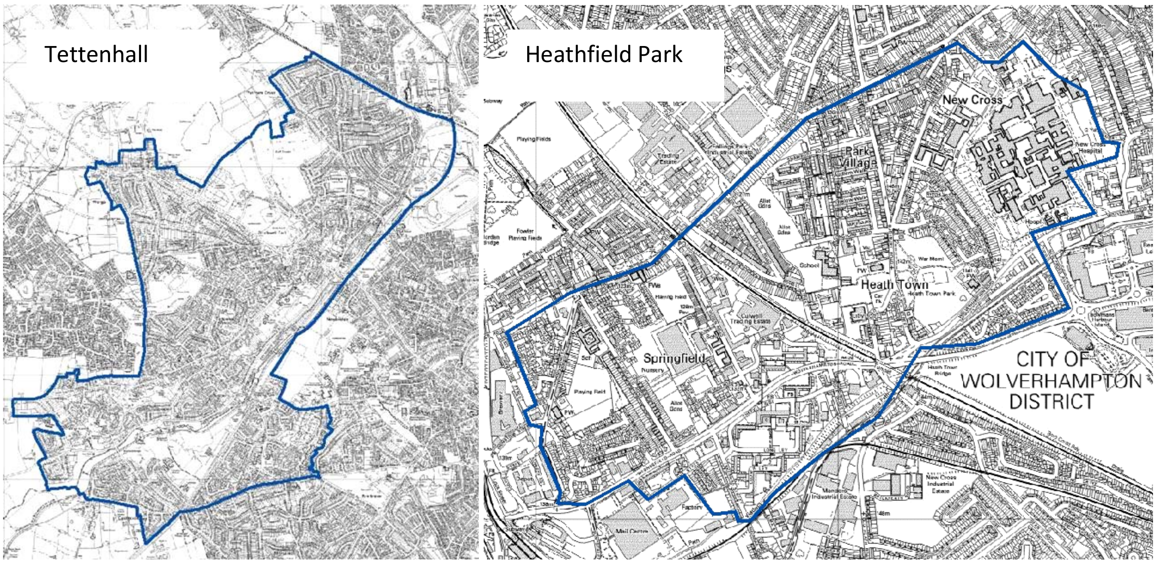
The justification for considering zero carbon development at the outset is set out in section 6. Achieving zero carbon performance has implications for both the design and viability of schemes. It is therefore crucial to consider this at the outset of the masterplanning process, given the lead-in times to AAP adoption and subsequent phasing of development. This will help to 'future proof' schemes and ensure flexibility.

Option 1 on its own is considered insufficient with respect to planning for the longer term. Option 3 will help to ensure that the capacity exists for AAP allocations to deliver zero carbon development, when this requirement is introduced, in a manner which minimises costs and maximises wider benefits.

Neighbourhood planning

Neighbourhood Plans are to be prepared for Heathfield Park and for Tettenhall (see Figure 8.1). Ultimately it will be part of the neighbourhood planning process as to how far communities choose to go in setting an approach to the provision of renewable and low carbon energy schemes. What this Study shows is the opportunities which exist to do so and it can form part of the evidence base for policies within the respective Neighbourhood Plans. It is worth noting, however, that relatively modest levels of housing growth in Tettenhall could limit the range of schemes which are feasible. For Heathfield, the presence of the hospital and existing district heating system could act as focal points for the further development of schemes of this kind in the area.

Figure 8.1 Neighbourhood plan areas



Note: for a more detailed plan showing the Neighbourhood Plan boundaries see Figure 3.1

8.3 Development control

Development control decisions in Wolverhampton will be taken within the framework of the Black Country Core Strategy, national planning policies (including PPS22 and the Climate Change PPS) and other local policies (e.g. the AAPs). Whilst the Council's development control can be positive regarding the potential for renewable and low carbon energy schemes, within the local and national policy framework, one of the key opportunities is to maximise the social, economic and environmental benefits associated with a scheme via planning conditions and Section 106 agreements. Clearly, this is something that is already being done (i.e. contributions towards transport infrastructure, ecological mitigation etc.), but the following is considered important when determining new proposals for Wolverhampton:

- Requiring developers to plan for connections to neighbouring areas - e.g. for an energy from waste/ biomass plant to facilitate a connection to existing homes and businesses in the area. With the existing built environment in Wolverhampton accounting for some 1M tonnes CO_2 per annum the Council needs to consider how new renewable and low carbon energy schemes can link directly to existing homes and businesses in order to maximise the local benefits from a proposal.

- The effective implementation of Black Country Core Strategy Policy EMP5 Improving Access to the Labour Market, to ensure that energy developers target local recruitment and provide training in order to maximise the local economic benefits for a scheme.

Of course, any planning condition or Section 106 request will need to be reasonable and proportionate to the scale of development proposed to accord with national policy.

8.4 The importance of monitoring

Monitoring planning policy outcomes and the wider measures undertaken by the Council will be crucial in order to understand successes, failures and barriers that need to be overcome. Feedback received via discussions with stakeholders during the course of the project demonstrates how important this is in terms of understanding the effectiveness of a technology, such as micro-generation within existing buildings (identified in discussions with Wolverhampton Homes with respect to the success of their All Saints scheme). In making the case for renewable energy and demonstrating the benefits having local evidence via monitoring is considered crucial to demonstrating what can be achieved.

Key indicators that need to be monitored include:

- Schemes granted consent which are required to comply with Core Strategy Policy ENV7.

- The subsequent performance of schemes complying with ENV7: what is the technology supplying per annum?

- The installed capacity from new renewable and low carbon energy proposals.

The Council can either condition developers to produce reports on an annual basis, demonstrating what is being achieved, or invest in the technology to undertake the monitoring centrally within the Council. The London Borough of Merton is one authority undertaking the latter approach[44]; the benefit being that it is much less resource intensive for the Council (it is all automated), however there are of course upfront costs associated with this.

[44] Fundamentally a data logger is installed alongside the renewable energy scheme, which links directly to the Council's system to show what level of energy is being produced by the system and the level of emissions that it offsets.

With respect to monitoring the uptake of renewable energy schemes, section 3 and Figure A provide a baseline against which performance can be monitored (i.e. current renewable energy supply totals circa 53GWh per annum, equivalent to 2% of Wolverhampton's energy demands).

In terms of aspirations for delivering a low carbon economy there are a range of other approaches to monitoring that the Council can consider:

- **Energy Performance Certificates:** All new buildings are required to have an Energy Performance Certificate. A preliminary EPC is produced at the design stage and an updated EPC produced on building completion. The Council could monitor EPC-ratings to ensure that performance cited by developers is achieved.

- **Smart-metering:** The UK Government has an aspiration to roll-out smart-metering to all UK homes and businesses by 2019. Theoretically, the installation of such meters should afford the opportunity for detailed energy consumption analysis of individual properties via remote links. However, there would be data privacy issues to consider should the Council wish to access such data.

- **Post Occupancy Monitoring:** The Council could consider a requirement for all new development to conduct 12 months (or similar) post-occupancy energy monitoring of new developments. For some non-residential developments, this may be required anyway via Display Energy Certificates[45]. Again, the installation of appropriate smart-metering technology should facilitate such a requirement, but data privacy issues remain. Also, this would not account for the behaviour of building occupants who may not operate the building as it was intended.

[45] Under the auspices of the EU Energy Performance of Buildings Directive, Display Energy Certificates (DECs) are required on all public buildings in England and Wales over 1,000m^2. The EPBD has recently been recast and it is expected that the provision of DECs will be extended to smaller public buildings and to other sectors (e.g. retail, commercial premises, etc.).

PART 4: CONCLUSIONS AND RECOMMENDATIONS

9. Conclusions and Recommendations

9.1 Purpose of the study

The purpose of the Study was to identify the opportunities for renewable and low carbon energy across Wolverhampton within the context of national and local policy priorities and the economic, social and environmental benefits that such schemes could have.

9.2 Conclusions and recommendations

***Conclusion 1:** There is significant potential for renewable energy to deliver a range of social, economic and environmental benefits for the City*

Renewable and low carbon energy can have significant benefits for Wolverhampton, including helping to support economic growth (new jobs and inward investment as part of a low carbon economy), delivering community benefits (reduced energy bills, responding to fuel poverty and providing greater energy security) and helping to mitigate future climate change (reducing the circa 1M tonnes of CO_2 associated with the City's energy demand for heat and power). Planning policy and development control can help to ensure that these benefits are maximised.

Recommendation 1: this Study is just the starting point and the Council needs to work with public and private sector partners to disseminate the Study findings and actively promote the benefits presented by renewable and low carbon energy, and more widely a low carbon economy, across the City. Securing buy-in from the different departments within the Council is also considered essential (Officers, Members and those within the Council's finance/accounting department).

***Conclusion 2:** With respect to CO_2 emissions it is the **existing** built environment that has the biggest contribution - new growth and development will not have a significant impact*

The Study shows that the energy used to heat and power Wolverhampton's existing homes and businesses account for over 1M tonnes CO_2 per year. Proposed growth through to 2026 will not have a significant impact on overall emissions and so the Council needs to consider the planning mechanisms by which reductions to existing emissions can be secured. An allowable solutions model could help deliver a range of solutions, from the retrofitting of renewables to existing homes and businesses to investment in strategic infrastructure such as the city centre heating network identified in this Study. There are of course also links to wider measures being implemented by Government and locally to reduce emissions from the existing built environment (Government's Green Deal and Council's Affordable Warmth Strategy for example).

Recommendation 2: identify the significant potential for 'allowable solutions' in the AAP areas to offset emissions within the existing built environment. Whilst the Council could set up its own Carbon Reduction Fund, it is recommended that, at this stage, the Council waits on Government proposals for an allowable solutions mechanism which could ultimately supersede any locally adopted approach. This may need to be supported by an SPD in the future, or make use of CIL as a mechanism.

Recommendation 3: continue to promote measures to reduce emissions within the existing built environment such as affordable warmth linked to national mechanisms such as the Green Deal. However, it is appreciated that opportunities are lined to individual buildings and require individual assessment and sign-up.

Recommendation 4: require developers of new renewable and low carbon energy schemes to facilitate connections to existing and proposed households and businesses, so that energy generated can be used locally. For biomass and waste-related projects the use of CHP needs to be promoted given the benefits in terms of reducing emissions from the existing built environment. This can be achieved via the development control process, though a stronger policy basis could be provided for this through the AAPs.

Conclusion 3: *Wolverhampton is a particularly attractive location for waste related facilities*

There is already an operational EfW in the City and proposals for new facilities at Purbrook Road (gasification plant with planning consent) and a new EfW at pre-planning stage close to i54 (Express Power's Greenpower.54 proposal). The City is an attractive location given the availability of commercial and industrial waste within the wider conurbation and its good transport links in terms of the M54 and M6. Energy mix 4 (Figure A) demonstrates that fully exploiting the renewable resource associated with the City's waste could equate to 17% of the city's energy supply.

Recommendation 5: continue to support waste-related energy projects given the significant potential that they have as a main supplier of low-carbon/renewable energy in Wolverhampton, and their potential contribution to delivering the waste management capacity requirements of the Core Strategy. However, there is a need to ensure that local benefits can be realised in accordance with Recommendation 4 (connections to surrounding development) via planning conditions and Section 106.

Conclusion 4: *There are a number of renewable and low carbon energy generation projects for the City Council and its partners to consider taking forward*

Section 4 reviews potential from a range of different renewable and low carbon technologies in Wolverhampton. The most significant scheme is a district heating network, which would have its core in the city centre with the potential to extend into the neighbouring Stafford Road Corridor and Bilston Corridor AAP areas in the future. In addition, micro-generation (solar thermal and solar PV in particular) will have potential, particularly where retrofitted to existing buildings. The opportunity for wind turbines on the edge of the city has also been identified, as well the potential for the City Council to drive the supply chain for biomass and waste.

Recommendation 6: carry out further feasibility work, where required, to examine the significant potential presented by a city centre district heating network in line with previous studies. Previous studies and AMEC's work show the significant potential presented by a city centre district heating network. The City Council now needs to consider whether it is a scheme they wish to pursue and secure Member and Officer support given the investment and resources that will be required to take the project forward. If the project is to be pursued, a *detailed* feasibility study (including business case and funding streams)[46] will need to be progressed building on the findings of this Study.

Recommendation 7: consider the opportunities to help support supply chains for both biomass and waste, utilising the potential of Council-owned land (e.g. for the storage and sorting of fuel and planting of biomass crops).

Recommendation 8: identify land ownership and City Council interest in progressing wind-related development on the four sites identified.

Conclusion 5: *There is a need to establish the Council's approach to an ESCO*

The City Council's preferred approach is for a public sector led ESCO, where the community benefits can be maximised and profit is not the sole driver. The Study identifies a number of local authority models, the most well known public sector led scheme being Woking Borough Council who established Thamesway to provide local energy to households and businesses. Recognising that this is a new direction for the City Council it is considered prudent to, in the first instance, consider setting up a 'pilot scheme' and engaging with local authorities such as Woking at an Officer and Member level to understand what can be achieved and lessons learnt.

Recommendation 9: identify a pilot scheme for a City Council-led ESCO to promote both renewable/low-carbon energy and cheaper local energy supplies, considering the potential role for the Black Country LEP.

Recommendation 10: engage with existing authorities such as Woking and Birmingham City Council at both Officer and Member level to share experience.

Conclusion 6: *The different energy mixes identified in this Study (Figure A) show the potential to achieve renewable energy supply of between 3%-20%*

Figure A in the Executive Summary provides an overview of the potential from the different renewable energy sources considered in this Study. In summary this shows the following:

- **Energy mix 1:** A strategy based on micro-generation and some wind turbine development could increase renewable energy supply from 2% to around 3%.
- **Energy mix 2:** investing in infrastructure such as a city centre heating network and planting biomass on previously developed land - in parallel to energy mix 1 - could increase renewable energy supply to around 5%.

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[46] Confirmation of specific sites and energy demand over the course of a year, sizing the equipment (plant and back up), QS support to establish detailed costs, pipeline, infrastructure, land ownership etc. (AMEC can advise on the scope of this and will provide more detail - we have seen local authority tenders for similar projects).

- **Energy mix 3:** taking energy mix 2 and considering the impact of a proposed energy from waste scheme (Greenpower.54) could increase supply to around 12%.

- **Energy mix 4:** fully exploiting Wolverhampton's waste resource alongside energy mix 1 could increase supply to around 20%.

The fundamental conclusion is that to achieve the most significant savings investment in the city centre heating network and wider infrastructure to support energy from waste/biomass based projects is essential.

Recommendation 11: establish monitoring to understand the installed capacity and annual energy supplied via operational renewable and low carbon energy schemes, using the information presented in section 3 and Figure A of this study as the baseline.

Conclusion 7: *The Council, developers and landowners need to plan for zero carbon development* ***now*** *if the government's 2016 (residential) and 2019 (non-residential) targets are to be met*

The Study is clear regarding the need to plan for zero carbon development now. This is essential in order to 'future proof' schemes which are at the early stages of planning and design. Achieving zero carbon performance will have implications for masterplans which need to be considered at the outset to ensure that feasibility and viability are properly taken into account. This will also help to avoid potentially costly revisions to masterplans at a later date.

Recommendation 12: engage with the developers of sites within the AAP areas as early as possible (linked to Recommendation 1 - dissemination of Study findings) to ensure that they are considering the need to plan for zero carbon homes from 2016 and non-residential schemes from 2019.

Recommendation 13: develop AAP policies which specifically require developers to demonstrate how their schemes can be future proofed to achieve zero carbon performance and which provide locally-specific guidance on appropriate technologies where possible.

9.3 The next steps

Section 10 presents an action plan to take forward the recommendations presented in the report.

10. Action Plan for Delivery

Recommendation	Key mechanisms	Responsibility	Timescale	Outcomes
1. Dissemination of study findings and promotion of the benefits presented by renewable and low carbon energy	Briefing to Officers and Members within the Council	WCC: planning policy and economic development	End 2011	Securing Officer and Member buy-in to the Study findings, particularly in relation to the actions that are required (including this action plan) and barriers that need to be overcome.
	Briefing to Carbon Reduction Cluster Group	WCC: economic development	End 2011	Engaging local businesses who will have a key role to play in delivery of renewable and low carbon energy and an interest in how the recommendations from the Study will be taken forward.
	Consultation on the AAPs with local communities and key stakeholders	WCC: planning policy	End 2011	Understanding of the role that the AAPs can play in helping to facilitate the delivery of renewable and low carbon technologies in Wolverhampton.
2. AAP policy to support allowable solutions	AAPs	WCC: planning policy	AAP adoption (2013?)	Clear role for allowable solutions in supporting the attainment of zero carbon standards.
3. Continue to promote energy savings measures (e.g. CESP and Green Deal)	Affordable Warmth Strategy Action Plan (or similar)	Wolverhampton Homes	On-going	More energy efficient buildings within the social housing stock, reducing energy bills and responding to fuel poverty.
	Energy efficiency fund	WCC	On-going	WCC should explore the potential of ring-fencing a fund (say £250,000pa) to install energy efficiency measures in private homes that are at greatest risk of fuel poverty.
4. Requiring developers of new energy schemes to facilitate connection to existing homes and businesses	AAPs	WCC: planning policy	AAP adoption (2013?)	Helping to reduce emissions within the existing built environment and providing a potentially cheaper and more secure supply of energy.
	Development control negotiations	WCC: development control	On-going	
5. Continue to support waste-related projects but ensure that wider benefits can be realised	Development control negotiations	WCC: development control	On-going	Ensuring that the wider benefits from strategic scale waste facilities are maximised.
6. Progressing city centre district heating network	ESCO	WCC/Black Country LEP?	On-going	Taking forward a city-centre district heating scheme allows for significant CO_2 savings to be achieved and have a major contribution to the City's renewable energy supply.

Recommendation	Key mechanisms	Responsibility	Timescale	Outcomes
7. Developing supply chains for biomass and waste (including use of previously developed land for growing biomass)	For investigation	WCC	To be determined	Additional biomass resource for renewable energy projects to draw on, such as the city centre heating network.
8. Identify land ownership and City Council commitment to wind turbine development	For investigation	WCC	To be determined	Understanding of the appetite to take forward detailed site screenings for wind turbine development on four potential sites identified.
9. Identify pilot scheme for an ESCO	For investigation	Wolverhampton Homes (potentially)	On-going	Initial understanding of how an ESCO could work in Wolverhampton before being scaled-up to deliver a much larger scheme.
10. Engage with existing authorities who have developed ESCOs	To be determined (potential links to established local authority working groups/seminars)	WCC: planning policy and development control	On-going	Understanding of the opportunities, constraints and benefits from ESCO development drawing on the invaluable experience from other authorities who have already gone down this route (would benefit at both an Officer and Member level to secure buy-in.
11. Establish monitoring	Annual Monitoring (linked to development control)	WCC: planning policy and development control	On-going	Understanding of performance and attainment in relation to targets.
12. Engage with developers of sites within the AAPs	AAP consultation process and discussions regarding site allocations	WCC: planning policy and development control	End 2011	Ensuring that developers understand what is required and the opportunities presented by renewable and low carbon energy.
13. AAP policies to ensure that zero carbon development can be achieved	AAP consultation process	WCC: planning policy	AAP adoption (2013?)	Ensuring that AAP developments are ‘future proofed’ to achieve zero carbon standards (for homes from 2016 and non-residential by 2019).

11. Glossary

Allowable Solutions: Allows a developer to meet targets (e.g. for zero carbon development) by making a higher provision of carbon savings than the development site would allow by taking financial contributions from the developer to fund low carbon technologies elsewhere.

Anaerobic Digestion: Anaerobic digestion is a well proven renewable energy and waste management technology. It produces renewable energy in the form of biogas from organic materials such as manures and slurries, food waste and sewage sludge.

BREEAM (BRE Environmental Assessment Method): BREEAM is the most widely used environmental assessment method for buildings (typically used for non-residential developments, similar to the way the Code for Sustainable Homes is used for housing). It sets the standard for best practice in sustainable design and has become the main measure used to describe a building's environmental performance.

CHP: Combined Heat and Power. The supply of both heat and power from a single generating facility. Differs from traditional generators where heat produced during the generation of power is released without deriving any benefit from it.

CERT: Carbon Emission Reduction Target. A scheme that requires energy suppliers to reduce emissions from the homes they supply. Providing free or subsidised energy efficiency measures (e.g. free low energy light bulbs) is one way that energy suppliers can meet their obligations.

CESP: Community Energy Saving Programme. A scheme that targets households in areas of low income, to improve energy efficiency standards, and reduce fuel bills. CESP promotes a ‘whole house’ approach i.e. a package of energy efficiency measures best suited to the individual property. The programme is delivered through the development of community-based partnerships between local authorities, community groups and energy companies, via a house-by-house, street-by-street approach.

Code for Sustainable Homes: the Code for Sustainable Homes (the Code) is the national standard for the sustainable design and construction of new homes. The Code aims to reduce our carbon emissions and create homes that are more sustainable. It applies in England, Wales and Northern Ireland.

The Code is not a set of regulations. The Code goes further than the current building regulations, but is entirely voluntary, and is intended to help promote even higher standards of sustainable design. The Code measures the sustainability of a new home against nine categories of sustainable design, rating the 'whole home' as a complete package. It covers Energy/CO_2, Water, Materials, Surface Water Run-off (flooding and flood prevention), Waste, Pollution, Health and Well-being, Management and Ecology.

The Code uses a one to six star rating system to communicate the overall sustainability performance of a new home against these nine categories. The Code sets minimum standards for energy and water use at each level and, within England, replaces the EcoHomes scheme, developed by the Building Research Establishment (BRE).

Carbon Reduction Commitment (now known as CRC Energy Efficiency Scheme): The CRC Energy Efficiency Scheme is a mandatory scheme to improve energy efficiency and therefore cut CO_2 emissions in large public and private sector organisations. These organisations are responsible for around 10% of the UK's CO_2 emissions. The scheme features a range of reputational, behavioural and financial drivers which aim to encourage organisations to develop energy management strategies that promote a better understanding of energy usage.

CLG: (Department of) Communities and Local Government.

Decentralised energy supply: refers to that which is part of or near to a development site and locally connected.

DECC: Department of Energy and Climate Change.

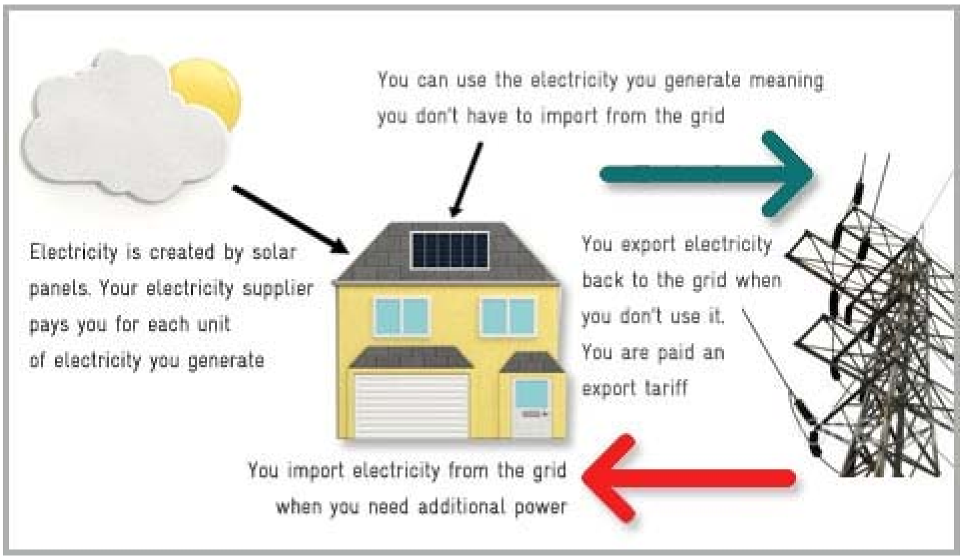
DEFRA: Department of Environment, Food and Rural Affairs.

DHN: District Heating Network.

ESCO: An energy service company (acronym: ESCO or ESCo) is a commercial business providing a broad range of comprehensive energy solutions including designs and implementation of energy savings projects,energy infrastructure, power generation and energy supply, and risk management.

Environmental Impact Assessment (EIA): An environmental impact assessment is an assessment of the possible positive or negative impact that a proposed project may have on the environment, together consisting of the natural, social and economic aspects.

FiTs (Feed in Tariffs): A Government scheme to promote the take up of small to medium scale renewable energy production by guaranteeing a rate of payment for the energy produced for a fixed term. The tariffs available differ by technology and energy output.



Source: Energy Savings Trust (see link overleaf)

"As an example, a typical domestic solar electricity system, with an installation size of 2.7kWp could earn around:

- *£990 per year from the Generation Tariff*
- *£40 per year from the Export Tariff*
- *£140 per year reduction in current electricity bills.*

This gives a total saving of around £1,170 per year.

This assumes 50% of the electricity generated is exported. The figure will vary depending on how much is exported."

Source (and for further information): http://www.energysavingtrust.org.uk/Generate-your-own-energy/Sell-your-own-energy/Feed-in-Tariff-scheme#howitworks

Green Deal: A Government scheme for reducing emissions and fuel poverty by providing financial support for efficiency measures to low income households.

GSHP: Ground Source Heat Pump. Low carbon energy technology which utilises the stable temperature found in the ground to provide heat to properties.

HCA: Homes and Communities Agency.

Installed capacity: this is the theoretical annual production capacity of a plant.

MUSCo: Multi-Utility Service Company. Similar to an ESCO but provides a range of utility services rather than just energy.

Renewable and low carbon energy: includes energy for heating and cooling as well as electricity. Renewable energy covers those energy flows that occur naturally and repeatedly in the environment, from the wind, the fall of water, the movement of the oceans, from the sun and also from biomass. Low carbon technologies are those that can help reduce emissions. Renewable and low carbon energy supplies include, but not exclusively, those from biomass and energy crops; combined heat and power (CHP); waste heat that would otherwise be generated directly or indirectly from fossil fuels; energy from waste; ground source heating and cooling; hydro, solar thermal and photovoltaic; and wind generation.

RHI: Renewable Heat Incentive. A Government scheme to promote the take up of small to medium scale renewable heat production by guaranteeing a rate of payment for the heat produced for a fixed term. The tariffs available differ by technology and energy output and are due to be available from Summer 2011.

ROCs: Renewable Obligation Certificates. A certificate issued for every megawatt hour of renewable electricity produced by licensed suppliers so they can prove that they are supplying the amount of renewable energy they are required to.

Appendix A
Energy Demand and CO_2 Emissions

City-wide energy demand and emissions

Existing energy demand and emissions

This section presents an overview of Wolverhampton's current energy use and resultant CO_2 emissions from the built environment; that is the energy used to heat and power the City's homes, offices, schools and other buildings. A summary of existing energy demand across Wolverhampton is provided in Table A.1.

Table A.1 Existing energy demand for Wolverhampton

Consumer	Electricity (GWh/y)	Natural Gas (GWh/y)	Total Energy Consumption (GWh/y)
Residential	415	1,495	1,910
Commercial & industrial	614	694	1,308
All Consumers	1,029	2,189	3,218
Consumer	**Average Electricity Consumption (kWh/y)**	**Average Natural Gas Consumption (kWh/y)**	
Residential	3,960	15,561	
Commercial & industrial	73,852	511,132	

Note: Data based on most recent data available from DECC (sales figures for 2008/2009)

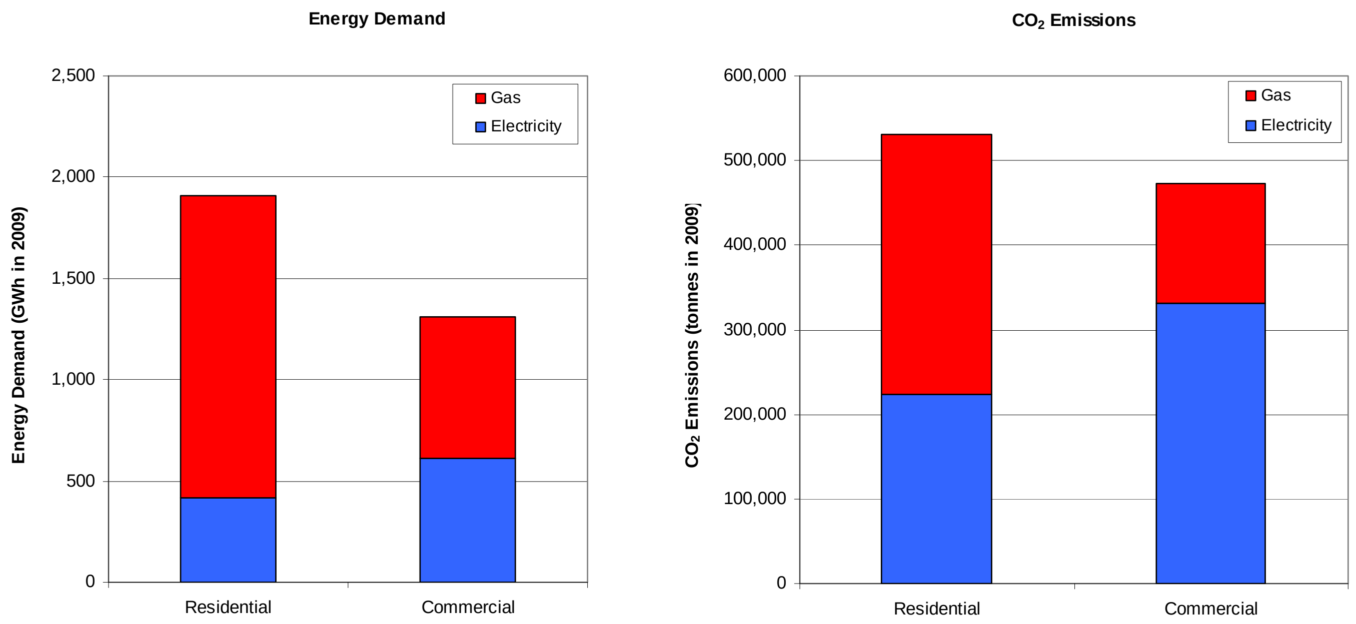
From the figures in Table A.1 the resulting CO_2 emissions can be calculated. The carbon factors in Table A.2 have been used. Figure A.1 provides a summary of the energy demand and CO_2 emissions.

Table A.2 Carbon factors

Fuel	Carbon Factor (kgCO_2/kWh)
Electricity	0.539
Natural Gas	0.205

Source: DEFRA/DECC (2010)

Figure A.1 Energy demand baseline (Wolverhampton)



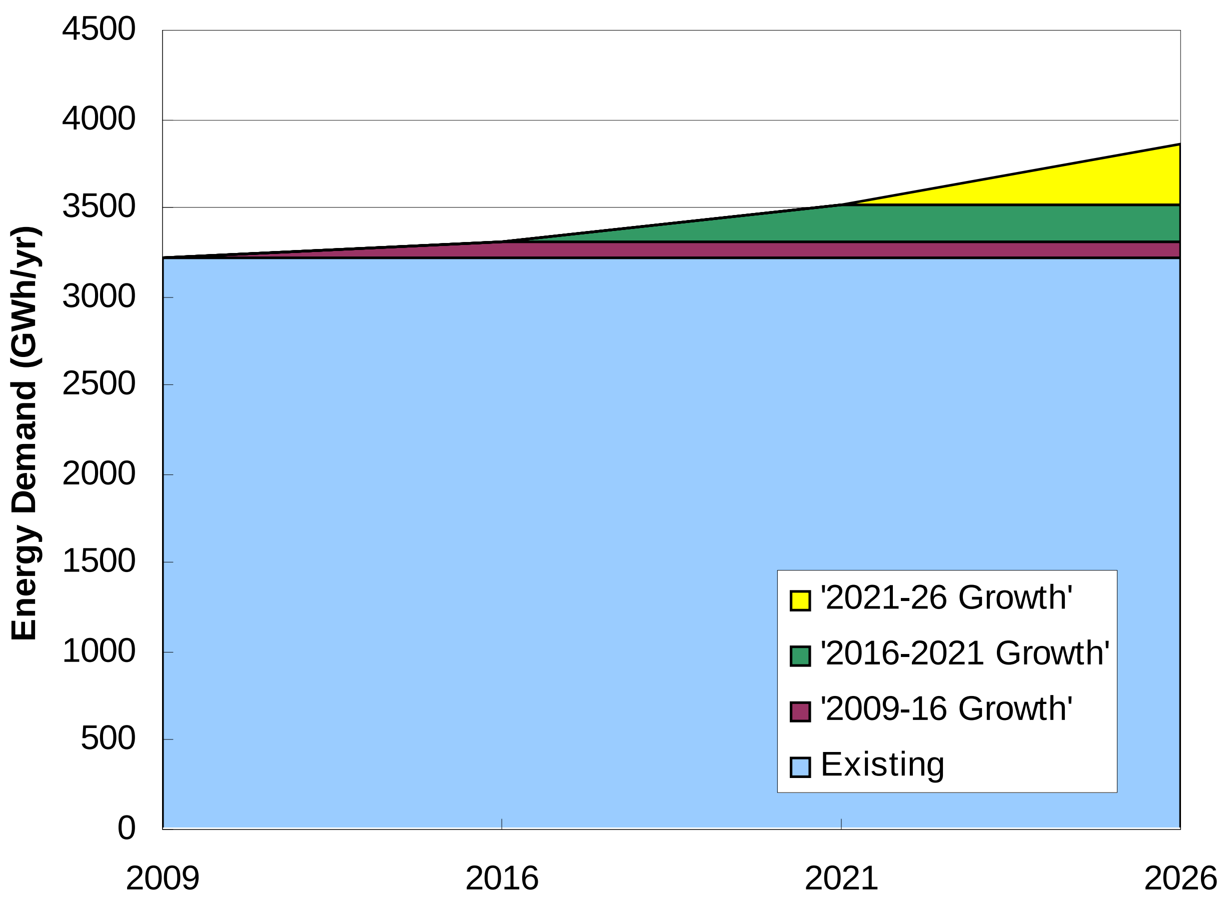
2008/09 Energy Demand (GWh/annum)		CO_2 emissions per annum (tonnes/annum)
Heat	2,189	448,745
Electricity	1,029	554,631
Total energy demand (2008/09)	3,218	1,003,376

Projected energy demand and emissions

The Black Country Core Strategy outlines future planned development 2009-2026 in terms of both additional residential properties and wider employment development (13,411 new dwellings [Core Strategy Table 7 page 49] plus a further 34 hectares of employment land [Core Strategy Table 4 page 47, based on bringing forward RELS sites]). While these figures provide a guide to what additional development might contribute to future energy demand there is clearly a large degree in uncertainty as to the precise timings and extent of such proposed developments. In particular, it is challenging to accurately estimate the change in commercial demand, since there is much uncertainty regarding the use of existing commercial land, specific industries coming forward and the future of existing businesses.

For this reason a range of energy demand is presented here, from a lower bound where only half (50%) of the proposed developments are completed, to an upper bound where all of the proposed development is achieved. Given present economic circumstances and inherent uncertainty in medium/long term projections this can only provide a guide as to the pace and magnitude of additional energy demand within the Wolverhampton area.

Figure A.2 Energy demand growth in Wolverhampton to 2026 (assuming all Core Strategy growth comes forward)



Appendix B
Review of Renewable and Low Carbon Technologies

Building-integrated Micro-generation

Overview

As demonstrated in Figure 2.1 there are a number of schemes where micro-generation, including solar PV and solar thermal systems, have been installed. In addition, a number of schools have incorporated biomass boilers. The wider potential for micro-generation in Wolverhampton needs to be considered, both retrofitting existing buildings and as part of planned new growth and development.

Solar PV

The principal driver behind solar PV within in an urban area is the level of available roof space. Key requirements are that the building has a roughly south facing roof, can support the weight of the panels and is not over-shaded by surrounding buildings or trees. This relatively straightforward installation requirements means a significant proportion of the existing housing stock will be suitable, giving a substantial resource. We consider the opportunity for solar PV in two ways; specific projects in the AAPs and a more general estimate of the potential in the City as a whole.

AAPs

In assessing the potential impact of Solar PV in individual AAPs it is useful to begin by assessing the largest available roof spaces considered feasible for installation. In this way attention can be targeted on a small number of larger scale projects to look at in more detail rather than a broad brush assessment trying to account for all building existing building stock.

For each AAP, therefore, GIS and aerial satellite data have been used to identify large buildings considered suitable for Solar PV and generated an estimate of the available roof area. On the assumption that this roof space is not significantly over-shaded it is possible to then estimate the potential energy output from these sites. Table B.1 summarises the estimated energy generation potential across each AAP; TableB.2 provides a breakdown by individual site, with commentary regarding roof space.

Table B.1 Estimated Solar PV potential among existing buildings in each AAP

AAP	Energy Generation Potential (MWh/yr)	Carbon Impact (assuming displacement of grid electricity) tCO_{2e}/yr
Bilston	6,046	1,775
Wolverhampton City	618	166
Stafford Road Corridor	6,585	1,630

Energy output estimated at 0.14 $kW/m^2/yr$; carbon impact assumes 50% of energy generation is consumed on site.
Grid electricity emission factor 0.539 $kgCO_{2e}/kWh$ as per DEFRA/DECC published figure for 2009

Table B.2 Individual potential Solar PV sites

Site	Energy Generation Potential (MWh/yr)	Comment
Bilston		
Retail Warehouses, Milfields Road	2,525	Large open roof, number of flat areas suitable for angled arrays, sky lights might be a problem.
Commercial Warehouses, Spring Vale Avenue	1,342	Large open apex roof, SW facing areas may be suitable, may be problem with skylights.
Wilcox Industrial Supply, Mount Pleasant	987	Number of buildings some new and old roof types. Some skylights and obstructions on roofs might be a problem. There are a number of SW facing roof areas.
Hill and Smith, Spring Vale Avenue	583	Large open apex roof, SE facing areas may be suitable, may be problem with skylights.
Cullina Logistics, Spring Road	383	Complex apex roof, but large areas of SW facing roof space
Wolverhampton City		
West Park Hospital, Park Road West	155	Most of the site, complex small buildings, most with tree shading issues. Main hospital building, large open roof space SW facing, some air vents.
Dunstall Primary School	105	Large flat roof spaces suitable for angled arrays, lots of air conditioning units on roof, plus complex structure, therefore only around /2 the roof space is suitable.
Blackenhall Community ad Healthy Living Centre, Bromley Street	94	Complex set of buildings, but two areas of flat roof space suitable for angled arrays.

Site	Energy Generation Potential (MWh/yr)	Comment
HM Revenue & Customs, Birch St	92	Large flat areas of roof, but complex roof structure, around two-thirds can be used for PV. SW facing.
Royal Wolverhampton Hospital, Compton Road	55	Complex site, most buildings shaded by trees, main hospital building has large flat roof area, facing SW.
Stafford Road Corridor		
Freshway Chilled Foods, Stafford Road Corridor	1,025	Large multi apex roof, half of apex's south facing, skylights all over.
Booker Cash & Carry, Stafford Road Corridor	880	Large apex roof half south facing, skylights might get in the way though.
Technopali UK, Headway Road	813	Large building, number of apex roofs, half with SW orientation
Cargill Meats Europe, Wobaston Road	763	Large roof space, lots of air conditioning units on roof, whole roof SE facing
EWS, Headway Road	665	Large roof, five areas only one SW facing

Largest five potential sites listed here for each AAP

Note, in the case of the Wolverhampton City Centre AAP the Council Headquarters Building has been excluded from the assessment since this is subject to an ongoing procurement process to install solar PV. The focus here is on potential future projects as opposed to those known to be in the process of delivery.

City-wide

The West Midlands Regional Study suggests that there is around 51MW of potential solar PV across the City as a whole (among existing building stock); the actual deployable potential is likely to be significantly lower than this. Even a simple assumption that the entire building stock roofs are predominantly orientated equitably (i.e. 25% north, 25% south etc.) reduces this potential by about half. While commercial premises may afford large roof areas the productive space for solar PV can be restricted by other plant equipment already on the roof (e.g. air handling units) or indeed the local electrical grid infrastructure. In the case of residential properties householders are more likely to focus on space/water heating requirements in the first instance rather than electrical supply via Solar PV (or other sources).

Economically, the availability of feed in tariffs assists in making Solar PV more attractive as a potential investment option. In the case of non-domestic premises, for example, a 5kWp array might now payback within 10-15 years (depending upon the balance of displaced grid electricity and level of exported power). However, this would still require a capital investment of the region of £20-25,000. In terms of carbon abatement, assuming that 50% of the power generated is exported to the grid then carbon savings would be of the order of 1tCO_{2e}/yr; even over a 25 year period (the full term of FITs eligibility) this would mean a unit abatement cost of £700-£1,000 per tCO_{2e} (capital spend per unit carbon saving). This compares with, in the region of, £300-500 per tCO_{2e} in the case of a boiler replacement.

In terms of future developments, both residential and non-domestic, solar PV is likely to be integrated into design specifications more frequently as tightening energy and carbon performance standards require.

Solar thermal

Solar thermal systems have similar siting requirements as those discussed in the case of Solar PV. In addition, there needs to be a significant hot water demand at the site, which remains reasonably constant throughout the calendar year. While this is typically the case for residential properties, it limits the impact of such systems in non-domestic premises. Swimming pools, hospitals and schools, as well as residential care homes typically provide suitable sources of hot water demand.

AAPs

For each AAP, therefore, GIS and aerial satellite data has been used to identify large buildings considered suitable for solar water and generated an estimate of the available roof area. This, combined with use of published benchmark energy consumption figures for different types of building, provides a means of assessing the deployable potential. On the assumption that this roof space is not significantly over-shaded it is possible to then estimate the potential energy output from these sites. Table B.3 summarises the estimated energy generation potential across each AAP; Table B.4 provides a breakdown by individual site, with commentary regarding roof space.

Table B.3 Estimated Solar Thermal potential among existing buildings in each AAP

AAP	Energy Generation Potential (MWh/yr)	Carbon Impact (assuming gas displacement) tCO_{2e}/yr
Bilston Corridor	1,684	312
Wolverhampton City Centre	4,991	1,023
Stafford Road Corridor	1,524	345

Carbon impact assumes 10% of hot water demand is met by solar thermal systems in office buildings; 20% in the case of residential care homes. Natural gas emission factor 0.20155 $kgCO_{2e}$/kWh as per DEFRA/DECC published figure

Table B.4 Potential individual solar thermal installations by AAP

Site	Potential Energy Generation (MWh/yr)	Comment
Bilston Corridor		
BIlston Leisure Centre	1,270	Complex roof structure, but a large section of SW roof space
South Wolverhampton & Bilston Academy	280	Complex roof structure some SE facing roof space
Green park School	72	Old complex roof structure, but some flat areas that are clear of obstructions for angled arrays
Hill Avenue Primary School	62	Complex roof structure but there may be some space for angled panels
Wolverhampton City Centre		
Royal Wolverhampton Hospital	2,337	Complex site, most buildings shaded by trees, main hospital building has large flat roof area, facing SW
West park Hospital	1,810	Most of the site, complex small buildings, most with tree shading issues. Main hospital building, large open roof space SW facing, some air vents.
City of Wolverhampton College	458	Multiple apex roof, se facing, some large areas for PV, skylights may be an issue though.
HM Revenue and Customs	159	Large flat apex roof, half facing se
Graiseley Primary School	96	Complex roof structure but some SW facing roof space
Stafford Road Corridor		
North East Wolverhampton Academy	636	Large flat roof areas, suitable for angled arrays,
Pendeford Business Park	344	Lots of small buildings, some SW roof space.
Blackmore, The Development Centre	228	Multiple apex roof, se facing,
Chart Energy and Chemicals	144	Large flat apex roof, half facing SE
Open College network of the West Midlands	96	Complex roof structure but some SW facing roof space

City-wide

The West Midlands Regional study suggests that there is a potential 43MW of solar water output across the City as a whole. As with the solar PV figure the actual deployable potential will be much lower. While commercial scale systems are available in the market today, commercial uptake will be limited by base-load water heating requirements as previously discussed. There is also, to an extent, competition from centralised energy networks; centralised CHP networks can potentially deliver space and water heating as well as electricity. This affords a larger potential net carbon saving than the solar water system alone and may therefore be more attractive from an investment return perspective. From a practical perspective, larger scale systems may not be viable due to roof limitations in terms of bearing the weight of the collector and water. Residential systems are therefore likely to predominate, particularly where existing systems include an immersion heater and dedicated water storage tank.

Economically, solar thermal systems typically cost in the region of £500 per kW installed capacity and offer simple paybacks in the region of 6-10 years, depending upon the proportion of total hot water demand that the system is sized to meet. These paybacks will be improved on the introduction of the UK Government's Renewable Heat Incentive (RHI) since output from solar thermal systems will be eligible for tariff receipt. In terms of unit carbon abatement costs values will range between £300-£400/tCO_{2e} saving, depending upon the size of collector and therefore proportion of hot water demand the system meets.

In the case of future build stock, it is unlikely that solar water systems will feature as a significant fraction of total low carbon generation. This is mainly due to the fact that the selection of a solar water system restricts further carbon saving potential in the design of any new properties therefore making it harder (and more expensive) to attain the levels of carbon and energy efficiency performance projected under tightening building regulations.

Heat pumps

Heat pumps concentrate and transfer heat from an external source (either air, ground, or water) to heat buildings. Electricity is required to drive the pump(s) required to circulate the working fluid around the system.

Heat pumps can help to reduce emissions and energy costs, particularly in electrically heated buildings. An important point to note however is that the CO_2 emissions from an Air Source Heat Pump (ASHP) are approximately similar to those from a modern condensing boiler when electricity to run the pump is sourced from the grid. Ground Source Heat Pumps (GSHP) give slightly better performance, but reductions are modest (~15%). Hence a large scale roll-out of ASHP in properties heated by gas will not lead to substantial CO_2 emissions reductions, at least not in the short to medium term. If, and when, emissions from the grid fall (i.e. due to increasing levels of renewable or low carbon energy), these technologies will become more effective.

Substantial carbon and financial savings can be generated by ASHPs and GSHPs when installed in buildings that are off the mains gas network and/or electrically heated. Given data available from DECC and the English House Condition Survey it is possible to estimate the number of properties across the City which fit into these categories and therefore generate an order of magnitude assessment of the potential carbon impact of such systems. A summary is provided in Table B.5. Heat pumps can also be beneficial in new highly-insulated buildings where the heat demand is very low and does not justify the installation of a gas heating system; electric heating would often be installed in this case but the use of a heat pump can help further improve the carbon emissions performance.

Table B.5 Potential impact of ASHP and GSHP

Parameter	Value	Comment
Total Dwellings	103,550	City wide
Total Number of Mains Gas Consumers	96,075	Assume all properties fed with mains gas use this as primary fuel for space heating and hot water
Total properties with no mains gas	7,475	= 103,550-96,075
Assume number of oil fired heating systems	1,495	20% of total off gas network properties
Assume number of electrical heated properties	5,980	80% of total off gas network properties
Estimated Net Carbon Impact (Oil Heating) - tCO_2e/yr	900-1,200	Assuming ASHP meets 50% of total heating demand
Estimated Net Carbon Impact (Electric Heating) - tCO_2e/yr	20,000-25,000	Assuming ASHP meets 50% of total heating demand
Total Net Carbon Savings - tCO_2e/yr	21,000-26,200	
Percentage Reduction vs. Residential Baseline Emissions	4-5%	Measured against 2009 baseline

In the West Midlands Regional Study the potential generation capacity for ASHP was stated as 409MW with GSHP potential as 102MW. As highlighted above, the deployable potential is much lower given the zero (or negative) impact on carbon emissions of installing heat pumps in properties with existing mans gas fed boilers. To achieve carbon reductions, deployment of heat pumps should be focussed on those properties off the mains gas network.

The physical space requirements of an ASHP are relatively modest, making retrofit installation feasible for most types of dwelling. However in the case of GSHP significant land area is required in order to allow boreholes or trenches (depending upon the system configuration chosen) to be installed. This further reduces the deployable potential given either a lack of physical space or difficult ground conditions. The maximum temperature output from such systems is lower than equivalent fossil fuel heating systems, which means that they are best suited to under-floor heating or similar where there is a large surface area for heat delivery.

Economically heat pumps will typically afford simple paybacks in the region of 10-15 years, depending upon the size of the system; longer paybacks are more typical of ground source heat pumps. These paybacks will improve on the advent of the UK Government's RHI scheme. In terms of unit abatement costs, the values will range from something in the region of £100-200/tCO_{2e} where heat pumps displace electric heating and £400-700/tCO_{2e} where they displace oil based heating (depending upon the system installed).

Water source heat pumps could also be used, linked to the existing canal network for example. The opportunity to use the existing canal network to provide heating and cooling for buildings is something that has been previously highlighted to Wolverhampton City Council by British Waterways[47]. The feasibility and viability of using this resource would need to be considered at a project specific level, for example where new development is proposed

[47] http://www.britishwaterways.co.uk/media/documents/SustainableCoolingSolutionForCanalsideProperties.pdf (last accessed December 2011).

adjacent to a canal. Depending on the scale of uptake this could have a helpful contribution towards the City's renewable and low carbon energy supply.

Micro-wind

Micro-wind is not expected to have a significant role to play in Wolverhampton. In urban areas the wind resource is generally very poor at rooftop level, with very high levels of turbulence, leading to poor energy yields from roof-mounted turbines. It is common for developers to install micro-turbines on new commercial buildings, as they are relatively simple and visible, but the yield is typically much lower than the nameplate rating suggests. Hence though they can make a strong visual statement, it is not recommended that strategies should promote micro-wind systems. Turbines greater than approximately 5kW in rated capacity may have a role to play however, as discussed in section 4.4.

Commercial-scale projects

Wind turbines

Identification of potential sites

As an almost entirely urban area, Wolverhampton has limited potential for wind energy. The West Midlands Regional Study identified 0.3MW of potential, but does not specify where this is located, nor what scale of turbine would be appropriate. AMEC has carried out a detailed constraints analysis which identifies areas which may have potential for medium scale turbines (with a capacity of greater than 50kW but less than 1MW). An initial constraints mapping exercise has identified some (albeit limited) opportunities that may be worth more detailed investigation. The following constraints have been considered:

- noise - a 300m noise buffer has been applied around all residential properties;
- Local Nature Reserves;
- Registered Parks and Gardens; and
- Listed Buildings.

The resulting areas with potential are shown in Figure 4.1 in the main body of the report, across four sites.

A brief summary of the main areas identified is provided overleaf.

Area 1 - Land north of Bushbury Hill
Main area is within woodland/farmland. M54 some distance to north. Farm in northern section. Smaller section is adjacent to M54 and next to major electrical substation and so would likely be ruled out on further investigation due to H&S. Smallest section appears to be within a car park for either a sports ground or an industrial unit.

Area 2 - Land on Planetary Industrial Estate
Area is located within a large industrial estate, characterised by large warehouses. The A4124 runs through this area. Aerial photos suggest some parts of the industrial estate may be more open than others. Access would be straightforward due to extensive road network.

Area 3 - Land south of Goldthorn Park
Area consists entirely of farmland and small areas of woodland. Access to area would be via farm tracks from either a housing estate or from the A459 to the east.

Area 4 - Land near Dunstall Park Racecourse
Area located between racecourse and railway siding, and consists of a mixture of grassland and wooded areas. Proximity to racecourse may be a concern with regards to British Horse Society. Canal cuts through the centre of the site so when considered in conjunction with the railway lines access may be an issue.

Potential energy supply

The key parameters of a typical medium scale turbine are shown below in Table B.6. The energy yield may be highly variable from site to site, but this gives an indication of the typical output that could be expected from a turbine of the scale likely to be appropriate in Wolverhampton.

Table B.6 Characteristics of a typical medium-scale turbine

Parameter	Value
Turbine Type (as modelled in the assessment)	Fuhrlaender FL 100
Total Installed Capacity	125kW
Estimated Turbine Output	300MWh/year
Estimated Capacity Factor	25%

A detailed site screening of each region would be required to understand specifically where turbines could be located. However, as an indication if a single 125kW turbine were to be located on each of the four identified unconstrained areas this could contribute in the region of 1.2GWh of renewable energy per year, sufficient to power around 450 homes. So it can be concluded there is a small, but not negligible wind resource, and a more detailed screening of each site would be recommended to more accurately determine the constraints and the number of turbines that could be accommodated and possible locations.

Hydro electric schemes

The potential for hydro electric schemes in the city is negligible. There are no major rivers in Wolverhampton, and though a number of small rivers and tributaries rise in the City (e.g. Watershead Brook, a tributary of the River Penk, and Smestow Brook, a tributary of the River Stour), these small watercourses are not considered likely to support a commercially viable hydropower scheme due to the low (and variable) flow rates.

Energy from Waste (EfW)

Household waste is already being exploited as a low carbon energy resource in Wolverhampton, but there is significant potential to further increase the energy recover from other waste streams. Targets to divert waste from landfill mean gate fees have increased considerably in recent years (and will continue to increase), giving a strong driver to develop alternative waste treatment plants. The key technologies include thermal incineration, gasification or pyrolysis with energy recovery, and biological treatment such as anaerobic digestion. A considerable fraction of waste is organic matter (biomass), and considered renewable. However, there are also non-renewable materials such as plastics that mean waste cannot be considered renewable, but still lower carbon than fossil fuels.

Several schemes are currently proposed, and it is expected that waste will be a significant contribution to energy supply in future. The sources of waste arisings in the City and a high level estimate of the energy recovery potential are presented in this section.

Municipal Solid Waste (MSW)

Municipal Solid Waste (MSW) is sorted at the kerbside, with the residual non-recyclable fraction sent to the Crown Street EfW plant, operated by Martin Engineering Systems (MES). This plant has a capacity of 110,000 tonnes of MSW per year, recovering energy from the combustion of this material via a steam turbine. The plant generates a net electrical output of 7.1MW, all of which is exported to the grid. The plant is not capable of exporting heat at present as the turbine is not designed to operate in CHP mode. There may be an opportunity to convert the plant into a CHP facility in future, which would enable in the region of 14MW (up to around 110GWh per year) of low carbon, locally produced heat to be piped to buildings in the city while still allowing a substantial electrical output. However, this is only likely to viable at a point when the plant requires major refurbishment (including replacement of the turbine) or replacement entirely. The plant was commissioned in 1998 and, based on a typical 25 year design life, a major overhaul or replacement could be expected around 2023 (also the end of the contract between WCC and MES) which in the absence of any other drivers would be the earliest likely date that the plant would be capable of exporting heat as well as electricity.

However, the development of a district heating network in the city centre (based on gas CHP initially) would allow the EfW plant to ‘plug into’ a network at relatively low cost, and if there were to be sufficient guaranteed heat demand on the network it may be economically viable to replace the current turbine with a CHP enabled unit before the end of the design life. Hence the potential for this plant to contribute additional low carbon energy to the City in the medium term is dependent on a heating network being established in order to provide an incentive to replace the existing turbine, otherwise it is likely to be well over 10 years before any low carbon heat is available from this source.

Note that food waste is collected separately and treated in an anaerobic digestion plant (see the Anaerobic Digestion and Biogas section for details).

Commercial and Industrial Waste (C&I)

Data on commercial waste arisings in Wolverhampton (and the UK in general) is limited as waste is collected and disposed of by numerous private contractors. Details regarding composition and energy content are unknown; however in general the CV is similar to or slightly above that of municipal waste. Hence we have assumed a typical CV of 12MJ/kg.

Other waste sources

As well as the above there are substantial arisings of waste from construction demolition and excavation activities (CD&E waste). Much of this waste is inert (rubble, soil etc.), with wood being the main combustible fraction. For CD&E waste an attempt has been made to estimate the biomass proportion using WRAP data. However, this appears to be a significant underestimate, with wood estimated to comprise only 3% of the total. However, in the absence of any other data, we have used this figure.

Hazardous waste is the other main category, and is subject to stricter disposal legislation. Clinical waste can be treated by incineration at high temperature (>1,200^{o}C). There is one such plant in Wolverhampton at New Cross Hospital (capacity 2,500 tonnes per year). This plant is not known to incorporate energy recovery, and the low capacity means it is unlikely to be viable to retrofit energy recovery equipment to this plant. There does not appear to be a need for additional plant, especially as the New Cross plant is only operating at around 50% of its rated throughput at present.

Other hazardous wastes include oils, paint and solvents, acids and alkalis. Generally these materials are not suitable for thermal treatment and are instead treated via a chemical neutralisation plant (with much of Wolverhampton's hazardous material sent to the Wednesbury Waste Management and Resource Centre where it is treated in this way). In addition the waste hierarchy encourages this method of treatment over thermal treatment with energy recovery. Hence hazardous waste is not considered to offer potential to contribute to energy supply.

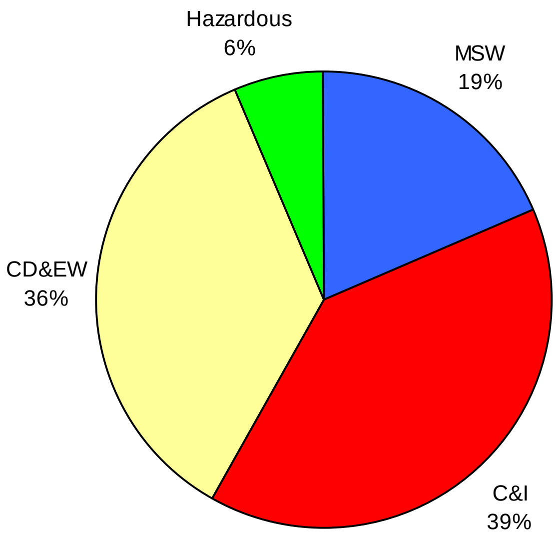
An additional potential source of heat is crematoria. A number of Local Authorities are considering using the residual heat for supply to nearby buildings, for example Redditch Borough Council is currently installing equipment to allow heat to be supplied to a local leisure centre. As the heat is free, the key issues it the equipment cost, the majority of which is in the hot water pipework. There may be potential for Bushbury crematorium to supply heat to local buildings, such as nearby schools; however it is located over 600m from any significant heat user, so the viability is uncertain (note the Redditch crematorium is less than 300m from the swimming pool).

Total arisings are estimated in the Black Country Core Strategy, summarised in Table B.7, with the breakdown by type shown in Figure B.2.

Table B.7 Waste arisings and energy recovery potential

Waste Type	Arisings (tonnes/y)	Calorific Value (GJ/tonne) [48]	Total Energy Content (MWh/y)	Potential Electrical Output (MWh/y)	Potential Thermal Output (MWh/y)	Electrical Installed Capacity (MWe)
MSW	147,000	9.3	379,750	94,938	189,875	12
C&I	311,000	12	1,036,667	259,167	518,333	32
CD&EW	280,000	n/a	n/a	n/a	n/a	n/a
CD&EW - Wood Only[49]	*8,316*	*17*	*39,271*	*9,818*	*19,636*	*1*
Hazardous	50,000	n/a	n/a	n/a	n/a	n/a
Total	**796,316**		**1,455,688**	**363,922**	**727,844**	**45**

Figure B.2 Breakdown of waste arising by type



Energy from waste (including biomass from waste sources) has a significant role to play in the energy mix of Wolverhampton for the following reasons:

[48] Assumed calofic values are typical average figures for the UK, though significant variation is possible depending on the actual waste composition.

[49] The figure for wood waste arisings from C&D activities are extrapolated from the WRAP market study, but is thought to be a considerable underestimate of the actual arisings so should not be relied upon.

- good availability of waste given high volume of arisings in a compact area, and good transport links within the City and beyond; and

- good opportunities to recover energy and provide low carbon heat and electricity to local homes and businesses to private wire/district heating networks.

However, although there are definite benefits there is a need to carefully consider impact of numerous EfW/ biomass plants on air quality and other planning and environmental measures. Although the emissions from modern combustion plant are very low, the cumulative impact in an urban area must be considered especially as the City falls within an Air Quality Management Area. There can also be issues with discouraging development and lowering house prices in close proximity to this type of plant, so appropriate siting is important. The use of, or redevelopment of, existing waste management sites can help avoid this problem.

Several EfW/biomass plants are planned in and near Wolverhampton (for further information see section 3):

- Monmore Road pyrolysis plant - 17,000 tonnes per year plant treating residual C&I waste (gained planning permission in 2011);

- Express Power's Greenpower.54 - 250,000 tonnes per year biomass/Sold Recovered Fuel plant on i54; and

- Four Ashes ERF (South Staffordshire) - 300,000 tonnes per year EfW plant under construction on Four Ashes Industrial Estate.

Biomass heating

Biomass differs from other sources of renewable energy in that it can be transported, stored and used at a wide variety of scales, giving significant advantages over variable sources such as solar and wind energy. However, there are also a number of potential barriers, such as the requirement for space and access for deliveries, air quality concerns in urban areas and increased complexity and maintenance requirements. Additionally, fuel supply chains are developing with better coverage in some parts of the country than others, and the regulatory framework continues to evolve, particularly regarding fuel standards.

Biomass resource - existing biomass arisings

As covered in the energy from waste section there is a substantial source of waste wood in Wolverhampton. There are no substantial woodland areas, so arisings from forestry management activities can be considered negligible. There will be small, but not negligible, resource from arboriculture activities (e.g. tree surgery, parks and garden management), but this is often difficult to collect centrally and exploit as a fuel. Despite the limited resource within the City boundary, there are considerable arisings in the neighbouring rural areas of Staffordshire and Shropshire. Biomass can be reasonably transported for approximately 30 miles without incurring major additional costs or CO_2 emissions, and there are a number of existing suppliers within this distance[50]. One of the key suppliers of both wood pellets and chip, Midlands Wood Fuel Ltd, has a depot in nearby Pattingham.

[50] http://www.biomassenergycentre.org.uk/portal/page?_pageid=77,241242&_dad=portal&_schema=PORTAL.

Staffordshire County Council has set up their own wood fuel company[51] which supply fuel to numerous public and private buildings. There may be a similar opportunity for WCC to help establish the supply chain, giving confidence to developers considering installing biomass plant from both the point of view of fuel availability and a clear endorsement from the authority. Such a scheme would be limited by the available resource, with a likely focus on waste wood and/or arisings from arboriculture. A scheme to help the segregation, collection and processing of clean waste wood (i.e. material that will not require WID compliant boiler plant) could be particularly beneficial as it requires a coordinated approach working in partnership with numerous waste contractors

Biomass resource - energy crops

As well as existing resource, there are opportunities to grow crops specifically for the purposes of supplying energy. Suitable sites include vacant industrial land and other wasteland, and the growing of energy crops can also help with remediation of derelict sites.

WCC has recently had discussions with E.ON regarding opportunities to grow crops on brownfield land to use as feedstock for an AD plant (specifically maize, but other crops may be suitable). The potential for the use of disused brownfield land to grow energy crops in the Wolverhampton city area was assessed by considering vacant brownfield land registered on the 2009 NLUD. Only areas of land greater than four hectares were considered as it was assumed that it would be economically impractical to cultivate the large number of small plots within the city area.

Plots of unused land within the i54 development zone were not included in the total, as there is a high potential for future development at the site with correspondingly high land values. The remaining total land area of approximately 120 hectares accounts for 36% of the total disused brownfield land area in Wolverhampton.

Information supplied by E.ON suggests that five hectares of energy crops would be enough to supply electricity for 200 average homes. The 120 hectares would therefore have the potential to meet the electrical demand of approximately 5,000 homes in the Wolverhampton area (equivalent to around 20GWh/year).

In reality, only a proportion of this land is likely to be available for this purpose, as only lower value, larger sites are likely to be viable (such as contaminated sites requiring remediation prior to redevelopment), and there may be competition for other uses in many cases. Nonetheless this does suggest that small scale cultivation of crops for energy production via AD or combustion could be worthwhile pursuing, as even if only a small proportion of the land is suitable there could still be a resource sufficient to power the equivalent of hundreds of homes with renewable electricity and/or heat. Further discussions with E.ON or other organisations active in this field are recommended to more accurately understand the opportunity.

[51] http://www.staffordshire.gov.uk/environment/woodfuel/home.aspx.

Deployment of biomass in Wolverhampton

There are a number of existing biomass boilers in Wolverhampton, the largest being a 1MW pellet boiler serving existing residential properties in Heath Town. Other boilers have been installed at several schools, and at the Cross Street South development (0.1MW).

Opportunities for biomass heating exist in almost any property with a requirement for hot water and space heating throughout the year, providing there is sufficient space to locate the boiler plant, fuel store and auxiliaries, and that has sufficient access. The space and access requirements rule out many homes from having a system sufficient to provide all heating needs, and even those that do have space may find that it is not economic. However, small stoves which can provide a proportion of space heating can be installed in most residential properties (log or pellet fuelled typically). Larger systems are better suited to flats than individual homes, and public or commercial buildings such as educational sites, hotels.

Biomass systems can give high CO_2 savings, but the cost of fuel often means it takes a long time to repay the capital investment (biomass boilers are several times more expensive than equivalent gas boilers). The introduction of the RHI should help to greatly improve the economics of biomass heating, particularly in buildings not heated by gas where payback periods can be less than five years.

Given the higher capital cost of biomass relative to fossil fuel boiler plant, it is essential to ensure all issues are considered prior to investment. As well as the obvious requirement to correctly size and specify the boiler plant and fuel store, it is important to establish fuel supply contracts (and ensure the chosen boiler and fuel specification match), consider access for deliveries, noise issues associated with deliveries and operation. Many biomass projects have been severely hampered by insufficient consideration of these issues at design stage.

A biomass boiler installation is currently being installed and due to be commissioned at the Heath Town boiler house in February 2012. The boiler is designed to supply heat to 1,123 properties within the Heath Town district heating scheme, a scheme previously fuelled by coal, oil and more recently gas. The scheme has encountered problems in its ability to claim the Renewable Heat Incentive, as a requirement for additional metering at a number of points across the estate will need to be incorporated for the system to qualify for RHI payments.

The recent hike in gas prices means that the difference in the cost of gas against wood fuel is fairly negligible which will mean that until the RHI can be claimed the fuel bills for the district heating scheme should not substantially increase than if it was run on gas alone. However the inability to claim RHI would have a negative impact as the income generated through the RHI would be included to fund other measures that would improve the thermal efficiency of properties, alleviate fuel poverty and reduce CO_2 emissions. Anaerobic Digestion (AD) and Biogas.

As well as the combustion of solid biomass and waste discussed in the previous section, certain waste and biomass streams are suitable for biological treatment in an anaerobic digester:

- food and green waste;
- farm waste;

- certain types of industrial effluent (especially food and drink); and
- landfill and sewage gas.

Food and green waste
A separate food waste collection scheme for households in Wolverhampton was introduced in 2011. Collected waste is taken to an anaerobic digester plant operated by Lower Reule Bioenergy Ltd in Gnosall near Stafford where the biogas produced is used to generate electricity. Therefore it can be concluded that this resource is already fully exploited, although energy recovered does not contribute to Wolverhampton's energy supply directly as the plant is outside the City boundary.

There is an opportunity to collect food and green waste from commercial sources, especially supermarkets, hotels and restaurants. A dedicated plant could be built in Wolverhampton, with opportunities to supply electricity heat to homes and businesses, or potentially even inject biogas directly into the local gas network. Alternatively waste could be collected and sent to other nearby plants, such as the recently commissioned Poplars AD plant in Cannock, currently the UK's largest. Encouraging retailers to collect food waste could have significant benefits in terms of avoided emissions from landfill, but also economic benefits especially if treatment plants are developed within the City with energy exported directly to local homes and/or businesses.

It is difficult to accurately determine the quantity of C&I waste suitable for AD; however to give a sense of scale we have assumed a similar organic fraction suitable for treatment via AD as post-recycling MSW of around 20%, which gives a total resource in the region of 60,000 tonnes per year. This is sufficient to supply a large AD plant (twice the size of the Gnosall plant) with a potential electrical output of approximately 3MW (24GWh per year). It may only be possible to viably recovery a proportion of the total, but it still appears a promising opportunity. Arranging long-term contracts with a wide variety of businesses to guarantee waste feedstock is the most significant obstacle that must be overcome prior to investing in such a facility.

Industrial effluent and farm waste
Waste from industrial processing is often rich in organic matter that is well suited to treatment via AD. This can give considerable long-term economic and environmental benefits of using a waste by-product to produce biogas to contribute to heating and/or powering the plant. Identifying and, where necessary, educating suitable industries of the potential to benefit from an AD plant may help to increase the uptake. Industries in Wolverhampton that may be suitable for AD include breweries (Marstons in particular) food and drink manufacturers and dairies.

Landfill gas and sewage gas
The other main source of biogas is waste, either collected from the decay of organic matter in landfills or produced as a by-product of the treatment of sewage sludge. It is best practice to collect biogas and use it for generating electricity and/or useful heat where viable to do so in both cases, so the resource should be fully exploited. A small increase in sewage treatment capacity will be required as the population grows, but the increase in biogas production will be very small.

Peak lopping plant

Peak lopping refers to the practice of using small scale standby generators to meet transient peaks in demand on the electricity network (note that it can also refer to the shedding of load at peak times). Locations that require an uninterruptible power supply, such as hospitals and data centres, are often good locations for such plant as they must be kept in a standby state in order to maintain supply in the event of a failure of the grid. Though the primary aim is as back-up plant, operation of the generator to export electricity to the grid at peak times (typically weekday mornings and evenings in winter) can result in premium payments for electricity. As well as this, dedicated plant can be installed purely to operate as Short Term Operating Reserve (STOR).

The main plant used for peak lopping plant is a diesel generator. Gas can also be used, though diesel is typically used as it can be stored easily and does not rely on the gas network. The fast response times required mean solid fuels (such as biomass and waste) are generally unsuitable. In addition, back-up electricity generation plant is almost always fossil fuel based, though the use of bio-diesel or other liquid and gaseous biofuels could potentially be used.

The potential to contribute to Wolverhampton's electricity supply is small, and there is certainly little or no benefit in terms of CO_2 emissions due to the use of diesel or other fossil fuels, and even the use of biofuels would result in minimal benefits due to the very low proportion of the time such plant. Peak lopping plant is generally employed for only one or two hours at a time, and for only a small number of times per year, so the total contribution is low.

In terms of economics, this can be an excellent use of existing back-up generation plant resulting in additional income for the operators, but is not likely to lead to substantial employment opportunities or benefits in terms of energy prices.

Mine workings

Flammable gas (firedamp) is often released from coal mining activities, and must be carefully drained off in a safe manner. The main component of this gas is methane, and it is best practice to capture and combust the gas to produce heat and/or power rather than venting it into the atmosphere (formerly a common practice, but highly damaging environmentally since methane is a potent greenhouse gas). At present there are 14 generators installed that run on mines gas at four deep mines in the UK.

Wolverhampton has a long history of coal mining, but there are no active mines at present. Though methane could be present, it is not suggested that the exploitation of this resource be pursued, since there are no carbon benefits and it would necessitate highly speculative and expensive exploration work for little potential economic benefit.

Other opportunities that could offer more potential are using mine water as a heat source or storing CO_2 in former mines. Water contained in disused mines can be exploited in two ways depending on the temperature; lower temperature water (below around 30^{o}C) can act as a sink for water source heat pumps, higher temperature water can be pumped and used to heat buildings directly should water temperatures be sufficiently high (similar to a successful project in Heerlen, Netherlands which uses mine water at 35^{o}C)[52]. The latter is a form of geothermal energy and has been considered at a number of sites in the UK, in particular at Blyth in Northumberland, though there are no operation projects at present. Understanding the true potential will require the services of specialist companies to be engaged given the highly specialist nature, but it may be worth enquiring about the potential particularly in the Bilston area where there are a large number of former mine workings.

Fuel cells

Fuel cell systems have potential application in a number of different sectors. In a fuel cell hydrogen and oxygen are combined, releasing energy which can be used to generate electricity with high efficiency. The only substantial by-products produced are water and heat; as such they afford an attractive alternative to conventional vehicles in reducing exhaust emissions, and as a clean source of electricity, heat and water to supply buildings. However, in order to be considered renewable the hydrogen must be produced from renewable sources, for example from the conversion of biogas or via wind turbines by using electrolysis to split water into hydrogen and oxygen. The potential applications are discussed below, as well as a summary of the opportunity for fuel cells to contribute to Wolverhampton's energy supply.

Passenger vehicles

While there are no commercially available hydrogen powered cars presently available in the UK market a number of manufacturers are running testing programmes. Industry projections suggest that mass production of fuel cell vehicles may be 4-5 years away; the UK Government's Low Carbon Transition Plan suggested it would be 2020 and beyond before such vehicles became widespread.

Such vehicles rely on hydrogen as a fuel source and therefore require the development of associated fuel stations in order to facilitate longer journeys. Present vehicles are capable of travelling distances of up to 250 miles on one fuel load.

In the West Midlands, Microcab, a spin-out company from Coventry University, has developed the H2EV hydrogen fuel cell vehicle powered by a 3kW fuel cell. The H2EV can be re-fuelled in a matter of minutes, and run for 100 miles before needing a top up. The CABLED demonstrator project will include eight of these vehicles in its evaluation and testing.

The UK's first public hydrogen fuelling station opened in Swindon, adjacent to Honda's manufacturing plant, in 2011.

Hydrogen fuel cell buses entered service in Transport for London's bus fleet in 2011 following a three year trial period. A wider European project (CHIC) has seen the introduction of 26 fuel cell buses across five cities.

A number of manufacturers continue to develop prototype vehicles.

[52] http://ec.europa.eu/environment/etap/inaction/showcases/netherlands/328_en.html.

Building energy supply
Fuel cell CHP technology is at an early stage of development with few examples installed in the UK to date. In the wider European context, commercially available systems are in operation at a number of sites including hospitals, IT operators and manufacturing plants.

At domestic appliance scale, commercial field trials of a 1 kW fuel cell CHP unit have begun in 2011. Extended trialling is planned in 2012 with a view to scale up to official launch thereafter.

While the domestic units will use natural gas as an initial fuel source, the larger commercial scale units can use a variety of fuel sources including landfill gas, methanol and biogas (subject to suitable pre-treatment). This affords the possibility of using gas outputs from the likes of anaerobic digestion plants to feed such systems and generate power.

Stationary power
Fuel cell systems are available for a range of stationary power applications in place of diesel fuelled generators. This includes use on yachts and boats, construction sites and in motor homes or caravans. Systems have also been tested within the military and aviation sectors.

Infrastructure requirements
In the transport sector, this therefore requires a network of hydrogen filling stations, or similar infrastructure in order to facilitate widespread public access to hydrogen fuel. In the case of providing heat or electrical supply to buildings, this means having a hydrogen source available (e.g. biogas from anaerobic digestion) with suitable pre-treatment plant prior to feeding the fuel cell system.

Summary
Exhaust emissions from fuel cell systems are much lower than those from ‘conventionally’ fuelled systems (virtually zero). However, all fuel cell systems require a suitable fuel input source of hydrogen which must be produced using energy from renewable sources if the fuel cell is to result in substantial CO_2 emissions reductions. Additionally fuel cells are an emerging technology and are currently expensive, requiring substantial subsidies to compete with conventional technologies. This is the case with all new technologies, but does therefore mean the focus in the short to medium term should be on increasing the supply of renewable energy (especially biogas) such that when fuel cells become more established and cost competitive, there is a potential source of low carbon hydrogen fuel. Fundamentally, without a source of renewable hydrogen, fuel cells will have minimal impact on CO_2 emissions reductions. They should be seen as a highly efficient technology with a potentially important role in the long term (especially in low carbon transport), but require an expansion to renewable energy to happen initially.

However despite the limited potential in the short to medium term, it would be worthwhile attracting fuel cell technology suppliers to be based in the City and encouraging the trialling of demonstration systems in Wolverhampton, as there is likely to be a substantial opportunity in future for the City to become a key hub of fuel cell development.

Considerable effort is presently being expended in developing commercial applications for fuel cells, which may well result in an expanding market for such products in the next 5-10 years.

Opportunity for heat and power networks

Wolverhampton has excellent potential for low carbon heating networks. In this section we present the opportunities, focusing on the City Centre initially, with the potential for a network to grow into the other AAPs.

Development of a district heating system requires a long term view. Networks may not pay back the initial investment for 10 years or more, but pipework and much of the other infrastructure can last for more than 50 years, giving substantial cost and CO_2 savings in the long term. Hot water based networks can accept heat from many different sources, with new generators 'plugging-in' to the system as and when. This means that new low carbon heat sources such as biomass and waste plants could be linked into the network even if not built for years to come. Large networks established in cities such as Nottingham and Sheffield continue to expand decades after initial installation.

When establishing a new network with no readily available existing source of heat it is generally best to use an established technology which has few technical or other concerns in order to minimise risk and give investor confidence. In an urban scheme this would be often be gas CHP which can give substantial CO_2 and energy cost reductions while being a compact and well understood technology. Clearly although highly efficient this requires the used of fossil fuels, but as the network expands and as new energy plant are brought forward, so the opportunities for using alternative sources of fuel for the network to give greater emissions and cost savings (and increasing energy security by using locally produced fuel) become greater.

It is often best to start by installing a core network based on existing public buildings. This can then be extended to other existing sites and also to areas with high levels of planned new development (such as the AAPs). This can provide the incentive for developers of new sites to incorporate district heating into their plans. When left entirely to developers, experience has shown it is unlikely that a heating network will be implemented unless a substantial grant can be obtained to cover the costs. Current sustainability targets can be met by simpler means, such as solar technologies. Demanding a network to be set up from scratch may discourage development, but it may be much more reasonable to request a developer to 'plug-in' to an existing network given the lower costs and complexity.

Network design

In this section we describe how a district heating network could be developed in Wolverhampton. This is an outline of a possible network based on previous work and initial estimates of promising sites and future development; a detailed feasibility study will be required in order to determine the details of a scheme and more accurately understand the viability. Such a study should determine the buildings included (gathering actual demand data and getting the buy-in of potential customers), network layout and a full financial appraisal. In addition to the core network described in the city centre, other networks may develop elsewhere, and there is a significant existing network in Heath Town (which serves over 1,000 residential properties). Ultimately these networks could be integrated into one City wide network; this is similar to how the extensive networks found in cities such as

Copenhagen[53] have developed (where 98% of heat demand is met by district heating), and are planned for London in order to meet challenging decentralised energy targets[54].

Core network

As a starting point we have based a network around the City Centre, as per a study carried out for the City Council and Wolverhampton University by I.C.E (UK). This study showed a heating network to be potentially viable. A key advantage that this outline scheme offers is that there are numerous public sector buildings included, giving an opportunity for the Council to lead or at least have a strong influence over the development of a network, and provide the contractual security required. The network could then expand to incorporate private sites and new development. We then considered how this could be expanded by identifying other public sector, high energy consumption sites. The sites identified in relatively close proximity in the City Centre area were grouped together to form a core network (see Figure 4.2 in the main body of the report). Annual heat demand estimates were made based on established benchmarks. This information is shown on the figure; the larger the circle the greater the estimated heat demand.

On the basis of the I.C.E. study Wolverhampton University have decided to install a CHP plant on the main campus in 2012, though this will be sized to meet only the demand of the University buildings. Therefore, although this could potentially tie-in to a wider network, it is not thought likely that the University will lead any expansion of a network into the City centre.

Extended network

Developing a core network in the City Centre, based primarily around public buildings could lead to significant CO_2 reductions in itself, but will also allow the network to be extended. Providing developers with the opportunity to connect to an existing network will greatly increase the likelihood of the new development incorporating a low carbon heating system.

Given the growth planned in the two other AAPs, we have considered the opportunities to extend the network into these regions. No substantial public sector energy users were identified in these areas but instead we considered the route a feeder pipeline could take, for example following the Stafford Road Corridor up to i54. We have included a number of small public sector sites (mostly schools); note that there may be other sites that could offer potential, but this would need to be the subject of a more detailed feasibility study.

The other main option outside of the AAPs appears to be to extend the network towards Heath Town where there is an existing district heating network and New Cross Hospital, the largest hospital in the Black Country and a high energy user. It is understood that New Cross Hospital are installing a new gas CHP plant, and it is possible there

[53] http://dbdh.dk/images/uploads/pdf-diverse/District_heating_in_Copenhagen.pdf.

[54] http://www.londonheatmap.org.uk/Content/About.aspx.

could be surplus heat which could be used to supply the Heath Town heat network (or additional capacity could be installed). In the long term there may then be an opportunity to connect this to the core network.

Technical and commercial overview

In order to estimate the viability of a district heating network, we have carried out a high-level assessment of the core network identified in Figure B.3, based on the heat for the network being supplied by gas CHP (and top-up/back-up gas boilers). The heat demand was estimated using benchmark data from CIBSE. Pipe lengths were estimated from the map. The plant was sized using rule-of-thumb data for gas CHP and back-up boilers, with the key technical parameters summarised in Table B.8. A high-level financial appraisal was also carried out based on typical costs of plant and fuel, and typical energy sales revenues. This suggests a payback period of around 10 years, which suggest a network could be viable (this payback must be considered in the context of the operational life of >25 years). A full feasibility study would be necessary to confirm the viability, and should include a detailed Discounted Cash Flow model.

Table B.8 Core network summary - indicative performance

	Value	**Unit**
Technical		
Gas CHP Capacity	2.6	MW_e
Gas Boilers Capacity	17.0	MW_{th}
Pipework Length	3.8	km
Financial		
Capital Cost	£5,800,000	
Annual Income (energy sales)	£2,300,000	per year
Expenditure (fuel and maintenance)	£1,900,000	per year
Simple Payback	12	years
Environmental		
CO_2 Savings	4,700	tonnes per year

Equipment sized as follows - 75% of average heat demand for CHP (to ensure high running hours), 300% for gas boiler (to ensure peaks can be met)

Key technical and financial assumptions made in the assessment are provided in Table B.9 and Table B.10.

Table B.9 Efficiency assumptions

	CHP	Gas Boilers
Electrical efficiency	30%	0%
Thermal efficiency	50%	80%
Availability	90%	90%

Table B.10 Cost assumptions

	Value	Unit
Gas CHP capex	£657	per kWe
Gas boiler capex	£32.50	per kWth
Gas cost (wholesale)	£20	per MWh
Heat Sale Price (average)	£30	per MWh
Elec sale price (average)	£60	per MWh
Maintenance costs	4%	of total Capex per year

An estimate of the heat demand of each site is shown in Table B.11. As shown, the core network constitutes the vast majority of the demand. However, extension of the networks into the Bilston Corridor and Stafford Road Corridor Corridor AAPs to include future development or existing, more remote sites could result in the connection of additional large energy users. The network could supply circa $50GWh_{th}$ per annum.

Table B.11 Sites identified as part of Potential District Heating Network (see Figure 4.2)

	Site	Estimated Heat Demand (MWh/year)	Additional Pipe Length (km)	Part of Core Network?
1	West Park Hospital	8,146	0.7	Yes
2	City of Wolverhampton College	2,063	0.3	Yes
3	Pond Lane Learning Disabilities Unit	267	0.5	No
4	Blackenhall Community and Healthy Living Centre	136	0.5	No
5	Graiseley Primary School	424	1.6	No
6	The Wulfrun Centre	7,085	0.2	Yes
7	Wolverhampton Magistrates Court	691	0.1	Yes
8	HM Revenue and Customs	1,429	0.5	Yes
9	Dunstall Primary School	182	0.5	No

	Site	Estimated Heat Demand (MWh/year)	Additional Pipe Length (km)	Part of Core Network?
10	Central Baths	1,749	0.3	Yes
11	Wolverhampton City Council Offices	3,249	0.2	Yes
12	Civic Hall	1,125	0.2	Yes
13	Molineux Stadium	2,748	0.3	Yes
14	University of Wolverhampton - Main Campus	10,765	0.0	Yes
15	Art Gallery and Museum	1,319	0.1	Yes
16	Asda Wolverhampton	985	0.4	No
17	Mander Centre	8,509	0.2	Yes
18	Wolverhampton Grand Theatre	923	0.2	Yes
19	New Archive Building	205	0.3	Yes
	Total	**52,001**	7.0	
	Core Network Total	**50,006**	3.5	

Appendix C
Opportunity for Electric and Hybrid Vehicles

Facts and figures

Electric and hybrid technology cars are considered to have the potential to make a significant contribution to the reduction in transport-related CO_2 emissions. The government's climate advisers wants to see 11m electric or plug-in hybrid models on UK roads by 2030, to meet the UK's carbon targets. The Plug-In Car Grant provides £300M to reduce the upfront costs of eligible vehicles to consumers and businesses, along with tax exemptions.

The Plugged-In Places (PiP) programme has £30M available to match fund eight pilot projects (including the West Midlands[55]) installing and trialling recharging infrastructure to support the Carbon Plan commitment to install up to 8,500 charge-points. It is envisaged by the Government that private sector investment will be the primary source of funding for recharging infrastructure.

Charging points will be wall or post mounted in car parks, on streets and at home (e.g. in a garage). The Midlands PiP scheme is aiming to fit 513 charging posts/points in public locations including motorway services, car parks and on street parking. Some 200 posts/points will be fitted in domestic locations and 1,000 posts/points have been allocated to an eco-housing development. The project runs for two years between April 2011 and March 2013. Birmingham currently has around 20 points, with applications for 32 being considered across the region.

Charging posts/points only need planning permission when they are fitted in certain locations such as near listed buildings or when photovoltaic canopy charging posts/points are required. Local initiatives such as car clubs are attempting to change the culture of car use and will demand investment in recharging infrastructure.

Guidance on the inclusion of policies on recharging points in local planning policy is being considered for the NPPF, to encourage local authorities to consider adopting policies to include plug-in vehicle recharging infrastructure in new domestic, workplace and retail developments.

National aspirations

The Government’s intention for the establishment of recharging infrastructure is long term, private sector oriented and targeted to places of greatest need and likely uptake such as workplaces and retail areas.

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[55] The Midlands Plugged-In Places (PiP) Project combines the roll-out of electric vehicle infrastructure with the development of regional capabilities associated with the electrification of road transport. Jointly managed by Cenex and Central Technology Belt, the project is one of eight 'Plugged-in Places' projects supported by OLEV, the Office for Low Emission Vehicles. http://www.cenex.co.uk/programmes/plugged-in-places.

Our vision for recharging[56]

*“**1.8** For plug-in vehicles to appeal to, and be a viable solution for, consumers, recharging needs to be convenient and safe. Plug-in vehicles allow a different approach from re-fuelling a car, as it is no longer just a case of vehicles having to go to infrastructure - infrastructure can be located where vehicles are parked for the longest periods, which many consumers may find more convenient.*

***1.9** We want to see the majority of recharging taking place at home, at night, after the evening peak in electricity demand. This is not only most convenient for drivers, but maximises the environmental and economic benefits of plug-in vehicles by using cheaper, lower carbon night-time electricity generation. Off-peak recharging will also enable best use of available electricity network capacity.*

***1.10** After home recharging, we want to see workplaces providing recharging opportunities, both for fleet vehicles and employees for whom recharging at home is not practical or sufficient.*

***1.11** Although chargepoints in public places and destination recharging will be the most visible type of recharging, we want this to be targeted at key destinations, where consumers need them, such as supermarkets, retail centres and car parks, supplemented by a focused amount of on-street infrastructure. This infrastructure will generally be used for top-up recharging or to extend journeys, although there is likely to be a role for public infrastructure in supporting those plug-in vehicle owners who do not have access to off-street parking.*

***1.12** Above all we want recharging to be simple for consumers, with trouble-free, safe, recharging at home or work, supported by public infrastructure that is easy to access, backed up by effective information on where it is located.”*

Regional developments - Plugged-In Places West Midlands

The Midlands Plugged-in Places project was jointly developed by Cenex, the UK’s first Centre of Excellence for low carbon vehicle technologies, and Central Technology Belt. Heading a consortium of Midlands businesses and local authorities, up to £2.9 million of Government funding is being deployed to support the installation of more than 500 charge posts in high profile locations across the East and West Midlands, as well as more than 1,000 charge points in domestic homes.

The first phase of the project (2011 to 2013) focuses on three areas:

- West Midlands: Coventry, Birmingham, Worcester.
- East Midlands: Three cities region of Leicester, Nottingham and Derby.
- East Midlands: Corby and Northampton.

[56] Office for Low Emission Vehicles (June 2011) **Making the Connection: The Plug-In Vehicle Infrastructure Strategy** http://www.cenex.co.uk/LinkClick.aspx?fileticket=CfJrNriRLMw%3d&tabid=715&mid=1634 .

The consortium has set a challenging but achievable target of 1,000 plug-in vehicles being registered in the Midlands, the UK's largest car buying region, by 31 March 2012. By ensuring highly visible and publicly accessible charging points are available, the project aims to unlock the large latent market for plug-in vehicles in the traditional heartland of the UK's motor industry. The project includes provision for quick chargers at motorway service areas on the main transport corridors intersecting the region, facilitating both intra- and inter-regional travel. It will also yield information on local through-route infrastructure requirements to support a proposed national infrastructure.

Birmingham City Council has taken the lead in developing a network of charging points in the City. Prior to the Plugged-In initiative, the City Council was the lead partner in the CABLED project which supported the installation of 18 electric vehicle charging points in the city centre. The City Council has also committed through the 'Birmingham Declaration' to all its vehicle purchases being electric or LPG by 2015. It is completing a major 'green fleet' review of its vehicles which will lead to new electric vehicle procurements in the next two years. The promotion of electric vehicles is a key priority for Birmingham in its Climate Change Action Plan and its aim to cut the city's overall carbon emissions by 60% by 2026.

Under the Plugged-In Places initiative Birmingham City Council has secured funding to add charge points at additional locations over the next two years across employee workplaces and public locations.

As part of their commitments to the Plugged-In Places initiative, the City Councils are committed to:

- putting charging posts at Park & Ride car parks and railway stations;
- expanding the use of EVs in council fleets; and
- encouraging the installation of domestic charging points in new housing developments.

http://www.cleantechinvestor.com/portal/transport/9707-towards-a-national-charging-infrastructure-.html

Box C1 Low Carbon Network Fund

CE Electric: Customer-led Network Revolution

A major project in North East England and Yorkshire is making important links between three key components of a smart grid: plug-in vehicles, smart meters and microrenewables. This £54M project is the largest in Ofgem's Low Carbon Network Fund and will explore interdependencies between these technologies, their impact on the electricity network and the potential to influence customer behaviours such as overnight recharging of plug-in vehicles. A partnership of CE Electric, British Gas, Durham University and EA Technology, the project will engage around 11,000 households and up to 300 plug-in vehicle drivers. Working closely with North East England's Plugged-In Places project, incentives have been devised to integrate the installation of home chargers with the provision of smart meters. This will facilitate the monitoring of electricity usage and trialling of innovative tariff structures to develop smart grid responses to the introduction of plug-in vehicles.

Low Carbon London

The £29.9M Low Carbon London programme will investigate how best to develop a smarter electricity network that can continue to deliver a safe and secure electricity supply in a low carbon economy, while keeping costs as low as possible for electricity customers. Plug-in vehicles will be one of the defining features of this low carbon economy - and London aspires, via the Mayor's Source London initiative, to be the electric vehicle capital of Europe. Low Carbon London is looking at how the behaviour of recharging plug-in vehicles in public, at home and at work impacts on the electricity network. It will also investigate the scope for different tariffs to reward customers for changing their plug-in vehicle recharging patterns to reflect periods of low electricity demand or high availability of greener electricity. Businesses and private plug-in vehicle owners may be able to realise significant reductions in their electricity bills by trialling these new tariffs.

www.ofgem.gov.uk/networks/elecdist/lcnf/pages/lcnf.aspx.

Prospects and potential for Wolverhampton

Extension of the Recharging Network

The prospects for an immediate role-out of the PiP initiative to Wolverhampton are centred on the provision of public and private sector charging points. As noted above, there is to be reliance placed on the private sector for the provision of the infrastructure, in turn perhaps encouraged through local planning policy.

Opportunities for Wolverhampton City Council

In order to help overcome the inertia of investment in recharging points, the Government[57] is encouraging local authorities to take a lead in both extending the recharging infrastructure and converting their vehicle fleet to electric power.

The potential for the City Council to take a lead in adopting electric vehicle technology, both in fleets and in recharging points should be explored. Whilst this will make a negligible contribution to reducing overall CO_2 emissions in the City, it would send out a strong signal to residents, businesses and visitors, and would put the City Council in the vanguard of what is likely to be a movement towards mass-adoption during the 2020s.

Equally, the City Council could explore the opportunities to team-up with other Black Country local authorities in order to promote the provision of an integrated network of charging points which again would form the basis of the comprehensive network which is likely to be required in future.

Box C2 **Case study: Durham County Council Workplace Charge-points**
Durham County Council, as part of its commitment to the plug-in vehicle agenda and the North East's Plugged-In Places project, has installed 28 charge-posts across County Durham, including in the City Council office car park to support their Nissan LEAF pool car. Over 30 staff are now able to use the pool car for business trips, and the vehicle is used every day for site visits within the county. The vehicle is being driven primarily by the Traffic Studies team and it is often used to promote plug-in vehicles at events, including summer shows, educational visits and seminars. John Mcgargill, Strategic Traffic Studies Manager, said: "*We tend to charge overnight which gives us enough range for the day's journeys, and we estimate that during our first month the car was driven 502 miles. The cost of electricity for these journeys was only £8.21. Fuelling a conventional vehicle to make the same journeys would have cost around £48 so we are already seeing significant benefits to the City Council owning an electric vehicle*."   source: Note 2 p.38

Conclusions

Whilst direct investment in charging infrastructure helps to overcome the inertia of ownership, there remains uncertainty as to when the more widespread adoption of the technology could take place. A recent report[58]

[57] See note 2.

[58] Element Energy (July 2011) Influences on the Low Carbon Car Market from 2020-2030 http://www.lowcvp.org.uk/assets/reports/Influences%20on%20the%20Low%20Carbon%20Car%20Market%20from%202020-2030%20-%20Final%20Report%20010811_pdf.pdf .

suggests that this could be beyond 2030, as the cost of these new technologies remains unattractive until economies of scale and technology exert an influence. Thus effectively, over the Core Strategy period, the prospects for the mass adoption of electric and hybrid car use across Wolverhampton is limited[59]. That said, there is a clear government commitment and for political reasons, as much as responding to emerging demand, direct promotion of the network could be pursued.

[59] The LCVP report suggests electric and plug-in hybrid cars produce lower carbon emissions over their lifetime compared to petrol and diesel cars, provided they are powered with renewable electricity. But it is unlikely such cars will make a large contribution to government carbon targets with the majority of carbon savings in transport coming through the improvement of conventional cars and the switch to biofuel.

Appendix D
Stakeholders Consulted as Part of the Study

Stakeholders contacted as part of study

Name	Organisation	Response received?
Richard Baines	Black Country Housing	Yes
Jane Holmes	Plugged in Places (Cenex)	Yes
Steven Cocks	Wolverhampton University	Yes
Keith Daw	Wolverhampton CC	Yes
Ian Cox	Thomas Vale	Yes
Les Brazier	Wolverhampton Waste Partnership	Yes
Bill Whitehouse	Express Power Ltd	Yes
Nick Abson	Cygnus Atratus	Yes
Steve North	Wolverhampton Homes	Yes
Stuart Hobbs	Wolverhampton Homes	Yes
Reg Crockett	Energy & Resource Recovery Ltd	Yes
Tom McInally	Carillion	Pending
Phil Barnett	Marston Brewery	Pending
Steve Cooper	Turner Power Train	Pending
Graham Risdon	Eurofins	Pending
Martin Jones	Timken	Pending
James Cartwright	Staffordshire Woodfuels	Pending
Paula McHugh	Heantun HA	Pending
Alan Yeats	Accordia HA	Pending
Amelia McCann	Bromford HA	Pending
David Cartwright	FHM Ltd	Pending
Shaun Fielding	Keepmoat Homes	Pending
Richard Hickman	St Modwen	Pending
David Bent	Redrow	Pending
John Harris	British Waterways	Pending
Steve Smith	HLN Architects	Pending
Mark Kowalski	Barratt Homes	Pending

Appendix E
Employment Land Assumptions

Job creation worked out using the following employment densities:

- B1(a) - 1 job per 19m^2 floorspace (net);
- B1(b) - 1 job per 29m^2 floorspace (net);
- B2 - High density 1 job per 37m^2 floorspace (net), low density 1 job per 40m^2 floorspace (net); and
- B8 - High density 1 job per 75m^2 floorspace (net), low density 1 job per 80m^2 floorspace (net).

Assumptions on land uses in employment areas:

- Area net to gross ratio = 0.7:1.
- B2/B8 Floorspace estimate = 4,750m^2 per net hectare.
- B1(a) Floorspace estimate = 7,500-10,000 per net hectare for town centre fringe office/business location.
- For Local Quality Employment Areas assume:
  - B2 accounts for 60% of the area; and
  - B8 accounts for 40% of the area.
- For High Quality Employment Areas assume:
  - B2 accounts for 25% of the area; and
  - B8 accounts for 75% of the area.
- For certain locations this will need to be varied, mainly relating to office based business parks (e.g. Wolverhampton Business Park and Pendeford Business Park are mainly office based employment areas, or significant retail/trade areas such as Spring Vale in Bilston Corridor).

The above is taken from the Black Country Study and Core Strategy Employment Land Studies.

Appendix F
Housing and Employment Land Calculations

Number of Dwellings			
	Existing at 2011	2011-2016	Post-2016
Mix assumption	No. of dwellings (approx)	No. of dwellings	No. of dwellings
	3,000		
50%	1,500		
50%	1,500		
0%	0		
100%			
		2,130	
30%		639	
55%		1,172	
15%		320	
100%			
			1663
30%		0	499
55%		0	915
15%		0	249
100%			

COMMITTED EMPLOYMENT LAND

Committed employment sites (gross ha)	
Committed employment sites (net ha)	
Floorspace (sq m)	-
50% B2 Industrial	-
50% B8 Storage and Distribution	-

EMPLOYMENT AND RETAIL - POTENTIAL

100,000 sq m retail
220,000 sq m B1 offices

OTHER EMPLOYMENT LAND

NA

Number of Dwellings			
	Existing at 2011	2011-2016	Post-2016
	No. of dwellings (approx)	No. of dwellings	No. of dwellings
	1,500		
10%	150		
50%	750		
40%	600		
100%			
		1,111	
10%		111	
50%		556	
40%		444	
100%			
		240	2,735
10%		24	274
50%		120	1,368
40%		96	1,094
100%			

COMMITTED EMPLOYMENT LAND

Committed employment sites (gross ha)	2.1
Committed employment sites (net ha)	1.47
Floorspace (sq m)	6,983
50% B2 Industrial	3,491
50% B8 Storage and Distribution	3,491

EMPLOYMENT LAND ALONGSIDE MIXED USE SCHEMES

Ha associated employment land (gross)		Ha associated employment land (net)	Floorspace (sq m)
43		30.1	
	66% B2 Industrial	19.866	94,364
	33% B8 Storage & Distribution	9.933	47,182

OTHER EMPLOYMENT LAND

employment land (gross)		employment land (net)	Floorspace (sq m)
98.2		68.74	
66% B2 Industrial		45.3684	215,500
33% B8 Storage and Distribution		22.6842	107,750

Number of Dwellings			
	Existing at 2011	2011-2016	Post-2016
	No. of dwellings (approx)	No. of dwellings	No. of dwellings
	4,000		
10%			
50%			
40%			
100%			
		92	550
10%		9	55
50%		46	275
40%		37	220
100%			
			1,005
10%			100.5
50%			502.5
40%			402
100%			

COMMITTED EMPLOYMENT LAND

Committed employment sites (gross ha)	16
Committed employment sites (net ha)	11.2
Floorspace (sq m)	53,200
50% B2 Industrial	26,600
50% B8 Storage and Distribution	26,600

EMPLOYMENT LAND ALONGSIDE MIXED USE SCHEMES

Ha associated employment land (gross)		Ha associated employment land (net)	Floorspace (sq m)
0		0	
	50% B2 Industrial	0	-
	50% B8 Storage & Distribution	0	-

OTHER EMPLOYMENT LAND

employment land (gross)		employment land (net)	Floorspace (sq m)
52.6		36.82	
50% B2 Industrial		18.41	87,448
50% B8 Storage and Distribution		18.41	87,448