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Strategic Design Advice Report

Decentralised Energy Study for
Crawley Borough Council

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1.0 LIST OF ACRONYMS

AD	Anaerobic Digestion
ASHP	Air Source Heat Pump
CHP	Combined Heat & Power
CIL	Community Infrastructure Levy
CO_2	Carbon Dioxide
COP	Coefficient of Performance
CSH	Code for Sustainable Homes
DECC	Department of Energy and Climate Change
DHW	Domestic Hot Water
DPD	Development Plan Document
DR	Discount Rate - The interest rate used in determining the present value of future cash flows.
EPC	Energy Performance Contract - A performance-based procurement method and financial mechanism for building renewal whereby utility bill savings that result from the installation of new building systems (reducing energy use) pay for the cost of the building renewal project. A "Guaranteed Energy Savings" Performance Contract includes language that obligates the contractor, a qualified Energy Services Company (ESCO), to pay the difference if at any time the savings fall short of the guarantee.
ESCO	Energy Services Company
FiT	Feed-in Tariff
GIS	Geographic Information System
GSHP	Ground Source Heat Pump
GWh	Gigawatt hour
IRR	Internal Rate of Return – The discount rate for which the total income from the project, once discounted, equals the initial investment.
kWh	Kilowatt hour
LA	Local Authority
LABV	Local Asset-Backed Vehicles
LDF	Local Development Framework
LSP	Local Strategic Partnership
LZC	Low and zero carbon
MSW	Municipal Solid Waste
MWh	Megawatt hour
NI	National Indicator
NPV	Net Present Value – Savings of a project less its cost in today's money over its expected lifetime.
PPS	Planning Policy Statement
PV	Photovoltaic
RHI	Renewable Heat Incentive
ROC	Renewables Obligation Certificate
SHW	Solar Hot Water

2.0 NON TECHNICAL SUMMARY

2.1. Project Background and Drivers

hurleypalmerflatt has been commissioned by Crawley Borough Council (CBC) through the Carbon Trust to undertake a study into decentralised energy opportunities. The study will support the reduction of CO_2 emissions from residential and non-domestic buildings in the borough by identifying opportunities for supplying energy from low and zero carbon energy sources including district heating, and encouraging decentralised energy generation in new development through recommended planning policy.

The key drivers for the study can be summarised as follows:

- Planning Policy Statement 1 (Planning and Climate Change) and the draft Planning Policy Statement ‘Planning for a Low Carbon Future in a Changing Climate, March 2010) require local planning authorities to have “an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies”. In summary, the policy supports the notion that the role of planning is to identify energy and climatic opportunities and risks spatially and to use this understanding to set out planning policies designed to support action and delivery, while also acting as a wider resource for use by the Local Authority and local strategic partnerships (LSPs).
- The Climate Change Act 2008 introduced a statutory target of reducing carbon emissions by 80 per cent below 1990 levels by 2050, with an interim target of 34% by 2020. Local Authorities can play their part on helping to meet these targets.
- EU Directive 2009/28/EC commits the UK to sourcing 15% of its energy from renewable sources by 2020 – an increase in the share of renewables by almost a factor of seven from about 2.25% in 2008
- The Low Carbon Transition Plan and the Renewable Energy Strategy were both published on 15 July 2009 and set out how the UK will achieve dramatic reductions in emissions and meet targets on renewables.
- The Household Energy Management Strategy was published on 2 March 2010, and placed a greater emphasis on district heating schemes and identified an essential role for planning in facilitating delivery of these and other community scale energy schemes.
- Proposed updates to the Building Regulations will require all new domestic buildings to be ‘zero carbon’ by 2016, with all non domestic buildings reaching this standard by 2019. Local Authorities can assist new development by identifying and co-ordinating low carbon infrastructure.
- Decentralised energy generation can help to reduce the impact of volatile fossil fuel prices on residents and businesses, and reduce the financial penalties associated with the Carbon Reduction Commitment, Climate Change Levy and EU Emissions Trading Scheme.

2.2. Opportunities for Low and Zero Carbon Energy

We have considered the various low and zero carbon technologies currently available and their implications in terms of opportunities and constraints. From information provided by the Council and our own research and national data sets, we were able to outline the opportunities for decentralised low and zero carbon energy installations in the Borough of Crawley including the generation of Geographic Information System maps (GIS) which identify opportunities and constraints. Key considerations are summarised as follows:

- Crawley currently has limited low carbon energy infrastructure with the majority of buildings heated and powered by natural gas and grid supplied electricity.
- Notable low carbon sources of energy in the Borough include gas fired Combined Heat and Power Engines in the K2 leisure centre and Royal Mail sorting office located on Manor Royal Business District, in addition to woodchip fired biomass boilers in Crawley Library and Buchan Country Park Education Centre.
- Crawley has limited opportunity for large and small scale wind turbines due to the constraints imposed by Gatwick Airport and the largely urban nature of the Borough.
- The Borough could generate around 23,600 MWhe per year from energy crops produced on grade 3 and 4 land. Energy crops include short rotation coppice, grasses (e.g. miscanthus) and conventional crops (e.g. rapeseed). This is equivalent to a reduction of 12,231 tonnes CO_2, the typical emissions from around 4,900 typical detached homes.
- Renewable electricity is currently generated from sewage gas at the Tinsley Sewage Treatment Works. Initial discussions with Thames Water have identified opportunities to increase the capacity of the plant, with potential to use waste heat to supply development adjacent to the site, including Gatwick Airport and the proposed North East Sector development. It is recommended that a detailed feasibility study should be undertaken to explore these opportunities alongside Thames Water and Gatwick.
- Crawley has potential to exploit a range of microgeneration technologies which are now incentivised through Feed-in Tariff's and the Renewable Heat Incentive. This includes:

    - Solar thermal and Photovoltaics (PV)
    - Heat pumps (air and ground sourced) may be suited to areas not served by gas and where low temperature distribution systems e.g. under floor heating is possible
    - Biomass heating is ideal where buildings are not connected to the national gas grid. In addition, biomass district heating is feasible in higher density urban areas.

Key 'next steps' for Crawley Borough Council resulting from this study are:

Recommendation 1: Review opportunities to develop a CBC or West Sussex County Council led biomass supply chain based on the low and zero carbon energy opportunities mapping. See section 5.4 and 8.0 (Next Steps) for further details.

Recommendation 2: Undertake a detailed feasibility study into the potential for heat off take from Tinsley Sewage Treatment plant that could supply proposed development located in the North East Sector or Gatwick Airport. See section sections 5.6 and 8.0 (Next Steps) for further details.

Recommendation 3: Review ways that CBC can encourage uptake of photovoltaic and solar hot water including providing information to residents and businesses and working alongside local installers. See sections 5.6 and 8.0(Next Steps) for further details.

2.3. Opportunities for District Heating and CHP

We have considered the opportunities for reducing CO_2 emissions through the supply of low carbon heat. District Heating (DH) is an alternative method of supplying heat to buildings, using a network of super insulated pipes to deliver heat to multiple buildings from a central heat source, such as a Combined Heat and Power (CHP) plant. A CHP plant is essentially a local, smaller version of a traditional power station but by being combined with heat extract, the overall efficiency is much higher (typically 80% – 85%). Whilst the electrical efficiency of smaller CHP systems is lower than large scale power generation, the overall efficiencies with heat use are much higher resulting in significant CO_2 reductions.

Through the development of a 'heat map' for Crawley which identifies density of heat demand across the Borough, the study identified a number of areas that could be viable for developing district heating schemes. The current and draft replacement PPS places significant emphasis on DH and on the role of Local Authorities in its facilitation.

Key considerations for District Heating in Crawley are as follows:

- Potential heat network opportunities were identified for the following areas within Crawley where there are public buildings with high heat demand (known as anchor loads) or high density from commercial buildings: Town Centre, Broadfield (K2 Leisure Centre), Manor Royal Business District (light industrial and offices), Gossops Green (social housing), North East Sector (proposed new residential development), Bewbush (social housing)
- Initial heat network layouts were developed for each cluster to assess the viability of connecting identified buildings. The two 'clusters' that were identified as potentially being viable were the Town Centre cluster and the Broadfield Leisure Centre cluster. Both of these clusters have the potential for Internal Rates of Return (IRR) over 20 years of 7% or greater.
- A district heating network supplying space and hot water heating to buildings in the Manor Royal Business District was found to be unviable. A potential opportunity could be to develop a steam heat network which could supply processes within the District and which are likely to constitute a higher energy demand. Process energy is very specific to the type of industrial process and therefore further investigation would be required to understand the nature of each business and the energy demand.
- Crawley Borough Council should, headed by a Working Group should setup a CBC led ESCO with the objective of delivering heat networks within Crawley, with initial focus on a Town Centre pilot scheme and

connection of the K2 Leisure centre to the adjacent College and school. The benefits of CBC establishing an ESCO with public sector involvement are numerous. The primary purpose would be to provide a delivery mechanism through which the Council can progress its policies and corporate plan objectives including carbon emissions reduction within the Borough, with particular focus on delivering decentralised energy supplies including district heating. The other benefits include:

- Providing a dedicated entity with the primary purpose of delivery of the Council's climate change and low carbon energy infrastructure objectives
- Providing an entity that can operate with a focus that is not available to existing council services.
- Creating a commercial environment outside the Council's existing services that may generate new revenue streams.
- The creation of an ESCO provides an additional level of flexibility to the Council for directing financial investment into its climate change objectives. This could include contributions from S106, the Climate Change Levy or 'Allowable Solutions'.

- For large social housing development located in areas where the installation of a district heating network is unviable, an alternative solution could be a communal gas or biomass/biofuel CHP. This could be delivered through an Energy Performance Contract (EPC) where an ESCO will install and operate a communal system with additional savings made through the ESCO investing in energy efficiency initiatives e.g. glazing replacement, cavity wall insulation, etc.

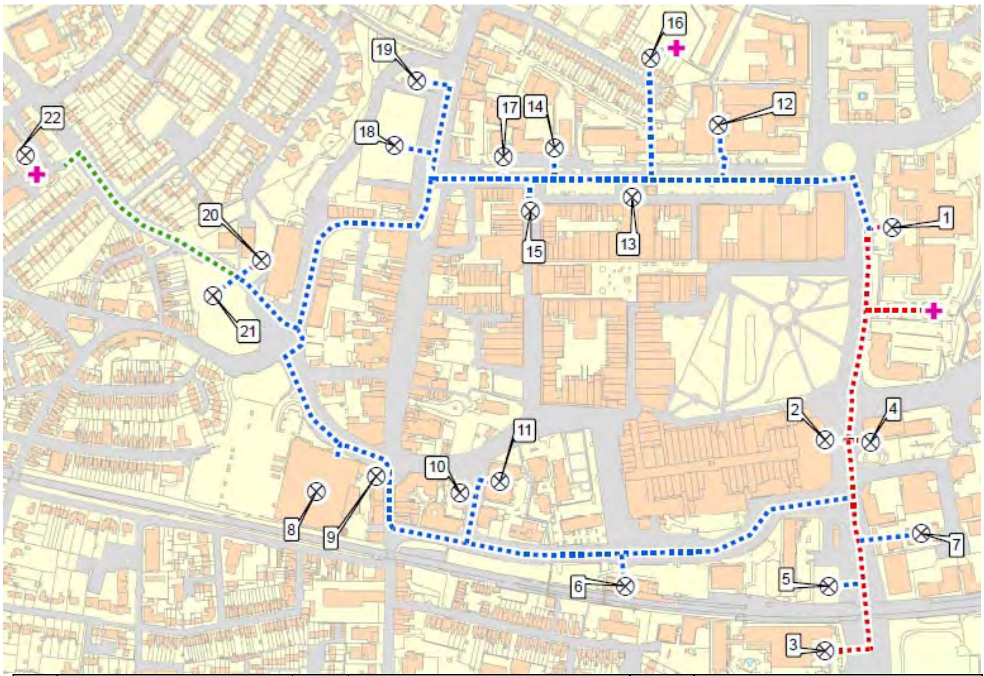
Town Centre Heat Network Cluster

The Town Centre is a high heat density area with a mix of commercial and residential properties, including anchor loads, which offers a viable opportunity for the development of a district heating network.

Additionally, the Town Centre North area will undergo a major redevelopment which will allow for early consideration of a connection to a district heating network which could be influenced by revisions to planning policy.

The study identified three phases for a heat network assuming use of gas fired CHP:

- Phase 1: Pilot Scheme connecting the Central Sussex College, Crawley Library, The County Mall and Arora Hotel with gas-fired CHP within an energy centre located within the grounds of the College.
- Phase 2: Expansion of the network to link in the Town Centre North redevelopment, Overline House redevelopment, Fairfield House development, Southern Counties development and existing buildings including the ASDA supermarket. An additional energy centre would be built within the proposed Town Centre North redevelopment to supplement the phase 1 energy centre
- Phase 3: Expansion of the network to link in Crawley hospital



1	Central Sussex College	9	25 High Street	17	Management Suite (proposed)
2	County Mall	10	Job Centre	18	Supermarket (proposed)
3	Arora Hotel	11	The Galleria (Virgin Holidays)	19	Hotel (proposed)
4	New library	12	TCN dept. store (proposed)	20	Fairfield House (proposed)
5	Brunel Hall	13	Additional retail (proposed)	21	Southern Counties (proposed)
6	Overline House	14	A3 Restaurant (proposed)	22	Crawley Hospital
7	Telford Place	15	Cinema (proposed)		
8	ASDA Supermarket	16	New Town Hall (proposed)		

Figure 1 Proposed District Heating Network Routes for the Town Centre

Table 1: Summary of Financial Viability for the Town Centre Cluster

Phase	Simple Payback	Capital cost (£)	IRR (%)	NPV[1](7%discount rate)	NPV) (5% discount rate)	Public contribution for IRR 7%	CO_2 savings[2] (tonnes)
1	12	1,666,352	6.38%	-£92,083	£237,854	£92,000	847(23% reduction)
1+2	12	5,604,780	6.49%	£254,616	£868,714	£255,000	2,400(24% reduction)
1+2+3	9	6,409,276	9.90%	£1,720,421	£3,372,122	-	3,322(25% reduction)

The table above shows the results of the financial modelling for the three scenarios proposed. The results are cumulative rather than per phase. On this basis, the second scenario considers phase 1 and 2 being build and the third one considers the development of the whole proposed network. If all the proposed network was developed, the project would have an IRR close to 10% and therefore no public funding would be required; however if only phases 1 or 1 and 2 were implemented public contribution would be required as a financial supplement to the capital cost in order to make the project viable with £92,000 contribution being required in the first case and £255,000 in the second.

[1] Over 20 years
[2] Against business as usual

K2 Leisure Centre Heat Network Cluster

The proximity between K2 Leisure Centre, Desmond Anderson School and Thomas Bennett Community College creates a very simple and attractive cluster for the installation of a district heating network.

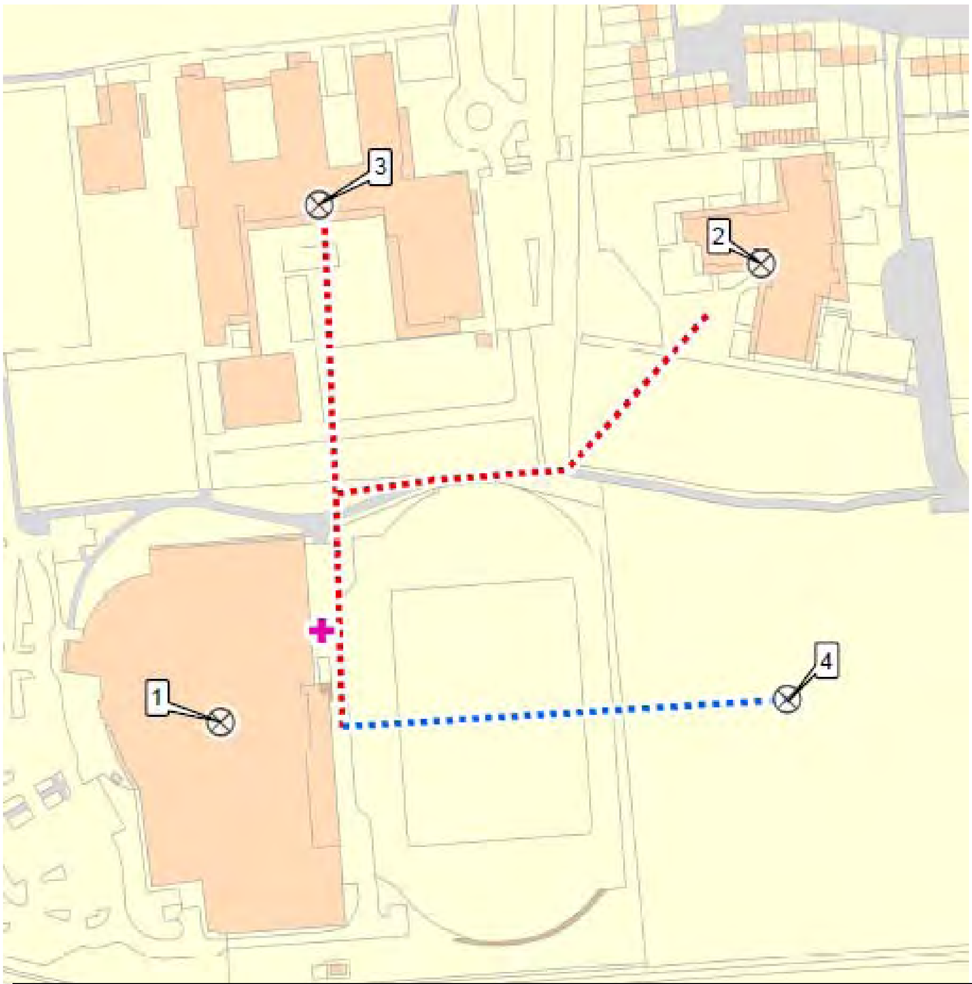
The operators of K2 Leisure Centre, which has an existing CHP engine to heat the building, are currently considering the installation of a larger unit which could be easily oversized to supply the school and college.

Additionally, a new residential development is expected to the east of the leisure centre with 80-100 new homes which could be designed to connect to the network.

The study identified two phases for a heat network assuming use of gas fired CHP:

- Phase 1: Pilot Scheme connecting K2 Leisure Centre, Desmond Anderson School and Thomas Bennett Community College
- Phase 2: Expansion of the network to link to the proposed residential development to the east of the leisure centre.

The possibility to extend the network towards the Broadfield area to link to the Broadfield Health Care Centre and Broadfield Football Stadium has been explored; however it has been deemed unviable due to the length of the pipe required. Additionally, there was a level of uncertainty regarding the future of the Broadfield Health Care Centre which would increase the risk of the project being unviable.



1	K2 Leisure Centre	2	Desmond Anderson School	3	Thomas Bennett Community College
4	Residential Development (proposed)				

Figure 2 Proposed District Heating Network Routes for the K2 Leisure Centre Cluster

Table 2: Summary of Financial Viability for the K2 Leisure Centre Cluster

Phase	Capital cost (£)	IRR (%)	NPV[3] (7%discount rate)	NPV) (5% discount rate)	Public contribution for IRR 7%	CO_2 savings[4] (tonnes)
1	£562,774	11.07%	£217,793	£377,478	-	342(29% reduction)
1 + 2	£917,274	7.62%	£51,003	£250,984	-	405(29% reduction)

Key 'next steps' for Crawley Borough Council resulting from this study are:

Recommendation 4: CBC should set up a District Heating Working Group, headed by a Project Champion and comprising members of staff from key groups with the Council (councillors, planning etc). See section 7.10 and 8.0 (Next Steps) for further details.

[3] Over 20 years
[4] Against business as usual

Recommendation 5: CBC, headed by the Working Group should setup a CBC led ESCO with the objective of delivering heat networks within Crawley. See section 7.10 and 8.0(Next Steps) for further details.

Recommendation 6: Develop detailed proposals for delivering a Town Centre heat network based around an initial pilot scheme. Please refer to section 7.10 for details on a recommended approach.

Recommendation 7: Develop and finalise the business plan for connecting K2 Leisure Centre, Desmond Anderson School and Thomas Bennett Community College onto a district heating network supplied from a new gas fired CHP engine within K2 Leisure Centre:

- Liaise with Freedom Leisure and BAM to assess the appetite, roles and delivery options for the network
- Undertake a detailed feasibility study and viability assessment (alongside delivery partner) based on detailed building surveys.

See section 7.11 and 8.0 (Next Steps) for further details.

Recommendation 8: Undertake a further feasibility study into the opportunities for a communal steam network to supply industrial processes and space heating on the Manor Royal Business District. See section 6.7.5 and 8.0 (Next Steps) for further details.

Recommendation 9: Crawley Homes to undertake a detailed feasibility study into the opportunities for communal gas, biomass/biofuel heat and/or CHP for installation into social housing blocks. This could be delivered under Energy Performance Contracting arrangement. Please refer to section 6.7.2.

2.4. Recommended Planning Policy to Support Low Carbon Development

Using the outputs from the heat mapping and low and zero carbon opportunities assessment, recommended policy wording has been developed. The suggested planning policy wording should be developed and included in a Development Plan Document (DPD) as required by the draft consultation PPS ‘Planning for a Low Carbon Future’.

Key considerations for planning policy are as follows:

- The policy sets out the requirements for new development based around the following energy hierarchy 1. Energy Efficiency 2. Decentralised Energy Networks 3. Renewable and low carbon energy
- The policy aligns to the policies detailed in the draft consultation PPS ‘Planning for a Low Carbon Future’ (see section 4.3)
- The policy focuses on maximizing development of district heating networks including the identification of ‘District Heating and Cooling Priority Areas’ that show broad areas where the Council have identified opportunities to develop heat networks.
- The policy refers to the evidence base for renewable and low carbon energy within the borough including opportunities for wind, biofuel supply, biogas and hydro energy. In particular, Policy D (Renewable and Low

Carbon Energy) highlights the potential constraints on developing wind turbine sites through reference to the constraints maps.

Key 'next steps' for Crawley Borough Council resulting from this study are:

Recommendation 10: The planning team should develop and integrate the recommended planning policy wording relating to energy efficiency, district heating and renewable/low carbon energy technologies into a Development Plan Document (DPD). See section 7.4 and 8.0 (Next Steps) for further details.

Recommendation 11: The District Heat Network working Group, led by planning, should develop a guidance document on 'District Heat Networks in Crawley' to encourage new development to install or connect to heat networks Please refer to section 7.4

Recommendation 12: The planning team should consider creating Supplementary Planning Documents that support the development of district heating networks in Crawley prior to adoption of the Core Strategy. Please refer to section 7.4

3.0 INTRODUCTION

3.1. Crawley Borough in Context

The Borough of Crawley is located in the County of West Sussex and is largely urban, bounded by Gatwick Airport to the North, the M23 to the East, Tilgate Forest/Buchan Park to the south and agricultural land/forest to the west. The Borough covers an area of 17.3 square miles and has a population of approximately 100,000 (2001 census).

The town is a main centre of industry in the region with the Manor Royal Business District to the North of the Borough supporting a large number of industries and services, many of which are connected with the airport.

There are 13 residential neighbourhoods, each with a variety of housing types: terraced, semi-detached and detached houses, low-rise flats and bungalows. There are no residential tower blocks. Many houses have their own gardens and are set back from roads. Each neighbourhood is based around a shopping parade, community centre and church, and has a school and recreational open spaces.

The Town Centre at the centre of the Borough comprises the High Street to the East with the large Queen's Square shopping area (developed in the 1950s and 60s) to the West in addition to the County Mall shopping centre which is located opposite Crawley Station. The Town is bounded by the Arun Valley Railway line which connects Crawley to Horsham and with the main London to Brighton line.

There are plans to expand Crawley's central shopping area northwards on to land occupied by the Town Hall and office buildings. The Borough Council's premises could be moved to a new site and The Boulevard would become a large pedestrianised shopping area. A 23,700 m^2 John Lewis department store may be the anchor store. The scheme, named "Town Centre North", is designed to make Crawley a major regional shopping destination.

3.2. Baseline CO_2 Emissions and Energy Consumption in Crawley

3.2.1. Total CO_2 Emissions and Energy Consumption by Sector

Based on Department of Energy and Climate Change (DECC) statistics for 2008, CO_2 emissions per capita in Crawley were 7% higher than the national average and 14% higher than the regional average (South East). The breakdown of emissions by sector can be seen in Table 3.

Table 3: CO_2 emissions in Crawley, South East Region and Great Britain for 2008 (Source: Emissions of CO_2 for Local Authority Areas, DECC)

	Crawley	Proportion	South East	Proportion	Great Britain	Proportion
	tCO_2/yr	%	tCO_2/yr	%	tCO_2/yr	%
Domestic	209,110	27%	20,294,890	37%	149,317,490	35%
Industry & Commercial	440,990	57%	20,103,710	37%	178,697,070	42%
Road Transport	125,030	16%	14,438,510	26%	102,154,980	24%

	Crawley	Proportion	South East	Proportion	Great Britain	Proportion
	tCO_2/yr	%	tCO_2/yr	%	tCO_2/yr	%
Total	775,130		54,837,110		430,169,540	
Emissions per capita	7.5		6.6		7.0	

Total CO_2 emissions in Crawley for the industrial and commercial sector were approximately twice (57% that of the domestic sector (27%). This is significantly higher than for the regional and national data sets where industrial and commercial emissions were 37% and 42% of the total respectively.

Figure 3 shows the total energy consumption in the domestic and industrial/commercial sectors for 2008 for Crawley. The high CO_2 emissions associated with non-domestic buildings can be attributed to the high consumption of grid supplied electricity which has a higher CO_2 intensity compared to natural gas.

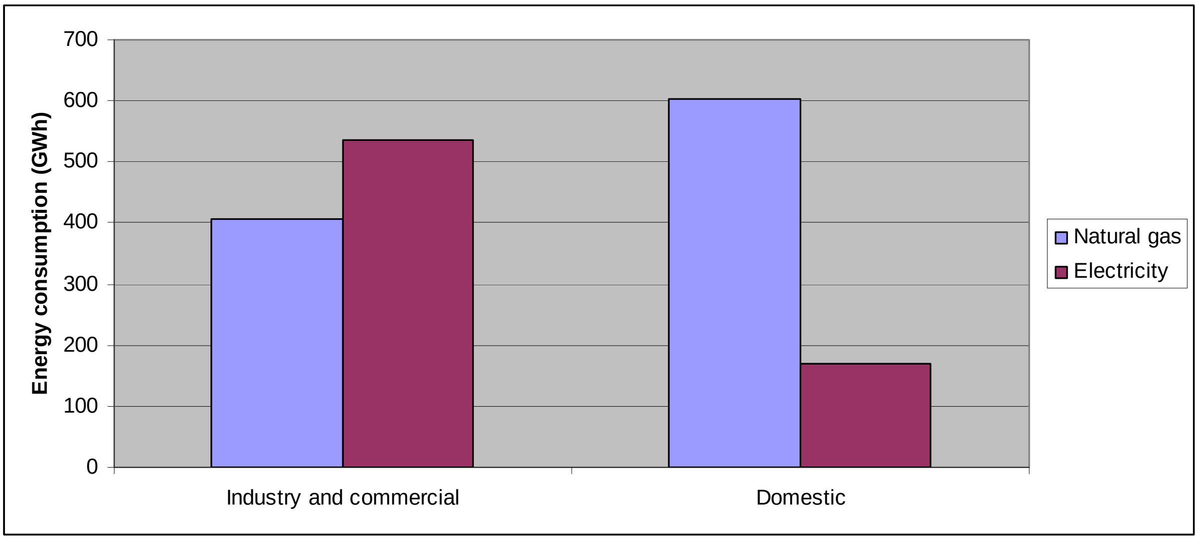


Figure 3: Total Gas and Electricity Consumption for Domestic and Non Domestic (Industrial and Commercial) Buildings in Crawley (DECC, 2008)

3.2.2. Domestic Energy Consumption

DECC provide statistical data that helps to understand the breakdown of actual energy use by sector and fuel type. The latest available data set (2008) was used in the analysis. **Table 4** compares the average annual electrical and gas consumption for domestic properties for Crawley compared to the South East and National averages. Consumption of both fuel types is less than the regional and national comparative data.

Table 4: Annual Gas and Electricity Consumption per Domestic Meter (DECC, 2008)

	Crawley	South East	Great Britain
	kWh	kWh	kWh
Electricity	3,942	4,477	4,151
Gas	13,926	15,536	15,382

Figure 5 and Figure 6 show the average annual gas and electrical consumption per meter in Crawley, broken down into Middle Layer Super Output Areas (MLSOA). The maps show a higher consumption of both energy sources in the east of the Borough, with the lowest energy consumption towards the south and west of the Borough. Natural gas is the primary source of domestic heating fuel across the Borough as illustrated in Figure 4.

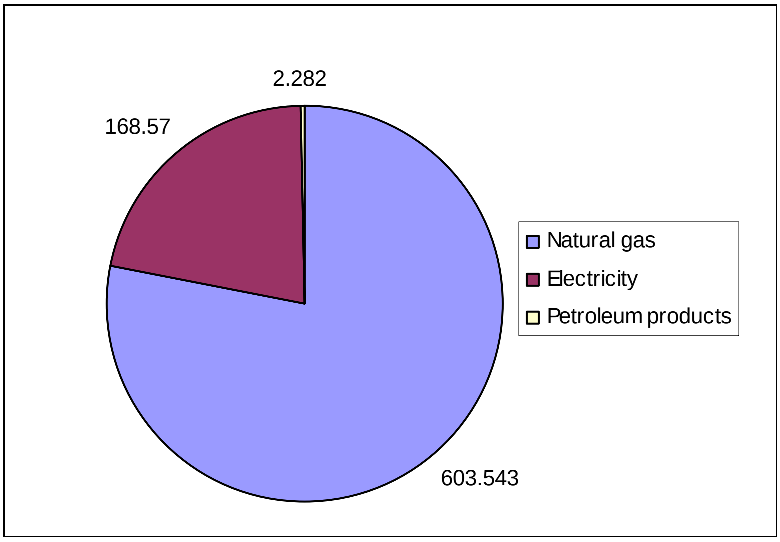


Figure 4: Total Domestic Energy Consumption in GWh by Fuel Type in Crawley (DECC, 2008)

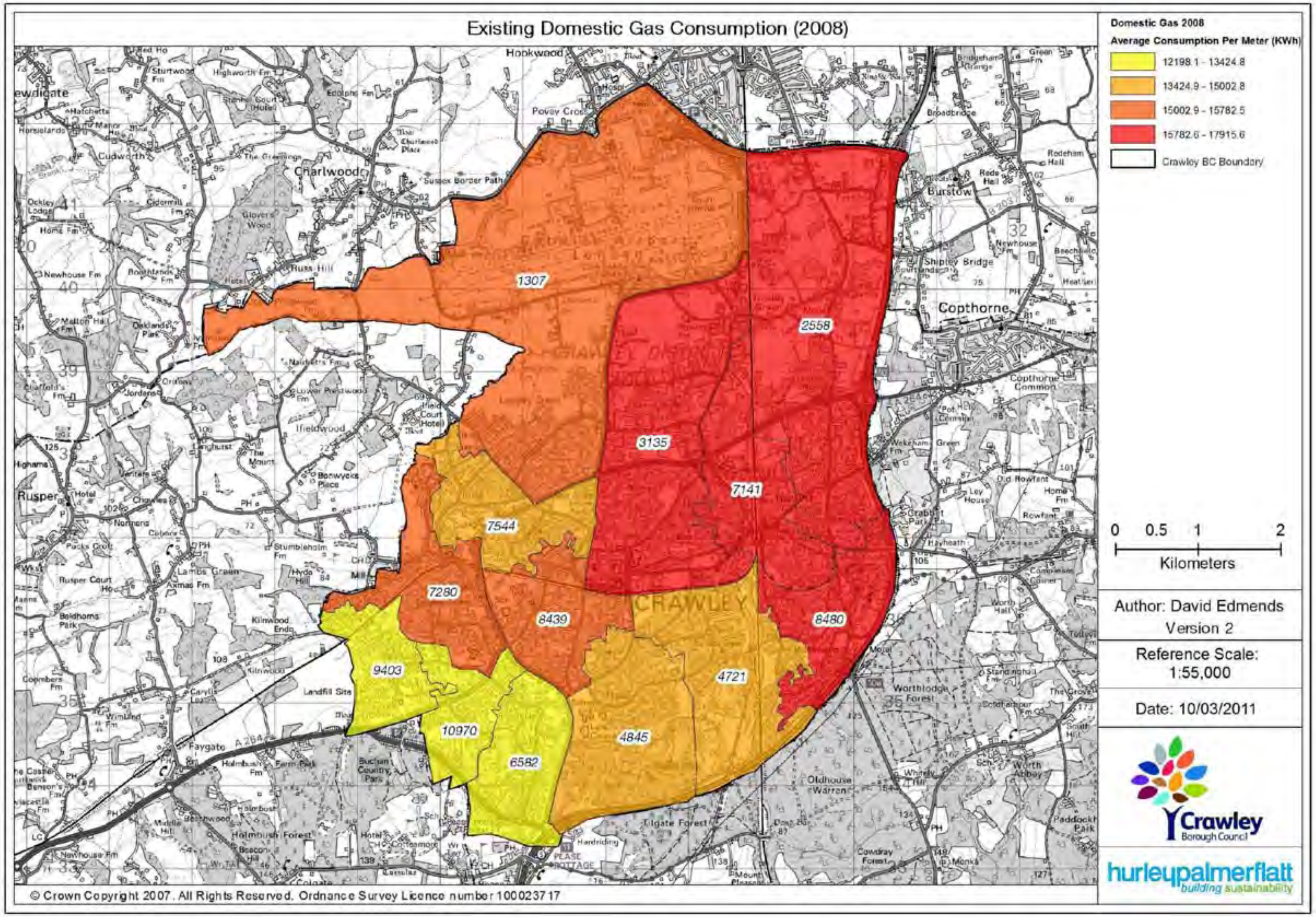


Figure 5: Average Domestic Gas Consumption for Crawley (kWh) per Meter (DECC, 2008)

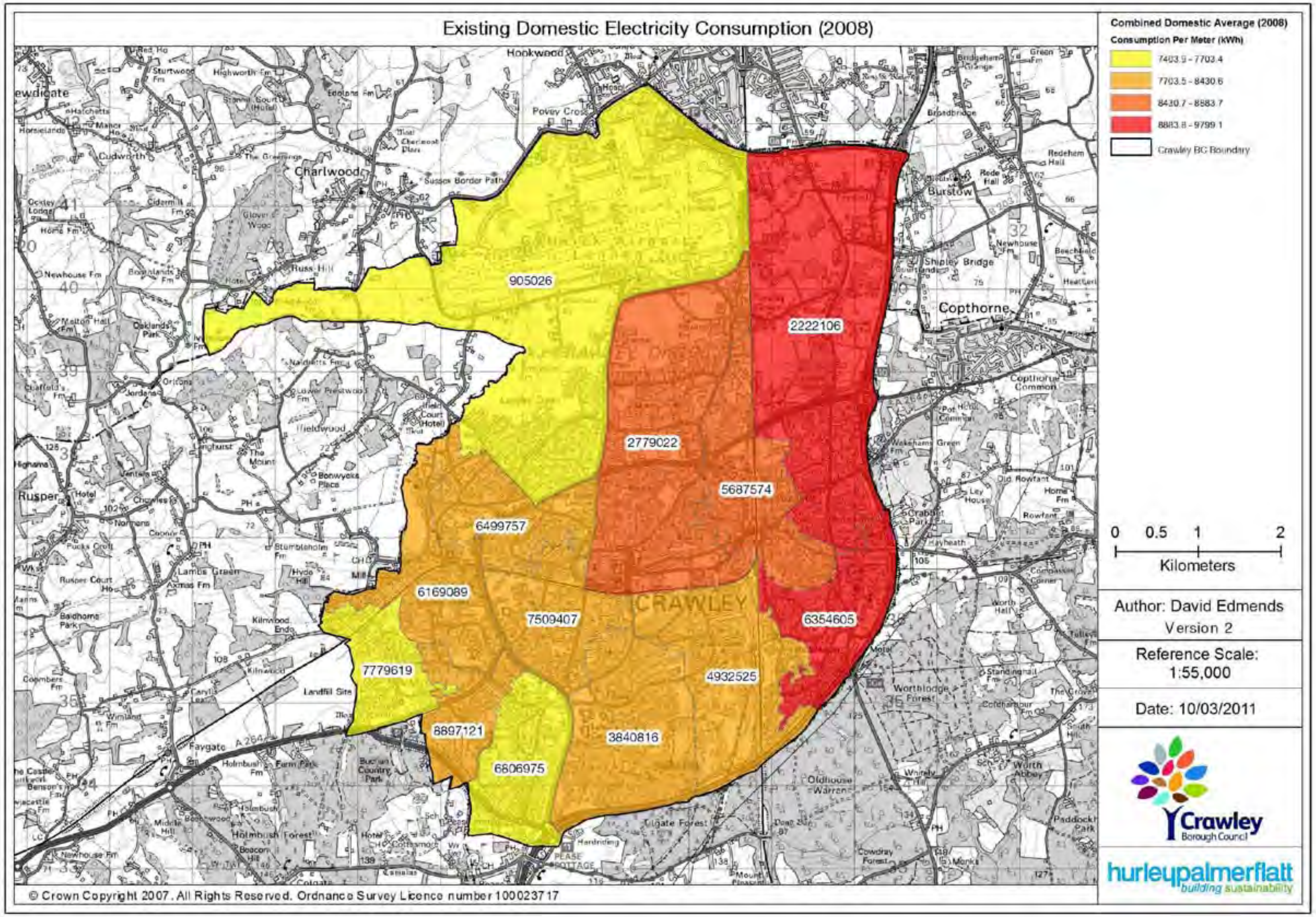


Figure 6: Average Domestic Gas Consumption for Crawley (kWh) per Meter (DECC, 2008)

3.2.3. Non-domestic Energy Consumption

Table 5 compares the energy consumption of industrial and commercial buildings per meter in Crawley against the South East and National averages. The figures show that both electricity and gas consumption is significantly higher than the regional and national averages. This is likely to be due to the high energy consumption of Gatwick Airport in addition to the large number of light industrial businesses servicing the airport.

Table 5: Annual Gas and Electricity Consumption per Industrial/Commercial Meter (DECC, 2008)

	Crawley	South East	Great Britain
	kWh	kWh	kWh
Electricity	158,712	70,434	76,262
Gas	729,262	450,448	663,764

Figure 7 shows the breakdown in annual energy consumption for different fuel types within the non-domestic sector within Crawley. Whilst consumption of grid supplied electricity is higher than for gas, there is also a significant consumption of petroleum products which are likely to the related to the operations of the airport (note: the data excludes energy consumption relating to air travel)

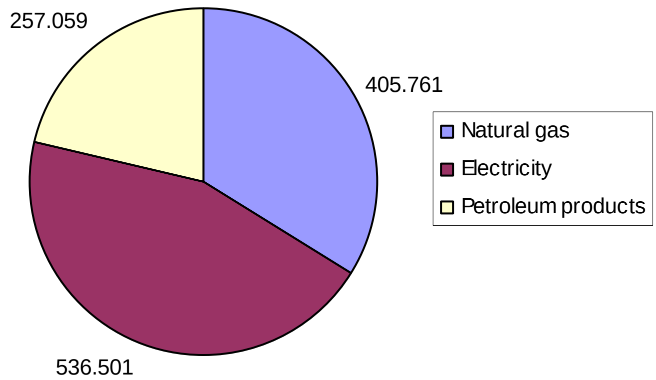


Figure 7: Total Non-domestic Energy Consumption in GWh by Fuel Type in Crawley (DECC, 2008)

3.3. The Need for a Decentralised Energy Study

The main objective of this study is to meet the policy requirements set by PPS1 and its Supplement, and to identify options for delivering low and zero carbon opportunities to the borough of Crawley including the development of district heat networks.

A key requirement of the PPS1 Supplement is for local planning authorities to have “an evidence-based understanding of the local feasibility and potential for renewable and low-carbon technologies”.

In addition, consideration has been given to the government consultation on a replacement PPS ‘Planning for a Low Carbon Future in a Changing Climate’ (published on 9th March 2010) which aims to combine and update the existing PPS on climate change and PPS22 on renewable energy. In summary, the policy supports the notion that the role of planning is to identify energy opportunities and spatial constraints and to use this understanding to set out planning policies designed to support action and delivery, while also acting as a wider resource for use by the Local Authority and local strategic partnerships (LSPs).

Other key policy drivers of low and zero carbon energy include:

- The Climate Change Act 2008 introduced a statutory target of reducing carbon emissions by 80 per cent below 1990 levels by 2050, with an interim target of 34% by 2020. Government departments will prepare carbon budgets to indicate how greenhouse gas emissions will be reduced across the Government estate and in sectors where departments take a policy lead.
- EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources, where the UK has committed to sourcing 15% of its energy from renewable sources by 2020 – an increase in the share of renewables by almost a factor of seven from about 2.25% in 2008, in scarcely more than a decade.
- The Low Carbon Transition Plan and the Renewable Energy Strategy were both published on 15 July 2009 and set out how the UK will achieve dramatic reductions in emissions and meet targets on renewables.
- The Household Energy Management Strategy was published on 2 March 2010, and placed a greater emphasis on district heating schemes and identified an essential role for planning in facilitating delivery of these and other community scale energy schemes.
- Meeting proposed zero carbon standard for domestic and non domestic buildings involves a combination of energy efficiency measures and the use of decentralised energy solutions, to be set out through Building Regulations and through use of a range of 'allowable solutions', the details of which are still to be decided (see section 4.4)
- The Energy Act 2008 introduced powers for a Feed-In Tariff and the Renewable Heat Incentive (RHI) aimed at driving an increase in renewable energy generating capacity, and which is likely to have an impact on planning.

3.4. The Big Picture: Meeting the 80 per cent CO_2 Reduction Target by 2050.

A number of studies have been undertaken to assess the options available within the UK to meet the statutory carbon reduction targets set within the Climate Change Act 2008. The Low Carbon Transition Plan developed by the Department of Energy and Climate Change (DECC) sets out a number of key steps to achieve a 34% cut in emissions on 1990 levels by 2020. The plan shows how reductions in the power sector and heavy industry; transport; homes and communities; workplaces and jobs; and farming, land and waste sectors could enable the carbon reduction target to be met. The key steps identified to meet the 2020 target that apply to primary energy generation and energy use in buildings include:

- Funding demonstrations of capturing and storing emissions from coal fired power stations
- Developing new nuclear power stations
- Sourcing 40% of energy from low carbon sources and 30% from renewable energy sources
- Rolling out smart meters to all homes by 2020

- Implementing 'pay as you save' schemes

Further to the Low Carbon Transition Plan, the Carbon Trust have published 'Building the future, today: Transforming the economic and carbon performance of the buildings we work in, which sets out the options to reduce carbon emissions in the UK's non domestic buildings. The key findings of the report are:

- A 35% CO_2 reduction by 2020 vs. 2005 can be achieved with a net benefit to the UK of at least £4bn[5].
- Reductions of 70-75% by 2020 can be achieved at no net cost[6], using options which exist today.

The report identifies that almost all of the carbon reduction measures that are available today will need to be implemented to achieve the 80% target reduction by 2050 - there is no 'either or'. This includes:

1. Decarbonisation of the electricity supply
2. Reduction in energy use of both new and existing buildings
3. Use of low and zero carbon energy generation on and near buildings.

To assess the potential impacts of the above measures in meeting the Climate Change Act targets to 2050 for non domestic buildings, the Carbon Trust developed the 'DeCODE'[7] model. The inputs to the model were the current UK building stock emissions and the measures that could be applied to reduce these emissions. The outputs of the model show potential emissions trajectories for new and existing buildings over time, as illustrated in Figure 8.

[5] Cumulative benefit to 2020 including impact of grid decarbonisation
[6] Cumulative cost to 2050
[7] Determining carbon opportunities in the non domestic environment

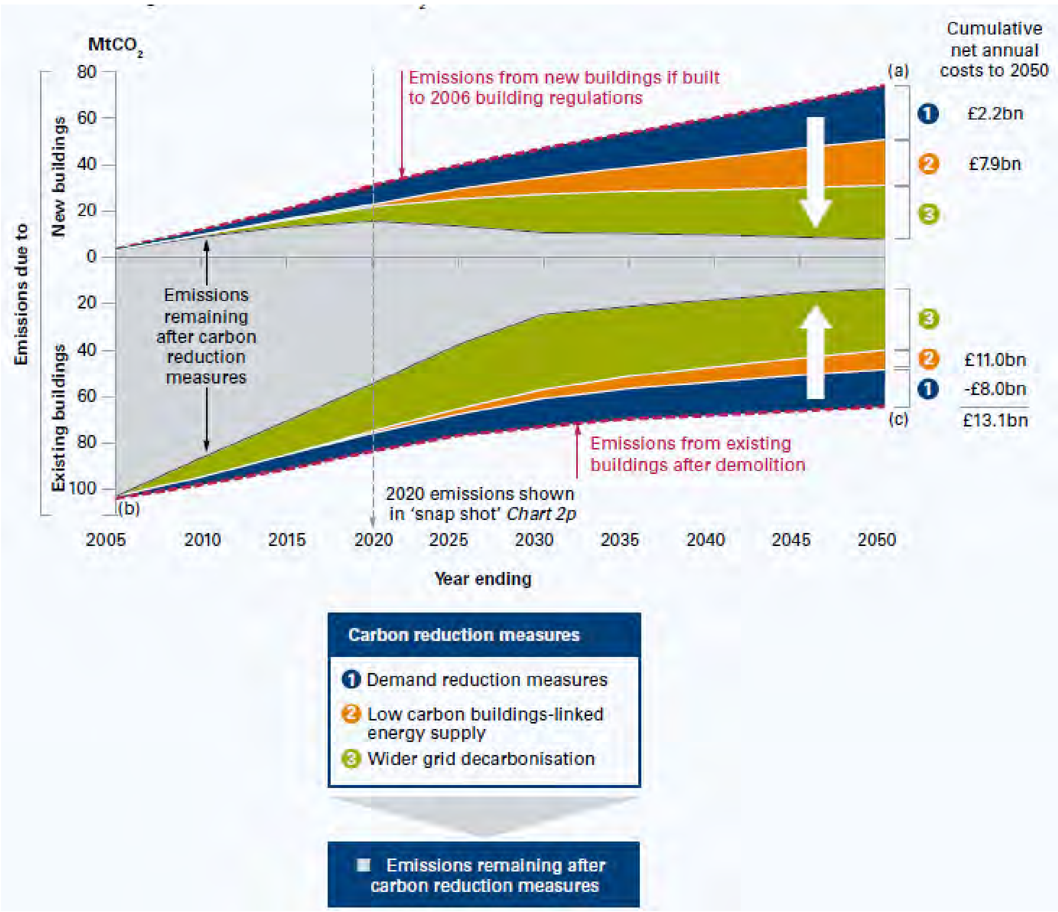


Figure 8: 'Wedge Chart' of Non Domestic CO_2 Emissions to 2050 (Source: Carbon Trust Analysis)

The model illustrated that to meet the 80% target by 2050, all carbon reduction measures would need to be implemented. Including a reduction in new build rates for offices, increase refurbishment rate of buildings and adoption of energy efficiency and low/zero carbon energy measures including demands reduction, low/zero carbon energy supplies (building linked) and electricity grid decarbonisation. The report proposes a time-line for implementing the measures as illustrated in Figure 9.

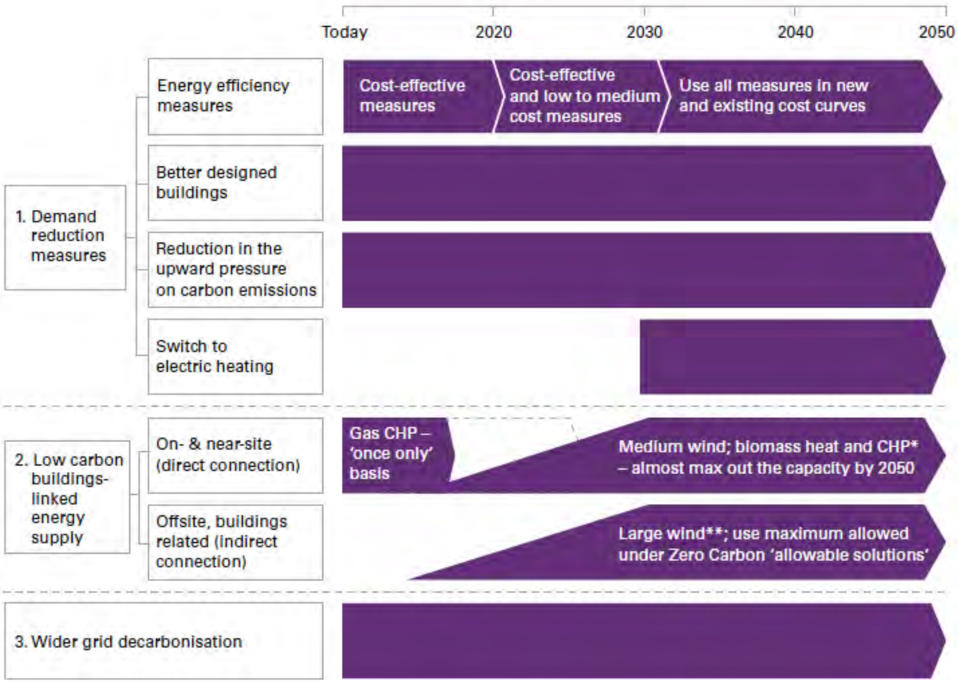


Figure 9: Proposed Timing of Measures (Source: Carbon Trust)

Whilst this report doesn't explicitly assess the opportunities for demand reduction measures or wider electricity grid decarbonisation, it does provide an evidence base for Crawley of building linked energy supplies including gas CHP, biomass heat and CHP and large scale wind. Key to the DeCODE strategy is the reduction in the carbon intensity of the grid from 0.562kgCO_2/kWh in 2005 to 0.08kgCO2/kWh by 2050 (based Committee on Climate Change forecasts). The model assumes a large switch to electric heating from 2030 which will supplement low carbon sources of heat including those from biomass. This could be used in conjunction with heat pumps (ground, water, air source) which would increase the efficiency of the system and hence further reduce CO_2 emissions. This would however need to be preceded by the development of alternative low and zero carbon measures including district heat networks fuelled by gas CHP and/or biomass heat and CHP.

4.0 PLANNING POLICY AND BUILDING REGULATIONS - CONTEXT

4.1. Introduction

The challenge of climate change and the need to reduce greenhouse gases and stabilise CO_2 levels in the atmosphere has intensified. There is now a comprehensive range of national legislation and policy at various scales which supports the development and implementation of local decentralised renewable and low carbon energy policy and targets. The following section summarises the key drivers, policy and building regulations that aim to reduce energy use and carbon emissions from buildings.

4.2. International and National Drivers of Planning Policy

At the international level, the Kyoto Protocol is currently being updated. The 'Bali Roadmap', an output from the Climate Change Conference in Bali (December 2007) set out a two year process to finalise a new legally binding international treaty at the United Nations Climate Change Conference in Copenhagen in December 2009 (COP15). COP15 did not produce this legally binding treaty. Politicians from the 192 participating countries recognised - through the Copenhagen Accord - the scientific view that the temperature increase should be held below a 2degC rise, and promised financial aid to developing countries to help them adapt to climate change. Further political effort is required to establish a new programme to reach an international, and legally binding, agreement on climate change.

The UK is already committed to meeting European CO_2 and energy targets, agreed between the European Commission and the Member States. The European Union has agreed to reduce CO_2 emissions by 20% on 1990 levels by 2020, with an intention to increase this target to 30% if international agreement is reached which commits other developed countries and the more advanced developing nations to comparable reductions. In addition the UK Climate Change Act (2008) sets a legally binding target for reducing UK CO_2 emissions by at least 80% by 2050. It also established the Committee on Climate Change which is responsible for setting binding carbon budgets for 5 year periods. In the 2009 Budget, the first three carbon budgets were announced, with the aim of achieving a 34% reduction in emissions by 2020. Based on the latest available statistics from the Department of Energy and Climate Change (DECC)[8], new carbon dioxide emissions fell by 9.8% between 2008 and 2009. This is mainly as a result of increase in the use of nuclear power rather than coal and natural gas for electricity generation, and lower demand for electricity as a result of the recession .

The Act is supported by the UK Low Carbon Transition Plan (2009), which sets out the Government's approach to meeting their carbon reduction commitments. The plan includes commitments to reducing greenhouse gas emissions from the existing housing stock by 29% on 2008 levels by 2020 and by 13% for places of work.

The EU has also agreed to increase the proportion of its energy supplied from renewable sources to 20% by 2020, including electricity, heating energy and transport energy. As its contribution, the UK has committed to supply 15% of all

[8] 2009 Greenhouse Gas Emissions, Final Figures, 1st February 2011

the energy it uses from renewable sources by 2020. To achieve this, it is anticipated that renewable sources will need to contribute approximately 30% of our electricity supply, 12% of heating energy and 10% of transport energy, as set out in the UK's Renewable Energy Strategy (2009). The draft Heat and Energy Saving Strategy (2009) aims to ensure that emissions from all existing buildings are approaching zero by 2050.
The Household Energy Management Strategy (HEMS) entitled 'Warm Homes, Green Homes' (March 2010) sets out the strategic role that local authorities have to play, and provides a new focus on district heating (DH) in suitable communities by removing barriers to the development of heat networks, encouragement of CHP and better use of surplus heat through carbon pricing mechanisms.

The role of Local Authorities is further endorsed by an Audit Commission report into the role of local councils in reducing domestic CO_2 emissions , which emphasises that "councils can use their influence, legal powers and resources to:

- Lead – encouraging local communities and public and private sector organisations to take action on domestic energy by developing a clear strategic vision, facilitating partnership working, providing information, advice and support and championing energy issues;
- Oblige – using powers within the planning system to promote the development of more sustainable homes and increase the supply of low-carbon and renewable energy; enforcing Building Regulations; and using the Housing Health and Safety Rating System (HHSRS) to improve private sector homes; and
- Subsidise – funding measures in council homes and using financial incentives – such as council tax rebates, and direct funding, for example – home improvement grants or loans to promote take-up of measures to improve energy efficiency and supply low-carbon and renewable energy."

Planning has an important part to play in making this a reality, particularly in providing the evidence and resource assessments, policies and targets that underpin wider Local Authority CO_2 reduction strategies.

In terms of District Heating, HEMS states:

"District heating using CHP has the potential to deliver significant carbon savings and lower bills, but requires significant local coordination and specific support, for example through the planning system, to promote market confidence and growth"
Through HEMS, Government will support the roll-out of DH through a framework of policy and financial support, including:

- Clarifying the role of local authorities in driving deployment of DH and consulting on specific provision through a revised PPS on climate change;
- Strengthening expectations on suitable local authorities to develop local partnerships that drive deployment of low carbon and renewable options such as heat networks in their areas;
- Integrating policies for zero carbon homes to support investment in larger offsite solutions such as DH, which typically offer better value carbon savings.

The Planning and Compulsory Purchase Act (2004) placed sustainable development at the heart of the planning system. The Planning Act (2008) established a single development consent regime and a new planning process for nationally significant infrastructure projects. The Act also introduced the enabling legislation for the Community Infrastructure Levy (CIL) which will empower local authorities to levy a charge on development to support infrastructure development.

4.3. Planning Policy Statements (PPS)

The draft consultation (Planning for a Low Carbon Future in a Changing Climate – Consultation, March 2010) replaces the earlier supplement to PPS1 (Planning and Climate Change) and PPS22 (Renewable Energy). Policies contained in the draft consultation must be taken into account by local planning authorities in the preparation of local development documents. In addition, the policies in the PPS are material consideration which must be taken into account in development decisions where relevant.

The draft consultation details four key policy themes which would support the development of low and zero carbon energy infrastructure at regional and Local Authority level:

1. Evidence based plan making:

    - Policy LCF1 (Evidence based for plan-making) states that regional authorities working with regional and local partners should assess the potential for renewable energy based on consistent guidance published by the Department of Energy and Climate Change (DECC)

    - Local planning authorities should assess their area for opportunities for decentralised energy, focusing on opportunities at a scale which could supply more than an individual building and include up to date mapping of heat demand and possible sources of supply.

2. Moving away from authority wide targets for decentralised energy:

    - Policy LCF7 (Local planning approach to setting requirements for using decentralised energy in new development) states that local requirements should be consistent with national policy on allowable solutions (see section 4.4 for definition) set out in support of the zero carbon homes and non domestic buildings policy.

    - Policy LCF8 (Local planning approach to setting authority-wide targets for using decentralised energy in new development) states that the progressively demanding standards for CO_2 emissions set through Building regulations, together with the assessment of local opportunities for renewable and low carbon energy, will help drive greater use of decentralised energy. Therefore, targets for application across a whole Local Authority area which are designed to secure a minimum level of decentralised energy use in new development will be unnecessary when the proposed 2013 revisions to Part L of the Building regulations (for both domestic and non-domestic buildings) are implemented.

3. Setting a local planning approach for renewable and low carbon and associated infrastructure:

    - Policy LCF4 sets out a number of approaches that local planning authorities should consider when developing policy including:
    - Design policies to support and not unreasonably restrict renewable and low carbon energy developments.
    - Set out how any opportunities for district heating (to supply existing buildings and/or new development) identified through heat mapping will be supported.
    - Strategic sites which are central to delivering the local planning approach for decentralised energy should be allocated in the Core Strategy.

4. Requiring proposed developments to connect to identified or future decentralised energy systems:

    - Policy LCF7 states that "Where there are existing, or firm proposals for, decentralised energy supply systems with capacity to supply new development, local planning authorities can expect proposed development to connect to an identified system, or be designed to be able to connect in future."

4.4. Building Regulation Part L (Conservation of Fuel and Power)

4.4.1. Summary of Regulation

The Building Regulations first started to turn its focus towards reducing CO_2 emissions in the 2002 revision of Part L (Conservation of Fuel and Power). Further revisions to Part L in 2006 brought the UK Building Regulations in line with the EU Energy Performance of Buildings Directive (EPBD), introducing amongst other things the requirement for Energy Performance Certificates (EPCs)

The current 2010 Building Regulations Part L requires that CO_2 emissions calculated for a new development should be equal to or less than a Target Emission Rate (TER). This is in the region of 25% lower than emissions from a building which complies with the 2006 Building Regulations, depending on the specific building type.

The following intermediary step changes are proposed to the requirements of Part L of the building regulations (for dwellings):

- 2013: 44% improvement in regulated emissions (relative to 2006 levels)
- 2016: Zero carbon in terms of both regulated and unregulated energy (see section 4.4.2 for definitions)

In the Budget 2008, the Government announced an ambition that new public sector buildings should be zero carbon from 2018, one year in advance of the commercial new non-domestic buildings sector. It defined the scope of this ambition as covering the central (but not local) government estate, hospitals, the defence estate, prisons, courts and schools.

4.4.2. Regulated Versus Unregulated Energy

Current Building Regulations (Part L 2010) only apply to emissions that are associated with regulated energy that is consumed in the operation of fixed plant (heating, ventilation, cooling and lighting systems). From 2016 (dwellings) and 2019 (non-domestic), the requirements will apply to all emissions associated with energy use in the building including cooking and other appliances (referred to as unregulated energy).

4.4.3. Zero Carbon, Carbon Compliance and Allowable Solutions

The Definition of Zero Carbon Homes and Non-Residential Buildings consultation in 2009 (Department for communities and local government) sought to clarify the definition of zero carbon that will be applied to new homes and non domestic buildings through proposed changes to the Building Regulations.

A statement by John Healey (Minister for Housing and Planning in July 2009) confirmed the policy to require all new homes to be zero carbon by 2016 and set out the proposals which will be taken forward to implement this policy. This addressed the concern that the original definition, which followed the Code for Sustainable Homes Level 6, would not be feasible or viable on many sites.

The consultation introduced the concepts of 'Carbon Compliance' and 'Allowable Solutions' as ways of achieving carbon emissions targets where they cannot be met on site. The approach suggested followed the following three steps (for residential buildings):

1. Energy Efficiency, the minimum level of which has not yet been agreed, but is likely to be measured in kWh/m^2/year and differentiate between dwelling types. This stage will take account of building fabric energy efficiency such as U-values, air tightness, thermal bridging and thermal mass.

2. Carbon Compliance, set at 70% of regulated emissions (the Dwelling Emission Rate or 'DER') and will take account of systems and controls, such as heating/cooling systems, low and zero carbon energy technologies and mechanical ventilation.

3. Allowable Solutions, which will cover the remaining carbon emitted from the dwelling for 30 years. The final list has yet to be confirmed but may include:

    - Further carbon reductions on site, through energy efficiency or on-site generation
    - Energy efficient appliances
    - Advanced forms of building control systems which reduce the level of energy use in the home
    - Exports of low carbon or renewable heat from the development to other developments
    - Investments in Renewable and Low Carbon community heat infrastructure

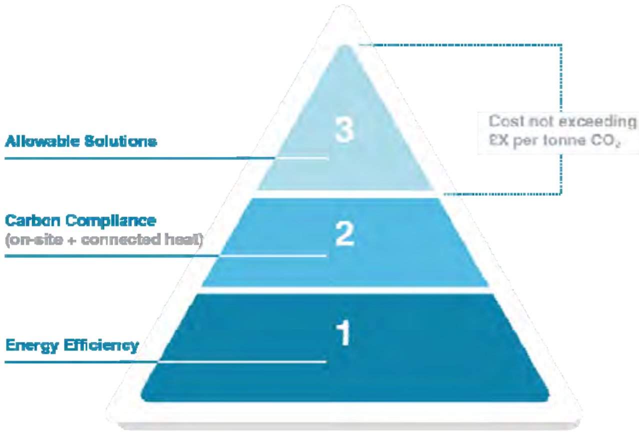


Figure 10: The Zero Carbon Hierarchy

The adoption of allowable solutions into Building Regulations means that there could be a significant investment in low carbon measures in local areas through developers either opting to save CO_2 offsite, or pay into an allowable solutions offset fund. It is currently not known how an offset fund would be administrated or who (potentially a Local Authority) would be allowed to allocate funding. However this could be a future source of finance for local authorities which could be used to contribute to low carbon energy schemes and infrastructure.

The policy recommendations in section 7.4 and Appendix D identifies the potential for developers to contribute to a carbon offset fund. This could come into force in the Borough before Allowable Solutions come into effect, allowing developers to pay into a fund where they cannot meet carbon reduction targets on-site. The amount payable would be based on a fixed price per tonne of residual carbon emitted, after taking into account any energy efficiency or on-site energy generation.

4.5. Local Planning Policy

4.5.1. Corporate Climate Change Strategy (Crawley Borough Council)

Crawley Borough Council summarised their Corporate Climate Change Strategy in a 'Report to Cabinet' dated December 2008. The key recommendations include:

Setting a vision to become a Carbon Neutral council and carbon neutral town by 2050.

Setting interim targets before 2050 including:

- Reduce carbon emissions by 32% by 2020
- Reduce carbon emissions by 60% by 2040

The report contains a structured plan to 2020 detailing initiatives that should be considered and implemented including:

- Minimising energy consumption
- Using Sustainable Energy

4.5.2. Existing Core Strategy

The existing Core Strategy provides the spatial vision, objectives and development strategy for Crawley up to 2016. Whilst there are no specific policies relating to low carbon and renewable energy provision or targets, the Core Strategy highlights the need to:

"Protect green spaces, encouraging the use of alternative forms of transport by locating new development in accessible locations and promoting the use of renewable energy in the design of new buildings".

4.5.3. Core Strategy Review

The Council is currently preparing the successor to the existing Core Strategy (as revised October 2008). This will cover the period to 2026. Consultation and development of the revised Core Strategy is ongoing and the strategy is expected to be adopted in early 2014. The Council undertook an Issues and Options Consultation in May/June 2009. The outcomes were published in a series of Topic Papers:

Topic Paper 2: Climate Change and Sustainability

The key issues raised within the topic paper include:

- Should the council adopt targets requiring a reduction in CO_2 emissions or set an amount of low and zero carbon energy that should be provided
- Should development be allowed to offset their CO_2 emissions outside of the development boundaries (e.g. renewable energy being produced of-site or contributions being made towards funding a large/wider scheme that will benefit areas outside of the development boundary).
- Should policies include a blanket approach/target for the whole Borough or one that defines special areas that require an even higher target?
- Should the policy set a single target across the plan period to 2026 or look at requesting a staged approach with targets getting higher over time
- Should the Council have its own local policies and targets?
- Should sustainability be a priority and if so, what targets and time periods should be used?
- How can the council assist developers to understand the requirements and ensure that they are met whilst being viable, deliverable and achievable
- What measures can/should the Council take to tackle climate change in Crawley?

4.5.4. Supplementary Planning Documents (SPDs)

The following provides a summary of the key Supplementary Planning Documents (SPDs) relating to energy and carbon reduction in new development.

SPG14 - Sustainable Design

- Provides guidance to architects, planners, designers and developers on ways to conserve energy, water and non renewable resources.
- Focuses on energy efficient design of buildings including passive solar design, natural ventilation, shading devices, minimizing heat loss (e.g. through minimizing exposed facades and high thermal insulation), maximizing daylight penetration, maximize the density of buildings to minimise heat loss.
- Recommends utilizing heating systems that may be adaptable to different fuels in the future.

SPG13 - Landscaping and Greening the Environment

- Highlights the benefits of planting which can shelter a building and therefore reduce heat loss.

Planning Obligations and S106 Agreements (SPD 2008)

- Under the heading 'Approach to Climate Change Issues' the SPD details expectations for sustainable new development including consideration of energy efficient design, carbon emission reductions, renewable energy use.

- The guidance mentions contributions to developing a (heat) network in the Town Centre

  "4.13.5 As a result of the potential for the development of alternative energy infrastructure which has been identified in the town centre, all developments within the Town Centre will, therefore, be expected, to contribute to such a network if it is proved to be viable following further work"

Crawley Town Centre North Development Principles - Revised Supplementary Planning Document (Jan 2009)

- Details opportunities for decentralised energy scheme to serve the development:

  "9.3 This development may provide a major opportunity to develop a local, decentralised energy scheme such as a Combined Heat and Power District Heating System to serve the development and the wider area. The developer, working with the Borough Council, will be expected to evaluate the feasibility of such a scheme and, if appropriate, its implementation through an Energy Service Company."

Town Centre Wide Supplementary Planning Document (May 2009)

- Section 8 (Utilities, Infrastructure and Planning Obligation) details expectations for decentralised energy in the Town Centre including:

  “8.2 The Borough Council will liaise with utility companies and transport providers to identify whether there are any key infrastructure requirements arising from the proposed level of development in the Town Centre which need to be addressed. This could include a decentralised energy scheme. The Borough Council and its partners will encourage the providers to prioritise the implementation of necessary improvements and will help, where appropriate, to secure sources of funding.”

5.0 OPPORTUNITIES FOR LOW AND ZERO CARBON ENERGY

5.1. Existing Low Carbon Energy Infrastructure

Crawley has a number of small scale low and zero carbon energy sources within the Borough (although the potential is much greater). There are three Combined Heat and Power (CHP) schemes in place including a unit at the Tinsley Sewage Treatment plant which is powered by sewage gas. As micro generation technologies (PV and Solar Thermal Hot Water) are permitted without planning permission, it is difficult to monitor uptake. Details of the current known low and zero carbon installations in Crawley are shown in the table below.

Table 6: Existing Low and Zero Carbon Technology Installations in Crawley

Energy Source	Plant Description	Location	Installed Capacity	Status
Biogas CHP	Sewage gas from anaerobic digestion feeding gas CHP engine	Thames Water Sewage Treatment works, Radford Road, Tinsley Green RH10 3NW	340kWe	Operational
Gas CHP	2 x Dresser-rand gas CHP	Royal Mail Sorting Office	702kWe	Operational
Biomass	1 x Binder Biomass boiler	Crawley Library and Register Office	149kWth	Operational
Gas CHP	1 x Cogenco gas CHP	K2 leisure centre	235kWe	Operational

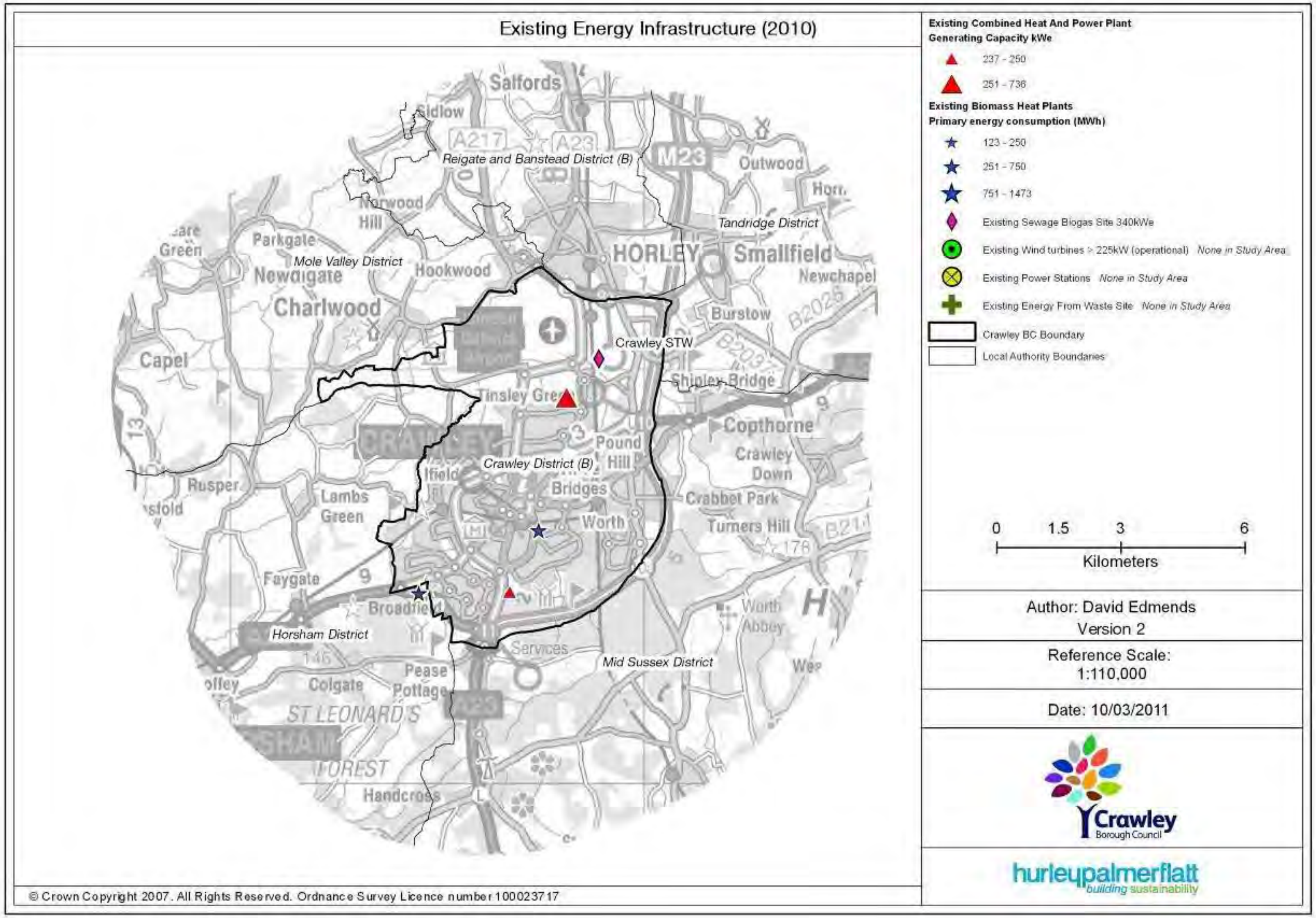


Figure 11: Existing Low Carbon Energy Infrastructure in Crawley

5.2. Estimating Borough Wide Low and Zero Carbon Energy Potential

To inform strategic planning of low and zero carbon technologies across Crawley, an assessment was undertaken of the potential opportunities and constraints of different forms and scales of technology. The findings of the study provide an evidence base to assist the Local Authority in the preparation of their own specific policy for low and zero carbon energy development. The study findings are also relevant in the context of the Coalition Government's commitment to "encourage community-owned renewable energy schemes where local people benefit from the power produced".

To ensure that the study is consistent with national guidance, the study broadly follows the methodology prepared by the consultant SQW for the Department of Energy and Climate Change (DECC) and the Department of Communities and Local Government (CLG)[9] (referred to within this study as the 'DECC methodology'). As this methodology was developed for regional scale capacity assessment, a number of data sets referenced in the methodology were not available at the Borough level. Where this was the case, reference was made to alternative sources of data.

The study focuses on off-site and building integrated low and zero carbon technologies at both commercial and micro-generation scale. It examines energy sources that can be generated within the Borough rather than the effects of importing or exporting resources for energy generation from outside the boundary of the Borough. Other energy sources including fossil fuel sources are excluded from the study.

It is important to note that the study is strategic in nature and is not intended to provide guidance for the assessment and development of specific renewable energy projects/sites.

[9] Renewable and Low-carbon Energy Capacity Methodology – Methodology for the English Regions, January 2010

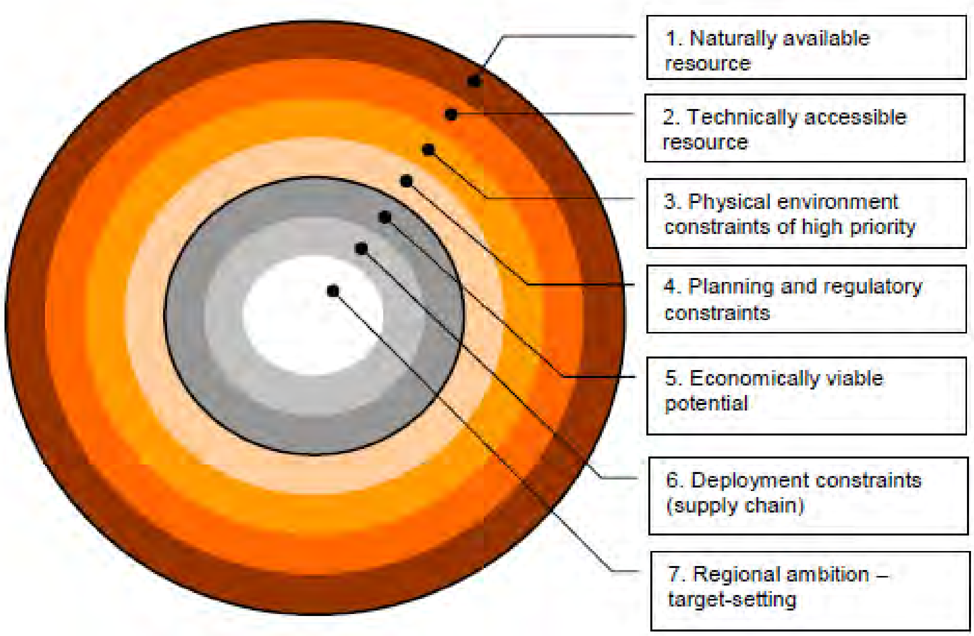


Figure 12: Stages in Assessing Potential for Low and Zero Carbon Energy (Reproduced from the DECC Methodology)

The figure above illustrates the key stages for assessing the potential of low and zero carbon energy sources. Stages 1 to 3 are an assessment of the potential accessible resource. The study has considered these stages across four key technology categories as detailed in the following sections.

5.3. Wind Turbines

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

5.3.1. Potential for Large Scale Wind Energy

Large scale turbines are those with the capacity of around 1MW or above and are typically used in the UK in commercial wind farms, with sizes now commonly being 2.5MW per turbine. There are currently no large scale wind turbines within the Borough of Crawley.

The wind resource in Crawley is potentially suitable for large scale wind energy with average wind speeds of greater that 6.0 m/s at 45m above ground level (agl) throughout the district, according to the UK Wind Speed Database – see Figure 13. The DECC methodology recommends that wind speeds above 5m/s agl are potentially viable for siting large scale turbines. At heights below 45m, and especially in urban areas, it is likely that the UK Wind Speed Database is not representative due to localised turbulence effects. However, in the more rural areas and at the heights of large scale turbines (typically 80-100m hub height), this data is likely to be accurate.

Geographic information systems (GIS) mapping of the physical constraints to wind turbines within the district has been carried out to identify areas where large scale wind energy may be feasible, based on a wind turbine with an 100m rotor diameter and 135m tip height – see Figure 14.

The study uses the following physical constraints for Large Scale Wind in line with the DECC methodology:

- Roads
- Railways
- Inland Waters – rivers, canals, lakes, reservoirs
- Built up areas – houses, buildings with 600m buffer zone
- Airports
- Buffer around roads and rail lines of 150 m (~110% of turbine height)
- Area of Archaeological Significance and Scheduled Monuments
- Woodlands, Ancient Woodlands and Parks

With the exception of a small area to the South of the Borough within Tilgate Forest Park, a majority of Crawley is constrained by the 5km buffer associated with Gatwick Airport in addition to the largely urban nature of Crawley. There is large potential for large scale commercial turbines within Mid Sussex and Horsham Districts. Whilst the study is based on recommended buffers as defined with the DECC methodology, this constraint should be periodically reviewed as technology advancements allow for wind turbine development closer to aviation facilities. Wind turbines can be accommodated in commercial areas and industrial areas with many precedents across the UK (the largest on-land wind turbine in the UK is installed adjacent to an industrial area in Lowestoft); however large turbines are generally unsuitable in residential areas due to possible noise impacts.

The opportunity areas for wind turbines as identified in Figure 14 would require detailed feasibility studies to ensure that a number of additional siting constraints are assessed before any of the sites could be confirmed for development., These include:

- Local wind resource survey
- Noise implications
- Aeronautical and defence impacts
- Grid connection and sub station requirements
- Flood risk
- Shadow flicker
- Telecommunications impacts
- Landscape and visual impact
- Bird migration impacts
- Transport access assessment
- Impact upon land use and land management
- Ground condition survey
- Archaeological constraints
- Listed buildings and conservation area impact

The assessment suggests that the Borough could generate around 1,679MWhe per year from large scale commercial wind turbines. This would result in carbon reduction of approximately 913 tonnes of CO_2 per annum compared to grid supplied electricity.

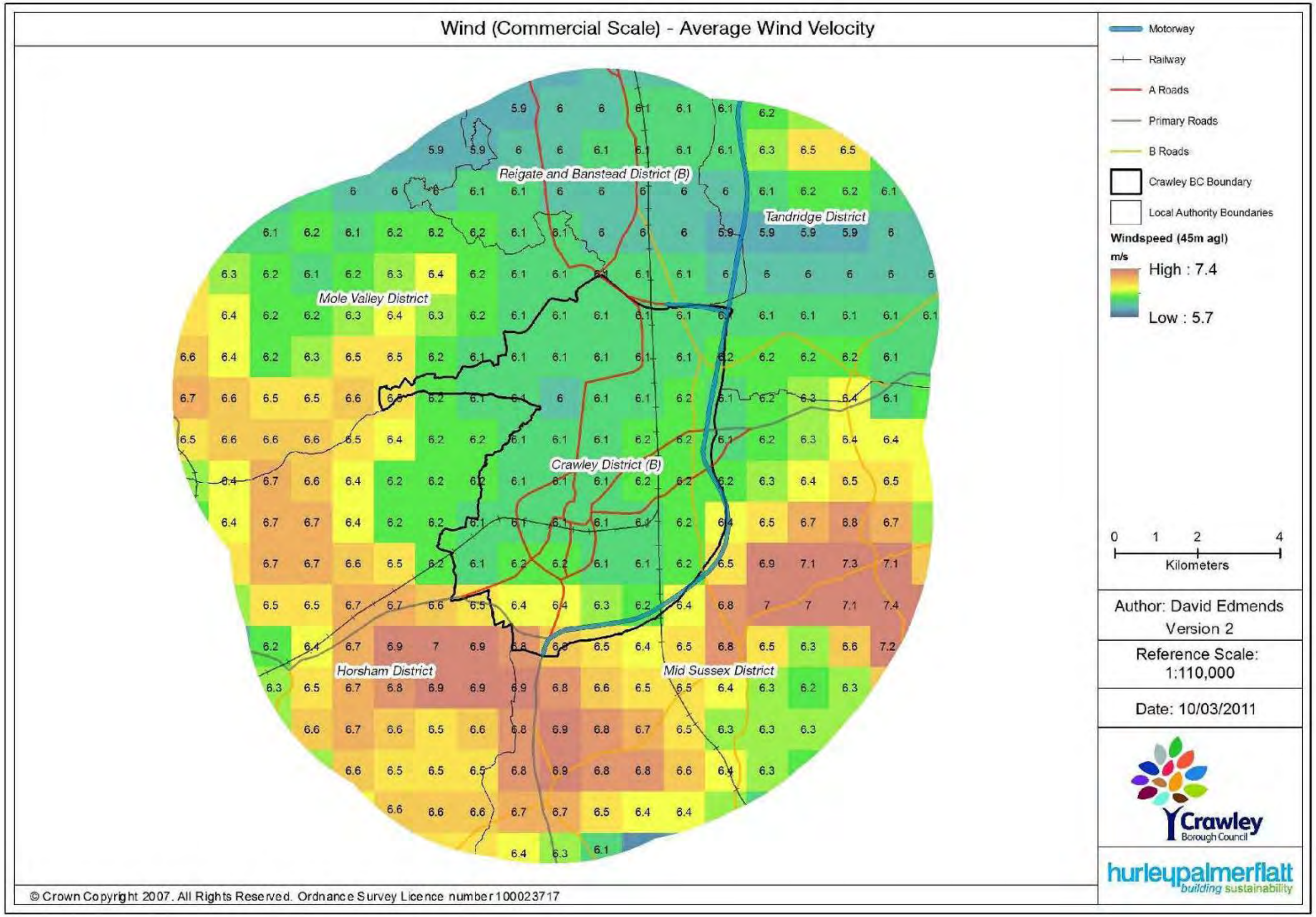


Figure 13: Average Wind Velocity at 45m Above Ground Level

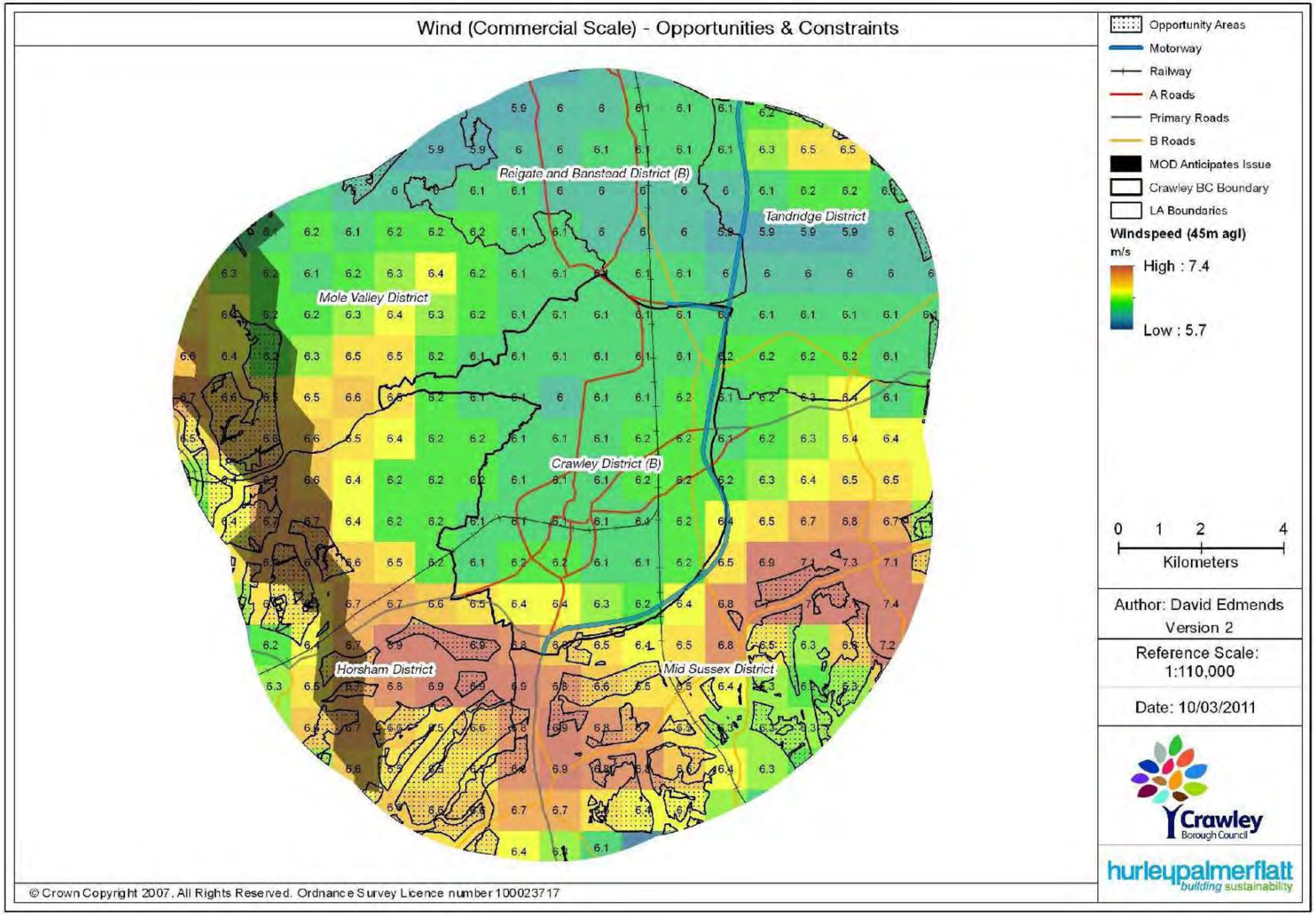


Figure 14: Opportunities and Constraints for Large Scale Wind Turbine in Crawley

5.3.2. Potential for Small Scale Wind Energy

The siting constraints on smaller scale turbines are dependent on a case by case basis. Due to their smaller size, the restrictions which may apply to large turbines covering visual appearance and noise do not typically apply to smaller scale systems, and in general, they can be located in most areas providing sufficient wind resource is available, including residential and urban areas, close to roads, and in areas of environmental sensitivity.

Due to their low height, the performance of small turbines is heavily dependent on localised wind conditions which in turn is influenced by the local topology and built environment. An estimate of average wind velocities at 10m above ground level throughout the Borough was made using the UK Wind Speed Database – see Figure 15. These wind velocities do not take into account the impact of terrain, buildings and trees on wind flow. Using the Microgeneration Installation Standard 3003 (MIS 2003) as guidance, the average wind velocities were adjusted based on the categorisations of urban, suburban and rural. Given the largely urban and suburban nature of Crawley, the adjusted wind velocities are less than the 4.5m/s at 10m agl which is deemed to be the minimum wind velocity for small scale wind turbines to be viable (as detailed within the DECC methodology). Whilst the DECC methodology provides a high level analysis of opportunities and constrains, this does not necessarily preclude small scale turbines where wind velocities are deemed to be sufficient.

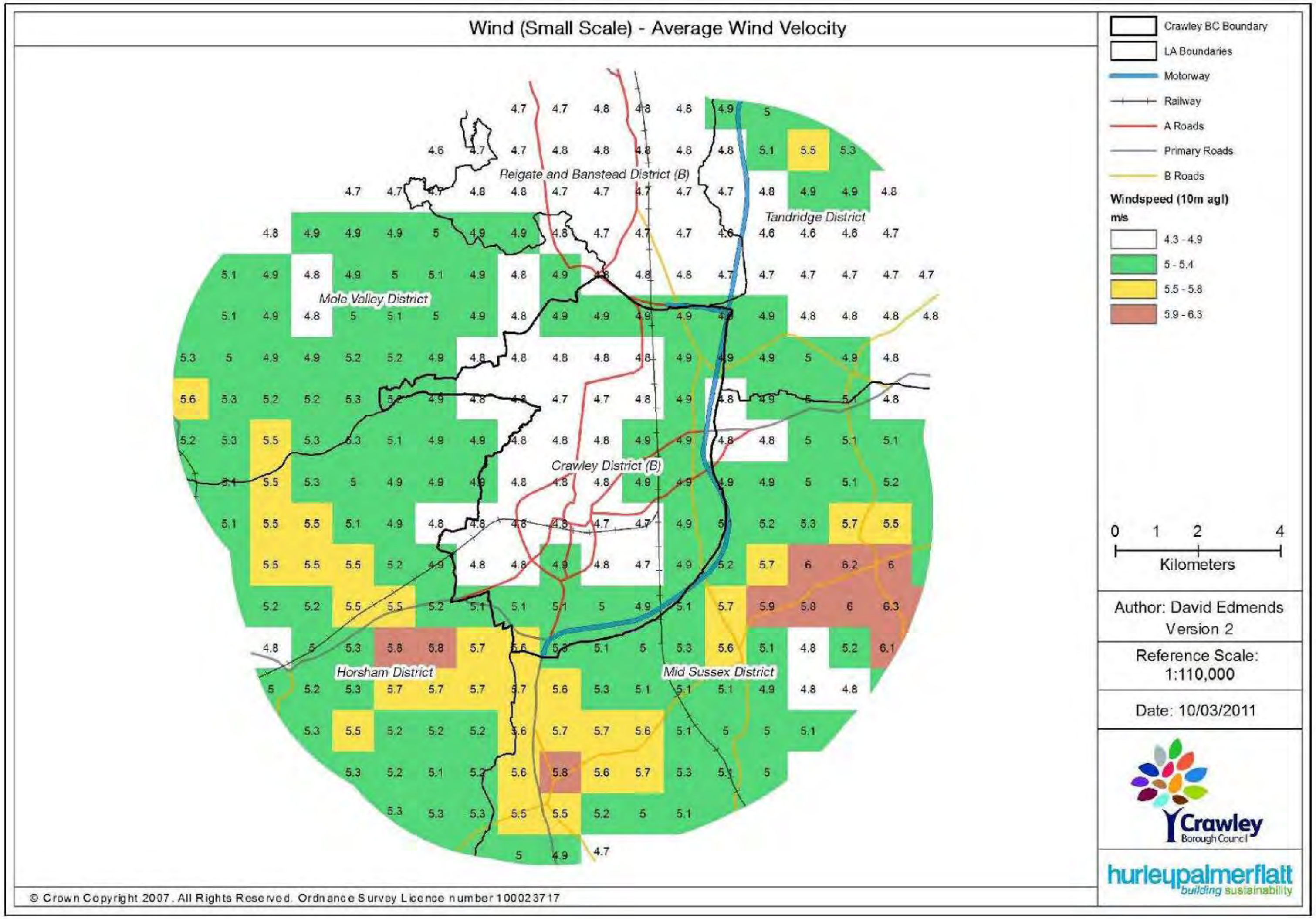


Figure 15: Average Wind Velocity at 10m above Ground Level (Does Not Account For Turbulence Effects of Terrain, Buildings and Trees)

5.4. Biomass

Biomass is a collective term for all plant and animal material and includes managed woodlands and energy crops. It is normally considered to be a renewable fuel, as the CO_2 emitted during combustion is assumed to be absorbed by plants or trees that are grown following cultivation of the crop. Biomass also refers to Wet Organic Waste (e.g. animal waste) or Municipal Solid Waste (household/commercial/industrial waste). Most CO_2 associated with the use of biomass fuels is due to the processing and transportation stages, which typically rely on grid electricity and fossil fuels. Liquid biomass fuels are not considered in this study as they are assumed to be more applicable to the transport sector in the form of bio-diesel and bio-ethanol.

5.4.1. Existing Biomass Energy Generation Sites

There is no existing biomass supply chain within Crawley although a number of small suppliers of wood chip are located within the wider region. A number of suppliers already service Crawley including County Tree Surgeons located in Ifield and Balcombe Saw Mill located on Balcombe Country Estate which currently supplies wood waste to biomass boilers installed at Crawley library and register office in addition to supplying woodchip to Buchan Country Park for heating an education centre, workshop and rangers offices

5.4.2. Biomass Resource

The assessment is based on the regionally available feedstock. A GIS mapping exercise has been carried out to estimate the biomass resource in Crawley Borough as shown in Figure 16. Four sources of biomass have been explored:

- Managed woodland
- Energy crops
- Wet organic waste
- Municipal Solid Waste (MSW)

GIS maps have been produced for managed woodland and energy crops to identify where this resource is located within Crawley. The maps and potential for biomass were developed using nationally available data sets. Reference was also made to previous biomass studies including the report 'Woodfuel Supply and Demand in West Sussex'[10]. And the Gatwick Diamond Woodfuel Supply Chain study[11].

Managed Woodland

Locations of woodland have been mapped (Figure 16) and their land areas were calculated. A realistic figure for biomass yield has been derived from these areas, using assumptions from the DECC methodology.

Resource availability is based on assumptions of potential annual biomass yields for different woodland types (broadleaved, coniferous, mixed etc). This includes trimmings, cuttings and other recovered biomass i.e. dead or fell trees.

[10] Woodfuel Supply and Demand in West Sussex, West Sussex County Council, January 2010)
[11] Gatwick Diamond Woodfuel Supply Chain, Gatwick Diamond Partnership, August 2009

The total area of woodlands were found to be 4.3 km^2. The Gatwick Diamond Woodfuel Supply Chain study (Part 1: Table 3) calculates that 52% of the woodland in Crawley is unmanaged. If all potential woodland was managed and arising collected, around 8,000 oven dried tonnes would be available annually for energy generation equating to 1,900 MWhe per year if used to generate electrical power within a biomass CHP plant.

Energy Crops

Energy crops include short rotation coppice, grasses (e.g. miscanthus) and conventional crops (e.g. rapeseed). The potential for energy crops has been assessed according to the availability of suitable arable land, taking into account competing land uses and typical yields. Agricultural land use classification maps have been used to delineate appropriate soil types.

The following criteria have been used to assess capacity:

- Grades 1 and 2 land have been omitted as being reserved for food production. These areas are prime quality land.
- The total energy crop potential includes use grade 3 and 4 land. These are of poorer quality and less suited to food production.
- Short rotation coppice (SRC) willow as the main energy crop. It has been assumed that 10 oven dried tonnes of willow SRC could be derived per hectare of grade 3 and 4 land.

The area available for Grade 3 and 4 land (within the Borough of Crawley), was estimated to be 17.97 k m^2 as illustrated in Figure 16. The assessment suggests that the Borough could generate around 23,600MWhe per year from energy crops if used to generate electrical power within a biomass CHP plant. This would result in carbon reduction of approximately 12,231 tonnes of CO_2 per annum compared to grid supplied electricity.

It is understood that West Sussex County Council have employed a woodfuel development officer to develop opportunities for growing energy crops within the County including on the Faygate landfill site (now closed).

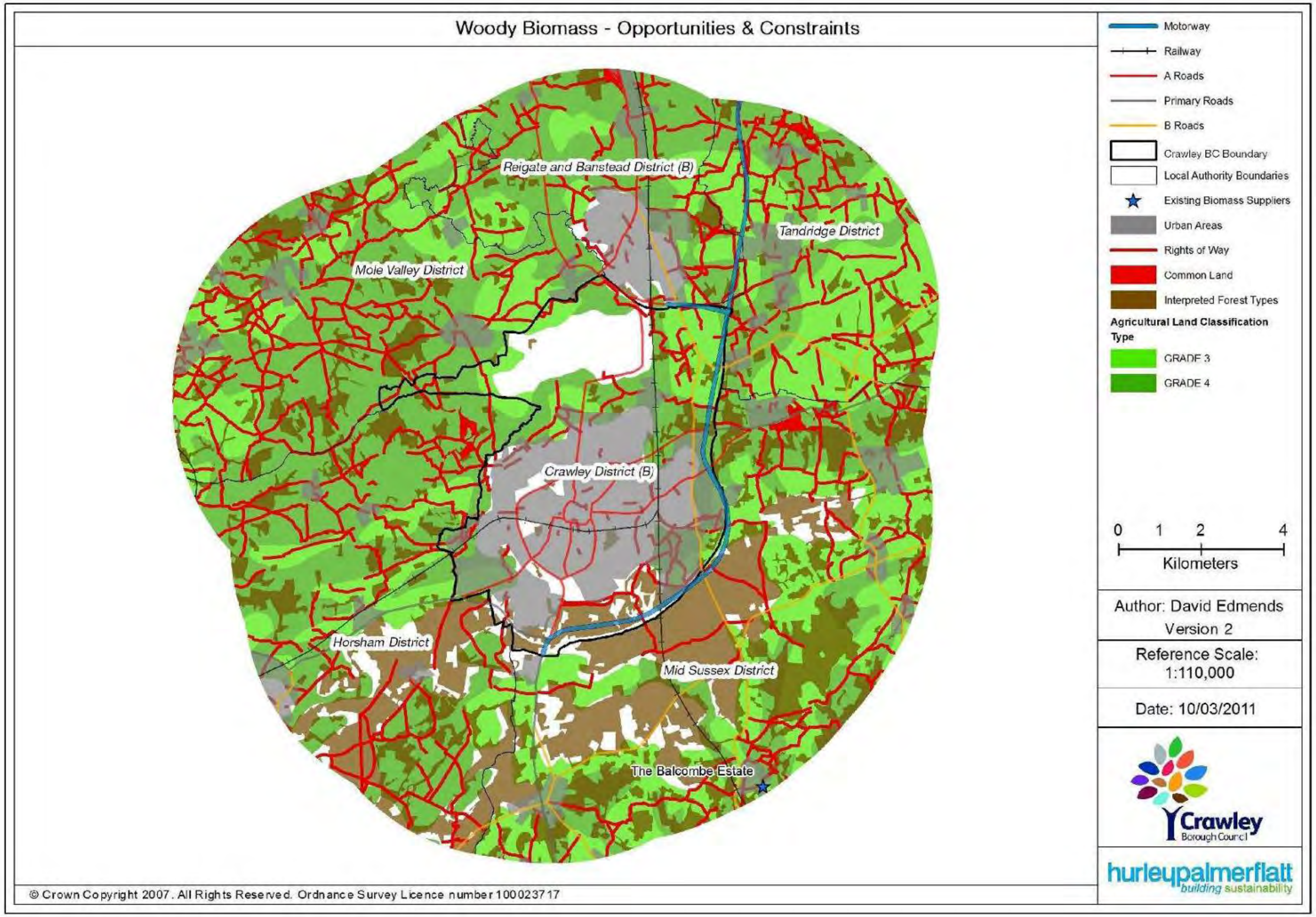


Figure 16: Opportunities for Biomass (Forest Arisings and Agricultural Land)

Wet Organic Waste

Other sources of biomass include animal waste, such as poultry litter and manures. Potential energy generation from animal waste is based on number of animals in the Borough and standard energy conversion figures for anaerobic digestion. We have used Defra Agricultural and Horticultural Survey - England (2007) datasets to estimate the number of animals and the wet biomass resource in the district. According to the databases there are approximately 5,500 poultry (layers), 280 cattle and no pigs in the Borough.

Cattle manure is typically converted to energy through anaerobic digestion (AD) that produces biogas. It has been assumed that small scale AD plants could be installed within farms in and around Crawley. This is because a centralised large scale plant taking manure from a number of sources would not be economically viable due to high haulage costs. In addition the energy yield from animal wastes is relatively low (due to the feedstock already being largely digested) and these schemes should be seen as a waste treatment process as much as an energy generation process. The relatively poor economics mean that smaller simple local schemes at farm scale are probably preferable.

Assuming all of the resource (cattle and poultry manure) can be utilised to supply AD plants, this would be expected to generate around 1,500 MWhe per year of electricity. This would result in carbon reduction of approximately 788 tonnes of CO_2 per annum compared to grid supplied electricity.

Municipal Solid Waste (MSW)

MSW consists of household waste, commercial and industrial waste and includes construction and demolition debris, sanitation residue and waste from streets. The potential energy yields from this form of waste is limited to the organic fraction of MSW which can be used to derive power through direct combustion, anaerobic digestion, and pyrolysis and gasification. While direct combustion is currently the primary method of waste to energy conversion in the UK, and the reference case for this methodology, other techniques are being increasingly promoted including pyrolysis and gasification.

The potential energy yield from MSW from Crawley has been calculated using Defra Quarterly Statistics which indicates a total annual quantity of MSW in Crawley of 34,500 tonnes/yr. This could generate in the region of 27,000MWhe of electricity a year if used alongside a combined heat and power plant (either through direct combustion, gasification or pyrolysis). This would result in carbon reduction of approximately 14,115 tonnes of CO_2 per annum compared to grid supplied electricity. This is the total potential for Crawley and includes any MSW that may already be diverted for treatment e.g. the MBT complex at Brookhurst Wood landfill site.

Whilst not located in Crawley, the Brookhurst Wood landfill site in north Horsham has been given approved by West Sussex County Council to house a Mechanical Biological Treatment (MBT) complex. The facility will sort and treat 320,000 tonnes a year of non-recycled rubbish from across West Sussex – metals present in the rubbish will be separated and sent for recycling, organic material (e.g. food waste) will be treated using anaerobic digestion to produce energy and a compost like material, other material will be used to produce a refuse derived fuel

(RDF) and the remaining rubbish that cannot be used as a resource will be sent to landfill.

5.5. Biogas

5.5.1. Landfill Gas

Landfill gas production results as a by product of chemical reactions and microbes which act upon the waste as the putrescible materials[12] break down. Landfill gas is approximately 40-60% methane which can be burnt in internal combustion engines, gas turbines or used to drive a fuel cell to make electricity and heat (combined heat and power / CHP).

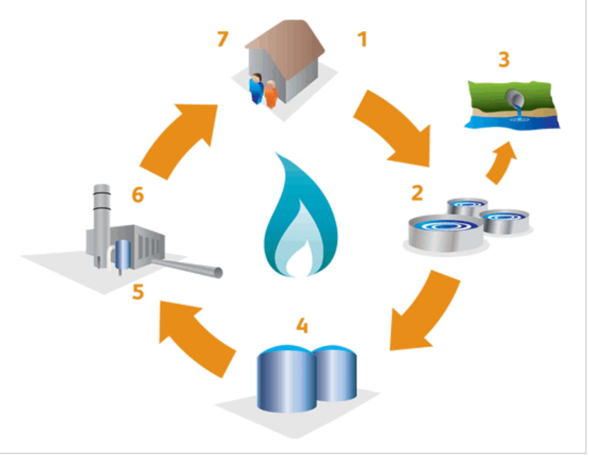
Landfill gas CHP is broadly similar to natural gas CHP. In the majority of cases the electricity is exported to the grid, and the waste heat from the exhaust and engine cooling jacket is rejected to the atmosphere via cooling towers. Heat off-take can readily be achieved from the type of gas engines used for landfill gas electricity generation. This requires the addition of waste heat boilers to capture the heat. The investment would rely on there being a sufficient heat demand within a viable proximity, and a heat network to convey the heat. The opportunity would then be constrained by the remaining lifespan of the landfill gas.

There are no landfill sites within the Borough of Crawley. There is a closed landfill site at Target Hill within Buchan Country Park which lies on the border between Horsham and Crawley .Whilst the site does produce methane, it is understood to be insufficient in quantity to generate power. Other landfill sites that are located outside of Crawley are shown in Figure 18. None of these sites are within close proximity of urban areas within Crawley and therefore there is no current potential for heat off take to supply a district heating network.

5.5.2. Sewage Gas

The water industry produces both wet and dry organic material in large quantities which can be diverted for energy recovery. The majority of biogas electricity projects in the UK are sewage gas projects that are less than 2.2MW in electrical capacity. Anaerobic Digestion produces a sewage gas which contains methane and can be used to fuel gas engines including gas combined heat and power (CHP).

[12] Putrescible material: material that contains organic matter capable of being decomposed



The seven steps to renewable energy from sewage gas:

1. Waste from baths, toilets, sinks, washing machines and dishwashers arrives at the sewage treatment works from customers to be treated and recycled back to the environment
2. The waste then goes into settlement tanks where it is separated into 'sludge' and 'water'
3. The water goes through various cleaning processes before being put back into the environment via a local watercourse
4. The rest is sent to large containers called digesters, where it is heated. This activates a natural biological process called 'anaerobic digestion', where bacteria break down the biodegradable material, yielding biogas
5. The gas is collected and fed into a gas cleaning machine
6. After the bio-methane, or biogas, has been cleaned up, it is fed into gas engines to produce electrical power
7. Heat can be recovered from the engine to supply district heating networks which in turn can be used to heat dwellings and commercial properties

Figure 17: Sewage Gas CHP – Process

The sewage treatment plant at Tinsley Green in Crawley already utilises biogas for energy generation. The site, which is operated by Thames Water, has an existing 340kWe biogas CHP with the heat principally used to drive the anaerobic process. Thames Water are currently investing the opportunity to increase the capacity of biogas energy production by increasing the number of anaerobic digestion gas engines. Planned works include fitting the sites with an additional pre-treatment process called thermal hydrolysis which involves pressure cooking the sewage sludge at 160 degrees C for about 40 minutes. Sludge put through this process yields up to 50 percent more biogas during digestion, breaking down far more quickly than ordinary sludge.

Whilst some of the heat from the gas engines at the Tinsley Sewage Treatment Works is used to drive the anaerobic digestion process, there is an opportunity to use any surplus heat to supply district heating. Opportunities for using the heat include the proposed residential/mixed use development known as the North East Sector and supplying heat to Gatwick Airport that could be used to prevent ice and snow formation around aircraft taxiing areas or to prevent ice formation in Gatwick airport’s pollution run off ponds which require microbial action to breakdown pollutants e.g. aircraft fuel. Initial discussions were held between

Thames Water[13] and Gatwick[14] to explore these opportunities. Due to the uncertainties over the quantity of surplus heat that may be available for supplying these opportunities, it is recommended that a more detailed feasibility study be commissioned by Crawley Borough Council alongside Thames Water and Gatwick to assess the technical feasibility and financial viability of heat off take options.

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[13] Thames Water (Contact: John Gilbert, Head of Carbon Management)
[14] Gatwick Airport (Contact: Joe Attwood, Environmental Strategy Manager)

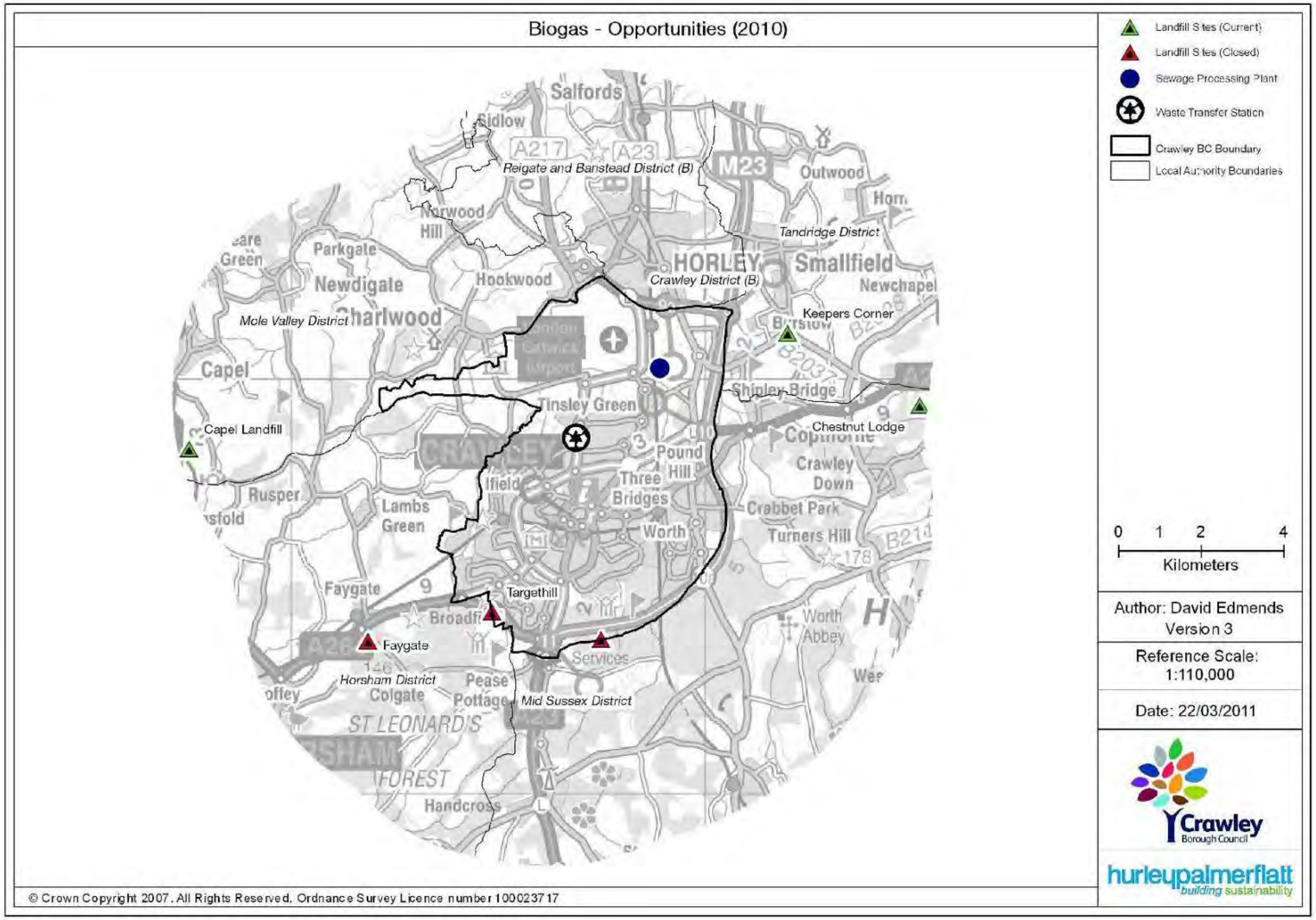


Figure 18: Opportunities for Biogas

5.5.3. Hydro Energy Potential

Using small scale turbines, the energy from rivers can be harnessed with less disruption to water flow than large scale hydro schemes. The introduction of government targets for renewable energy generation, combined with technological development has increased the feasibility of micro-hydro generation.

Micro generation has a number of advantages. As well as being a zero-carbon power source, the ecological impacts of small scale turbines are small compared to large scale, dam based hydro power. Compared to solar and wind power, micro-hydro power sources offer more constant generation. In addition, maintenance costs are reasonably low and systems generally have a long life-time over 25 years.

The Environment Agency report ‘Opportunity and environmental sensitivity mapping for hydropower in England and Wales’ identifies nine sites within Crawley that could develop micro-hydro schemes – see Figure 19. All the opportunities would be small scale (0-30kWe peak) and would typically be based around river weirs. The total estimated capacity of all sites could be up to 65kWpeak, although further detailed assessment would be required to understand the detailed technical feasibility and constraints of each site. This would generate approximately 515MWh of electricity a year and offset 279 tonnes of carbon.

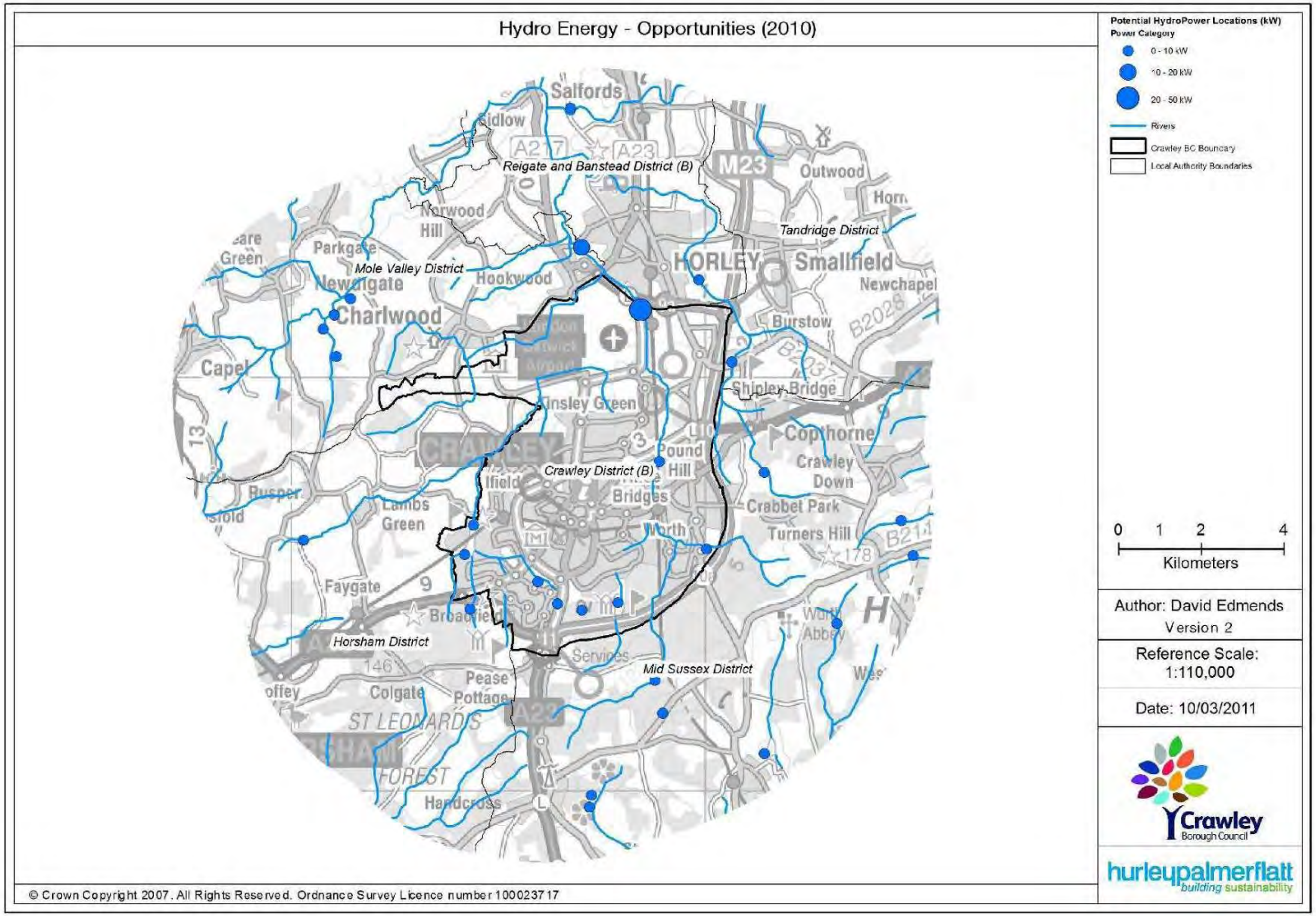


Figure 19: Opportunities for Micro-Hydro Energy within Crawley Borough

The conversion of potential to delivery for micro hydro energy requires consideration of a number of factors including:

- Land ownership – access in terms of ownership of land can be an issue for site development.
- Extraction licence – required on hydro schemes on rivers via the Environment Agency to ensure the water levels aren't compromised.
- Fish passage – The Environment Agency requires fish passages to be installed which increase the construction costs of any future schemes
- Planning considerations – schemes will need to demonstrate their impact (both positive and negative) in order to achieve planning consent.
- Access – the accessibility of the sites to construction vehicles and machinery is varied.
- Scheme design – each weir would require a bespoke design which responds to the unique flow characteristics and site constraints
- Delivery – the delivery of schemes could be associated with new developments adjacent to the identified sites and could generate electricity as part of their onsite requirements.

5.6. Microgeneration

The term "microgeneration" is used to describe the array of small scale technologies, typically less than 50 kW electricity generation and 100 kW heat generation, that can be integrated as part of the development of individual sites, or retrofitted to existing buildings. Microgeneration systems are typically designed and sized either in relation to the on-site demand or in proportion to the physical constraints on-site such as available space, whichever is more appropriate.

Microgeneration technologies cover the full range of renewable energy categories: wind, solar, biomass, hydropower and heat pumps. In terms of assessing the opportunities and constraints for deployment, some of these categories are already captured in full in the earlier sections of this chapter. Their full potential is not directly constrained by the built environment and more specifically by what can be installed on-site as other deployment options are available, e.g. off-site or large scale capacity development. These categories include, biomass and hydropower.

Technologies that directly depend on the built environment capacity to take microgeneration systems are solar (solar photovoltaics and solar water heating) and heat pumps (grounds source heat pumps and air source heat pumps). This section assesses the potential of these four sub-categories.

5.6.1. Solar Photovoltaics (PV) – Technology Summary

Solar PV panels use semi-conducting cells to convert sunlight into electricity. The output is determined by the brightness of natural light available (although panels will still produce electricity even in cloudy conditions) and by the area and efficiency of the panels. PV is expensive in comparison to other renewable energy options, but is one of the few options available for renewable electricity production and is often one of the only on-site solutions to mitigate CO_2 reductions associated with electricity use. In addition initiation of feed-in tariffs makes this technology a significantly more attractive solution financially. A feed-in tariff is a mechanism for encouraging investment in renewable generation. It is essentially a premium rate paid for clean generation, e.g. from solar panels or small wind turbines, and guaranteed for a long time period. Currently[15], the tariff for PV ranges from 43.3p per kWh (for less than 4kW on a building that is already occupied) to 8.5p/kWh for new installations greater than 250kW. Typical paybacks for systems of less than 50kWpeak range from 7 to 12 years. Therefore it is anticipated that the deployment of this technology may be accelerated in the near future.

5.6.2. Solar Hot Water – Technology Summary

Solar water heating panels are used primarily to provide hot water. Output is constrained by the amount of sunlight available, panel efficiency and panel area. Devices are most cost effective when sized to meet 50-70% of average hot water requirements, which avoids wasting heat in the summer. It should be noted that solar water heating supplements and does not replace existing heating systems.
There are two standard types of solar water heating collectors: flat plate and evacuated tube collectors. Historically, flat plate collectors have dominated due to their lower cost per unit of energy saved. However, recent advances in evacuated tube collector design have achieved near parity in terms of cost per kg CO_2 saved. Generally, evacuated tubes are more expensive to manufacture and therefore purchase, but achieve higher efficiencies and are more flexible in terms of the locations they can be used.

5.6.3. The Potential for Solar PV and Solar Hot Water in Crawley

Deployment of either solar technology (PV or Solar Hot Water) in practice is subject to available suitable space for installation. A building may have either or both technologies installed, however the total capacity of the system(s) will not vary considerably, i.e. a large system of either technology or two systems, one of each technology. Therefore, the assessment uses a single set of parameters for both categories to avoid double counting.

The potential capacity for PV and Solar Hot Water has been assessed using the DECC methodology which assumes that 25% of existing domestic properties and 40% of commercial properties are suitable for solar technology. The average system capacity for each building type is assumed to be 2kW (domestic) and 5kW (commercial).

Assuming all suitable buildings (as defined above) are fitted with solar PV only, the peak installed capacity is 24.16MW. This would result in 16.38GWh of electricity per year and carbon savings of approximately 8,872 tonnes CO_2.

5.6.4. The Potential for Heat Pumps (Ground / Air Source)

Heat pumps are low carbon rather than renewable devices since they require electricity to run which is partially derived from fossil fuels. They can provide significant CO_2 savings in comparison to standard electrical heating systems, since they require around a third less electricity. However, due to the carbon intensity of the grid, CO_2 emissions from heat pumps are similar to those of an efficient gas heating system. As electricity is currently around four times more

[15] As of March 2011, following the announcement by DECC on 18 March to reduce the Feed-in Tariff for installations of greater than 50kWpeak.

expensive than gas, running costs are also comparable with, and often higher than an equivalent gas system.

Heat pumps are primarily space-heating devices and the best efficiencies are achieved by running systems at low temperatures. For this reason, they are ideally suited for use in conjunction with under floor or air-based heating systems. This creates a significant challenge for heat pumps installed in future homes, where hot water demands are likely to be comparable to the (reduced) space heating requirements. Due to the higher temperature requirements of hot water, the coefficient of performance (COP) of heat pumps reduces and so where the hot water is a significant fraction of the overall heating demand, the overall efficiency can be relatively poor. In such cases, heat pumps should be complemented by other microgeneration systems that are sized in relation to domestic hot water requirements, for instance, solar hot water systems.

The performance of ground source heat pumps is linked to the average ground temperature, while air source heat pump performance is influenced by the average air temperature.

The high cost of ground works for ground source heat pumps means that air source heat pumps are typically around half the installed cost, albeit with a lower efficiency. For air source heat pumps, retrofit costs are slightly higher than new build to allow for increases in plumbing and electrical work. For ground source heat pumps, the cost for retrofit is higher to allow for modifications to existing plumbing and removal of existing heating system, plus ground works costs when digging up an established garden.

The potential peak capacity for heat pumps has been assessed using the DECC methodology which assumes that 75% of detached and semi detached properties, 50% of terraced properties, 25% of flats and 50% of commercial buildings could be suitable. The average system capacity for each building type is assumed to be 5kW (domestic) and 10kW (commercial).

Assuming all suitable buildings (as defined above) are fitted with heat pumps, the peak installed capacity is 211.56MW. This would result in carbon savings of approximately 2,401 tonnes CO_2 compared to use of gas fired boilers. Carbon savings have been calculated assuming an average coefficient of performance of 2.5 for all heat pumps. This value has been used following the findings from a study by the Energy Saving Trust[16] into the efficiency of heat pumps in the domestic sector.

5.7. Crawley – Energy and Carbon Reduction Potential (All Technologies)

The table below summarizes the potential peak output from each technology category. It should be noted that wind, hydropower and microgeneration technologies will not produce the peak output throughout the year due to natural variations in the available resource (wind, water, solar) and actual energy demands of buildings (in the case of in building technologies including microgeneration). In addition, most technologies will not run continuously due to allowance for maintenance and down-time of equipment (e.g. for replacement).

[16] Getting Warmer: a field trial of heat pumps, EST (September 2010)

Table 7: Potential Peak Output for Low and Zero Carbon Energy Resources in Crawley

Technology Group	MWpeak by Technology Group	Sub Category Level 1	Sub Category Level 2	Assumed Energy Type / Generation	MWpeak by Sub Category
Wind (onshore)	0.85	Wind - commercial scale	Wind - commercial scale	Electricity	0.85
		Wind - small scale	Wind - small scale	Electricity	0.00
Biomass	7.23	Woody biomass	Managed woodland	Electricity (CHP)	0.25
			Energy crops	Electricity (CHP)	3.00
			Waste wood	Electricity (CHP)	0.00
		Animal biomass	Wet organic waste	Electricity (CHP)	0.19
		Municipal solid waste (MSW)	Municipal Solid Waste (MSW)	Electricity (CHP)	3.46
		Biogas	Landfill gas	Electricity (CHP)	0.00
			Sewage gas	Electricity (CHP)	0.34 *
Hydropower	0.07	Small scale hydropower	Small scale hydropower	Electricity	0.07
Microgeneration	235.72	Solar Energy (SHW + PV)	Solar Energy (SHW + PV)	Electricity (PV)	24.16
		Ground/Air Source Heat (GSHP/ASHP)	Ground/Air Source Heat (GSHP/ASHP)	Electricity	211.56

* Sewage gas potential may be greater than the quoted figure. The figure quoted is based on the existing CHP output from the Tinsley Sewage Treatment Works.

The study assessed the potential annual energy yields and associated carbon reduction potential from each technology category by applying a capacity factor and availability factor to each technology. Figure 20 illustrates the carbon reduction potential for each resource/technology when compared to the carbon emissions assuming 'business as usual' (e.g. assuming that electricity from biogas CHP would be provided from the national grid in normal circumstances). The carbon emissions factors for each fuel source are based on Carbon Trust conversion factors for 2009[17].

[17] www.carbontrust.co.uk

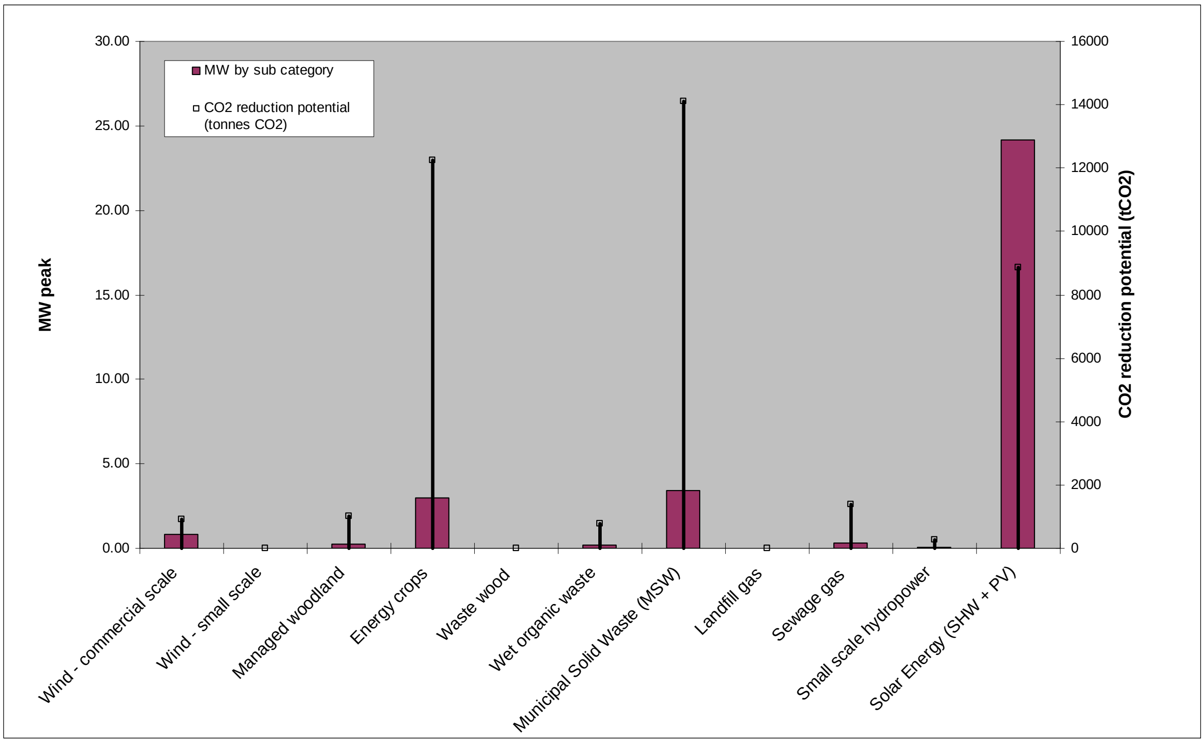


Figure 20: Predicted Peak Power Output and Equivalent Annual Carbon Reduction Potential of Technology Categories Compared to 'Business as Usual' Energy Sources (Note: MSW potential is for the entire Borough and includes waste that may be diverted to the Brookhurst Wood MBT Plant)

The total estimated carbon reduction potential for all resource / technologies is approximately 42,000 tonnes CO_2. This is equivalent to 5.4% of Crawley's total carbon emissions (domestic, commercial and road transport) based on Department of Energy and Climate Change statistics for 2008[18].

[18] www.decc.gov.uk

6.0 OPPORTUNITIES FOR DISTRICT HEATING

6.1. Introduction to District Heating

District heating is an alternative method of supplying heat to buildings, using a network of super insulated pipes to deliver heat to multiple buildings from a central heat source. Heat is generated in an energy centre and then pumped through underground pipes to the building. Building systems are usually connected to the network via a heat interface unit (heat exchanger), which replaces individual boilers for space heating and hot water. Whilst there is some amount of thermal loss from the heat distribution infrastructure, the aggregation of small heat loads from individual buildings into a single large load allows the use of large scale heat technologies, including the capture of waste heat from industrial processes or power generation, or other large scale heat generation technologies which are not viable at a smaller scale. Of particular interest is combined heat and power (CHP).

Figure 21: Schematic of a Typical District Heating Network

6.2. Key District Heating Networks components

There are three main elements which constitute a district heating network:

- The generation systems
- The distribution systems
- The heat interface units and meters

This sections aims to provide a general overview of the systems and available options.

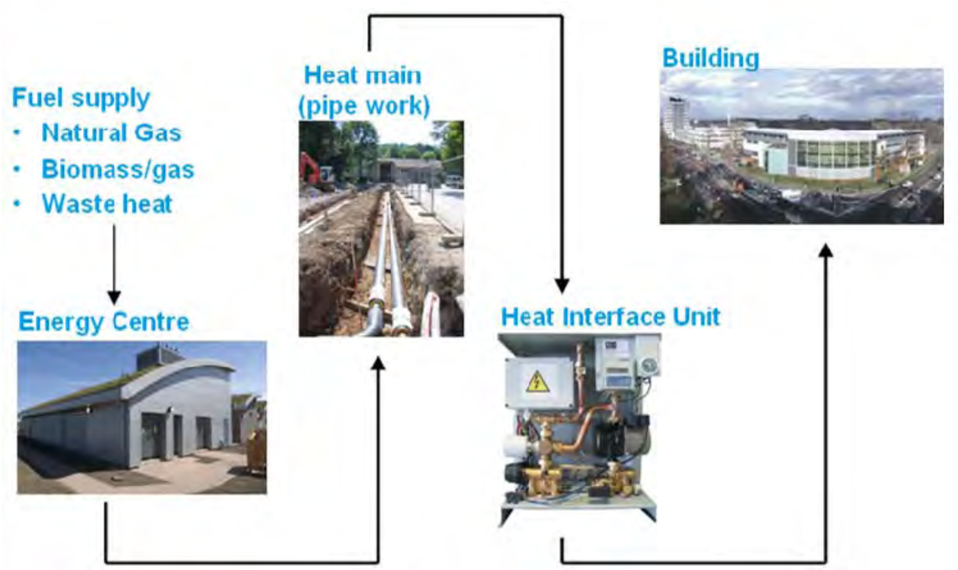


Figure 22: District Heating Network Main Components

6.2.1. Generation Systems

The centralisation of the production of energy results in larger heating loads and a wider range of technically feasible technologies for the generation of heat. The use of Combined Heat and Power (CHP) engines which produce electricity and heat are the most common solution for the energy generation on district heating networks. Alternative systems which use renewable fuels such as biomass are also available in the market which can significantly reduce CO_2 emissions.

The use of biofuels in these systems can provide even higher reductions in CO_2 from electricity and heat generation.

6.2.2. Gas CHP

The traditional method of generating electricity at power stations is relatively inefficient, with at least 50% of the energy in the fuel being wasted in the form of heat. Whilst this could be used for a district heating scheme, power generation is often not close enough to heat demand centres, and there are significant challenges in establishing large scale (town and city-wide) heat networks for connection to power stations in the UK.

A CHP plant is essentially a local, smaller version of a power station but by being combined with heat extract, the overall efficiency is much higher (typically 80% – 85%). Whilst the electrical efficiency of smaller CHP systems is lower than large scale power generation, the overall efficiencies with heat use are much higher resulting in significant CO_2 reductions. An additional benefit can be the reduced need for major grid reinforcement through the integration of smaller local power generation. A standard, gas-fired CHP based on a spark ignition engine typically achieves a 35% reduction in fuel use compared with conventional power stations and gas boilers. There are many other CHP technologies available based on gas or steam turbines, or gasification.

6.2.3. Biomass Boiler

Biomass heating is a simple alternative to fossil fuels to minimize carbon emissions. This is now a reliable solution with a wide range of boiler sizes available on the market. Biomass heating, although more expensive than traditional gas boilers, is one of the cheapest renewable energy technologies. Local reliable supply and long term contracts are required for the success of the project.

Grade 3 and 4 agricultural land with potential for growing energy crops have been identified to the North of Manor Royal which offer the possibility for local supply – see section 5.45.4.2.

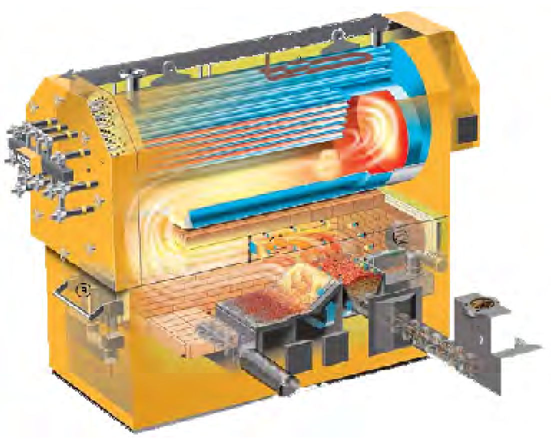


Figure 23: Biomass Boiler

6.2.4. Biomass CHP

Biomass CHP technology is a newer technology for the UK which, to date, has only had limited application. Tried and tested steam generator (rankine cycle) technology is currently the preferred technology. However it requires economies of scale in order for it to be technically and financially viable.

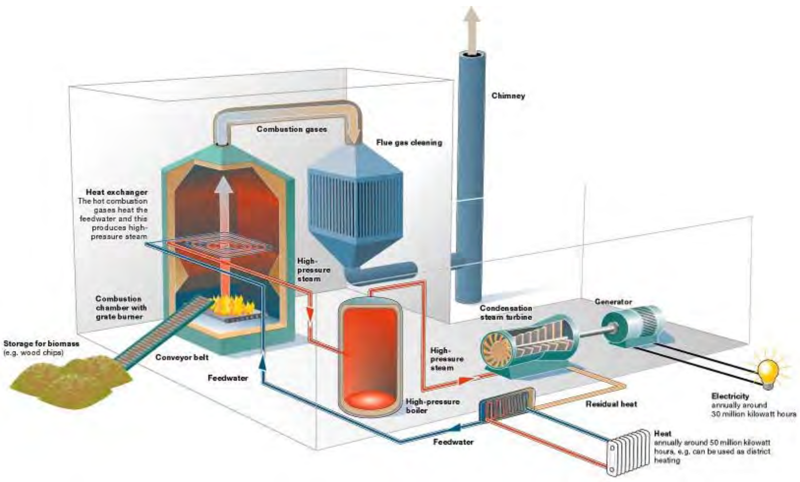


Figure 24: Biomass CHP

6.2.5. Distribution Systems

The heat is distributed to the consumers through underground insulated pipes. District heating networks started running on steam distributed through steel pipes; however modern networks run on water and use plastic pipes for the distribution which have a lower cost and are easier to install.

Despite the general reduction in cost from steel pipes to plastic pipes, the distribution system is still the most expensive element of a district heating network with the main cost being the trenching and installation of pipes. Trenching costs are lower for soft landscape areas than for hard landscaping areas; however, often the routes of the pipes depend on land ownership rather than cost. Pipes are typically installed in publicly owned land and follow existing road network.. Costs can be significantly reduced if site works are scheduled and combined with the provision of other infrastructure/trenching works e.g. cable television, gas mains replacement, etc.

6.2.6. Heat Interface Units and Meters

The heat interface unit is the element which enables the exchange of heat between the district heating network (primary circuit) and the end consumer (secondary circuit). Heat interface units can be connected to individual houses as well as to larger buildings replacing the boilers which brings a number of advantages such as lower space requirements, silent operation, elimination of flues and flue cleaning requirements or reduction of the danger of explosion through gas.

Heat interface units often have integrated heating meters required to record the consumption of the building allowing accurate billing.

6.3. Identification of District Heating Opportunity Areas

District heating networks generally reduce the cost of generating energy. However, while operational costs can be lower than for a standard system, the cost of the required distribution system can often make the project unviable. The minimization of the pipe length to be installed becomes then a key issue for the design of a district heating network. Areas with a higher density will require shorter pipes than less densely populated areas to deliver the same amount of energy and therefore are more attractive for the installation of district heating networks. Town centres, residential areas with block of flats or high energy consumers closely co-located are likely to be viable clusters. Preliminary research conducted by the Department of Energy and Climate Change into the potential for district heating in the UK identified that areas with a heat density above 3000 kW/km^2 could provide returns on investment of 6% or above.

Diversity in the property types is also beneficial for the viability of a district heating network. Ideally, a system would run for at least 4,500 hours per year for a reasonable return on investment which is around 17.5 hours per day. Buildings with different uses such as residential and commercial properties, usually have complementary energy demand profiles which allow the CHP system to run for a longer number of hours. Complementary profiles can also be seasonal. For example, heat generated during the summer, when the demand for space heating in residential buildings is low, can be use to run absorption chillers and provide cooling.

A third important criterion for the selection of potential cluster areas is the presence of 'anchor loads' which are buildings likely to commit to long-term contracts such as public sector organizations.

New developments can be influenced by planning policies to consider district heating and can therefore act as a catalyst for network development. The cost of installation, especially for the piping, can be significantly reduced if it is combined with other infrastructure upgrades, therefore, areas where such works are planned also need to be considered.

In summary, there are five key issues to be considered for the identification of district heating opportunity areas:

- High heat density
- Demand complementarily
- Anchor loads
- Proximity to new developments
- Planned infrastructure upgrades

Heat density maps are a very powerful tool which allows the evaluation of some of these parameters simultaneously. Heat maps have been developed for Crawley where anchor loads have also been plotted. The next section details the methodology used and the results obtained.

6.4. Heat Networks – Impacts of Climate Change on Design

Consideration should be given to the potential impacts of climate change on the development of new energy infrastructure including district heating networks. According to the UK Climate Change Projections (UKCP09), the South East of England is likely to experience a number of changes to its climate over the coming years. The table below, details the likely changes, the impacts on heat networks and the potential mitigation measures that should be considered during the design / development process.

Table 8: Climate Change Impacts and Mitigation Strategies for District Heating Infrastructure

Climate Event	Impact On District Heating Infrastructure In Crawley	Potential Adaptation Solutions
Increase in mean temperatures in both winter and summer	Reduced space heating demand, increased cooling demand – leading to a reduction in heat revenue from district heating networks.	Factor in allowance for reduced heating demands when assessing revenue potential / viability of schemes. Consider potential to supply cooling via district heating networks linked to absorption chillers in order to maintain revenues if heat demand falls.

Climate Event	Impact On District Heating Infrastructure In Crawley	Potential Adaptation Solutions
Drier summers	Soil shrinkage and subsidence (Crawley contains large deposits of Weald Clay which are prone to these impacts) – leading to risk of energy centre subsidence and movement of soil around heat mains.	Energy centre foundations to be designed to allow for potential subsidence. Heat main trenches to be designed to allow for movement in soil as a result of shrinkage / subsidence.
Heavy winter precipitation	Increased flood risk – especially around the K2 leisure centre and North East Sector (adjacent to Gatwick Stream) – potential impact of flooding within energy centres.	Where possible, energy centres should be located outside of flood zones. Where this is not a possibility, they should be designed to mitigate against flood damage.
Increase in extreme weather events (e.g. wind / lighting)	Increased lighting events resulting in power outages from Combined Heat and Power plant	Ensure that the buildings connected to the CHP have an alternative supply of power in the event of power failure from the CHP

During the detailed development proposals for any district heat network schemes, consideration should be given to assessing the risks of climate change and identification of any mitigation measures to minimise the risks. The UK Climate Impacts Programme (www.ukcip.org.uk) have developed an adaptation wizard that provides a framework for organisations to assess climate change impacts and mitigation strategies.

6.5. Heat Mapping

6.5.1. Heat Density Assessment Methodology

This section explains the methodology, assumptions and sources of data used for the development of the heat maps for Crawley. The aim of the heat maps is to identify areas with high heat demand density with potential for the installation of a district heating network. As previously discussed, clusters will have a limited extension due to the cost of the pipes and therefore, heat maps need to have sufficient resolution to allow identification of these areas. For this reason heat demands have been assessed down to post code level.

Space heating and domestic hot water (DHW) can be provided by a centralised energy centre and therefore the sum of both demands has been plotted.

Two scenarios have been considered: the present demand and the demand in 2025 to account for future developments as well as for the potential heating consumption reduction through energy efficiency measures applied to the existing buildings.

Anchor loads have also been included in the map as they are key elements for a district heating network.

6.5.2. Current Heating Demand

Heating demand has been taken from real data where available and based on energy benchmarks when the real consumption is unknown. It has been found that while accurate data is available for public buildings, access to data associated with privately owned buildings is more limited. The following table summarizes the different scenarios:

Table 9: Summary of Energy Consumption Data Sources for 2010 Heat Mapping Scenario

1. Crawley Borough Council Buildings	
Available data	Actual gas and electricity consumption
Assumptions	Buildings with gas consumption are gas heated All gas consumption corresponds to heating energy
2. West Sussex County Council Buildings	
Available data	Actual gas and electricity consumption
Assumptions	Buildings with gas consumption are gas heated All the gas consumption corresponds to heating energy
3. Private Commercial Buildings	
Available data	Area and building use from Valuation Office Agency (VOA) data Benchmarks per building use – CIBSE Guide F
Assumptions	Good practice assumed for the benchmarks Retail buildings assumed to be electrically heated
4. Private Residential Buildings	
Available data	Average gas consumption per meter based on Lower Layer Super Output Area (LLSOA) from DECC statistics Number of meters per post code – from GIS mapping data
Assumptions	One meter per residential unit

Both benchmarks and real data referred to gas consumption. In order to estimate the heat demand, assumptions had to be made regarding the efficiency of the generation systems. An efficiency of 70% has been assumed for the existing gas boilers and 100% for the electrically heated systems.

6.5.3. 2025 Heating Demand

In line with the environmental agenda and the carbon emissions reduction targets, it is expected that the existing building stock will generally improve the energy performance through energy efficiency measures and therefore reduce the heating requirements. In line with expected Building Regulations improvements, it has been assumed that space heating demand of existing commercial buildings will be reduced by 50% by 2025. For the existing housing stock, it has been assumed that up to 50% of the houses will be improved up to a Code for Sustainable Homes Level 4 house from the present to 2025.

Regarding the future buildings, information has been provided by Crawley Borough Council regarding expected development areas and timescales.

Table 10: Summary Gas Consumption Data Sources for 2010 Heat Mapping

1 Future Commercial Buildings	
Available data	Areas and building type provided by CBC Benchmarks per building use – CIBSE Guide F
Assumptions	Good practice assumed for the benchmarks 75% space heating reduction over current CIBSE Guide F benchmarks
5 Future Residential Buildings	
Available data	Number of units Energy Saving Trust energy consumption benchmarks
Assumptions	It has been assumed that all future houses from present to 2025 will be built according to the CSH level 4[19]

Regarding the systems efficiencies, 90% efficiency has been assumed for new gas boilers and 100% for electric heating.

[19] This assumes that there are a number of houses to be built which have already been designed in line with CSH Level 3 and 4 standards and future designs to comply with Level 5 and 6 standards.

6.5.4. Crawley Heat Maps - 2010

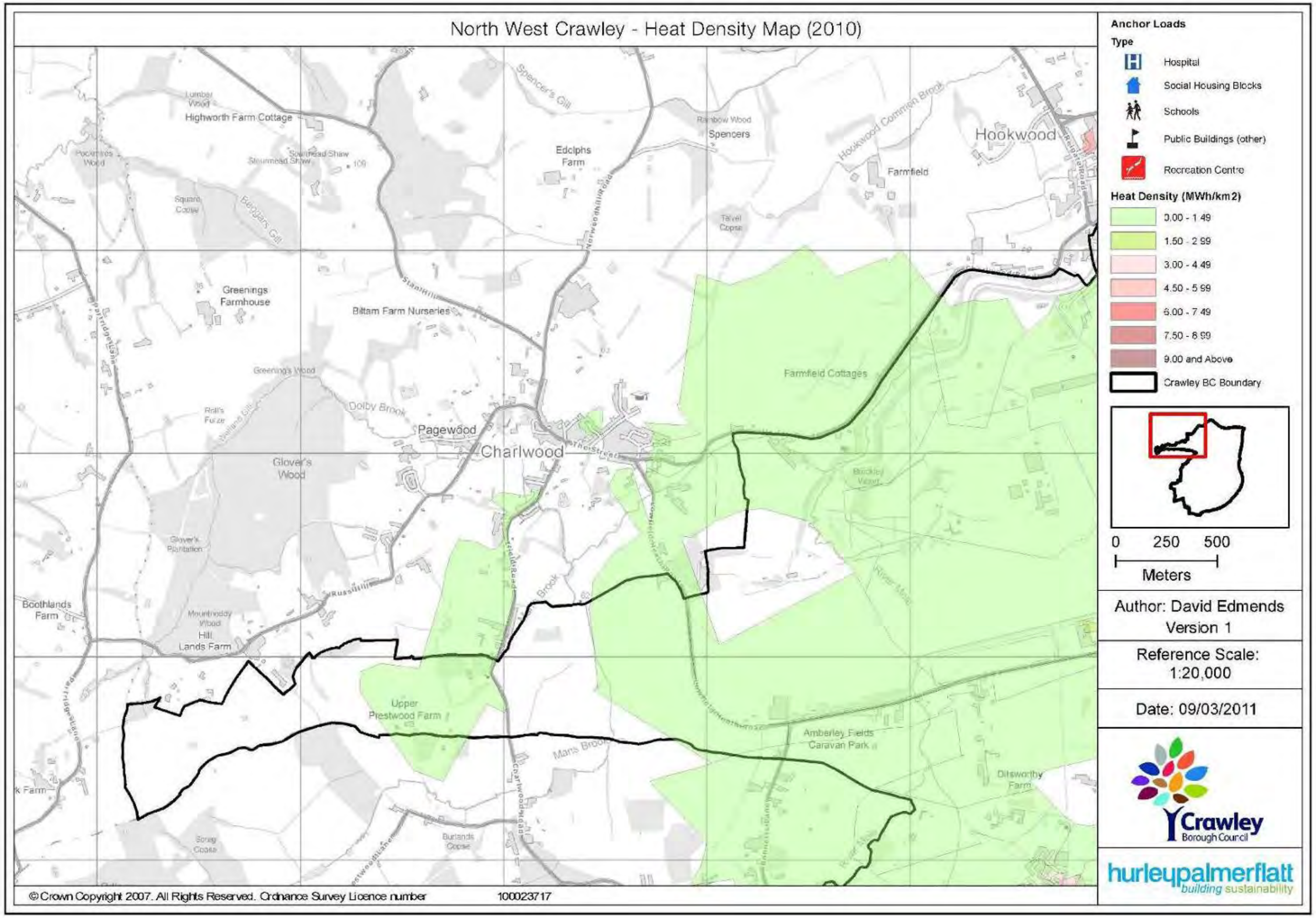


Figure 25: North West Crawley – Heat Density Map (2010)

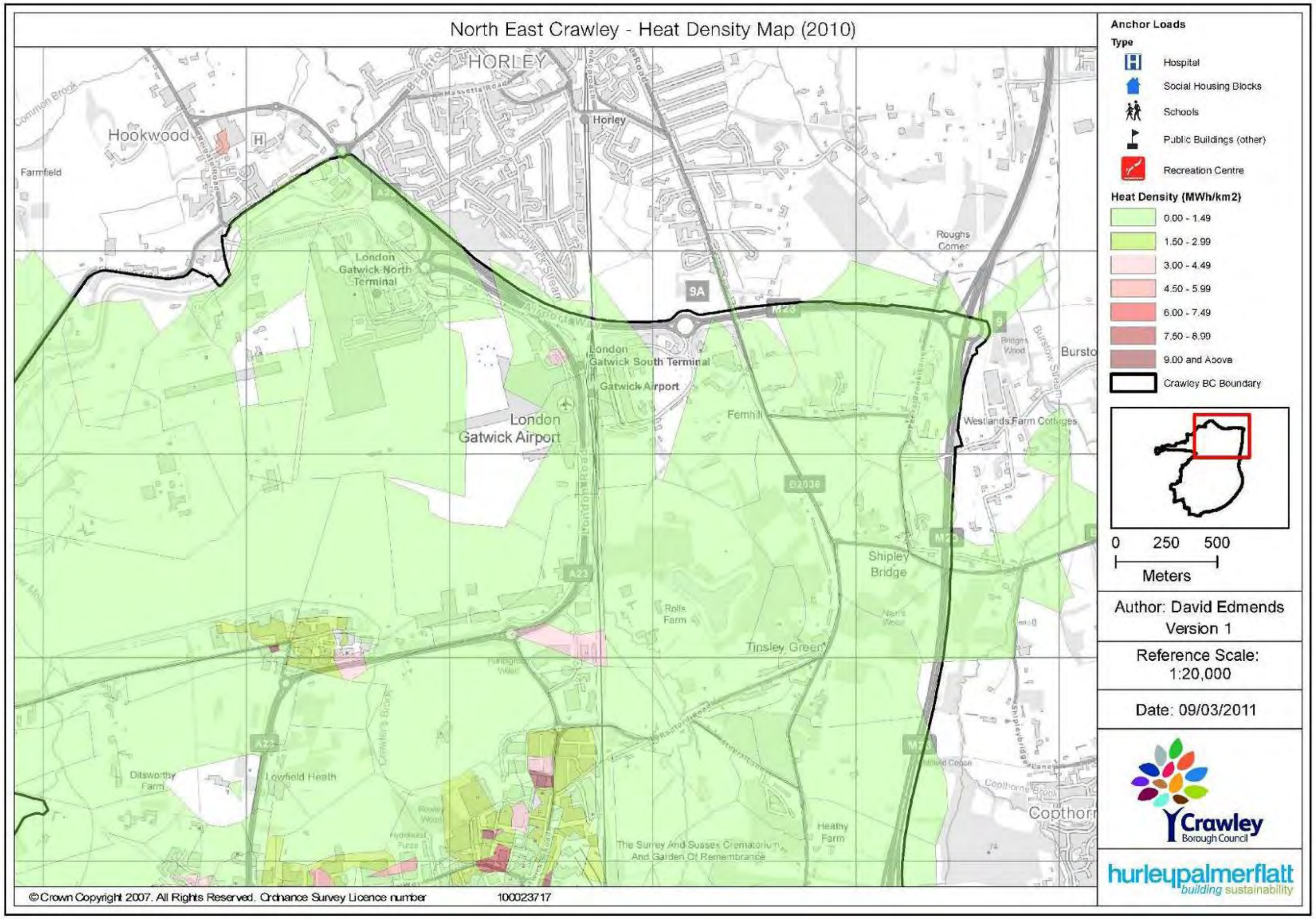


Figure 26: North East Crawley – Heat Density Map (2010)

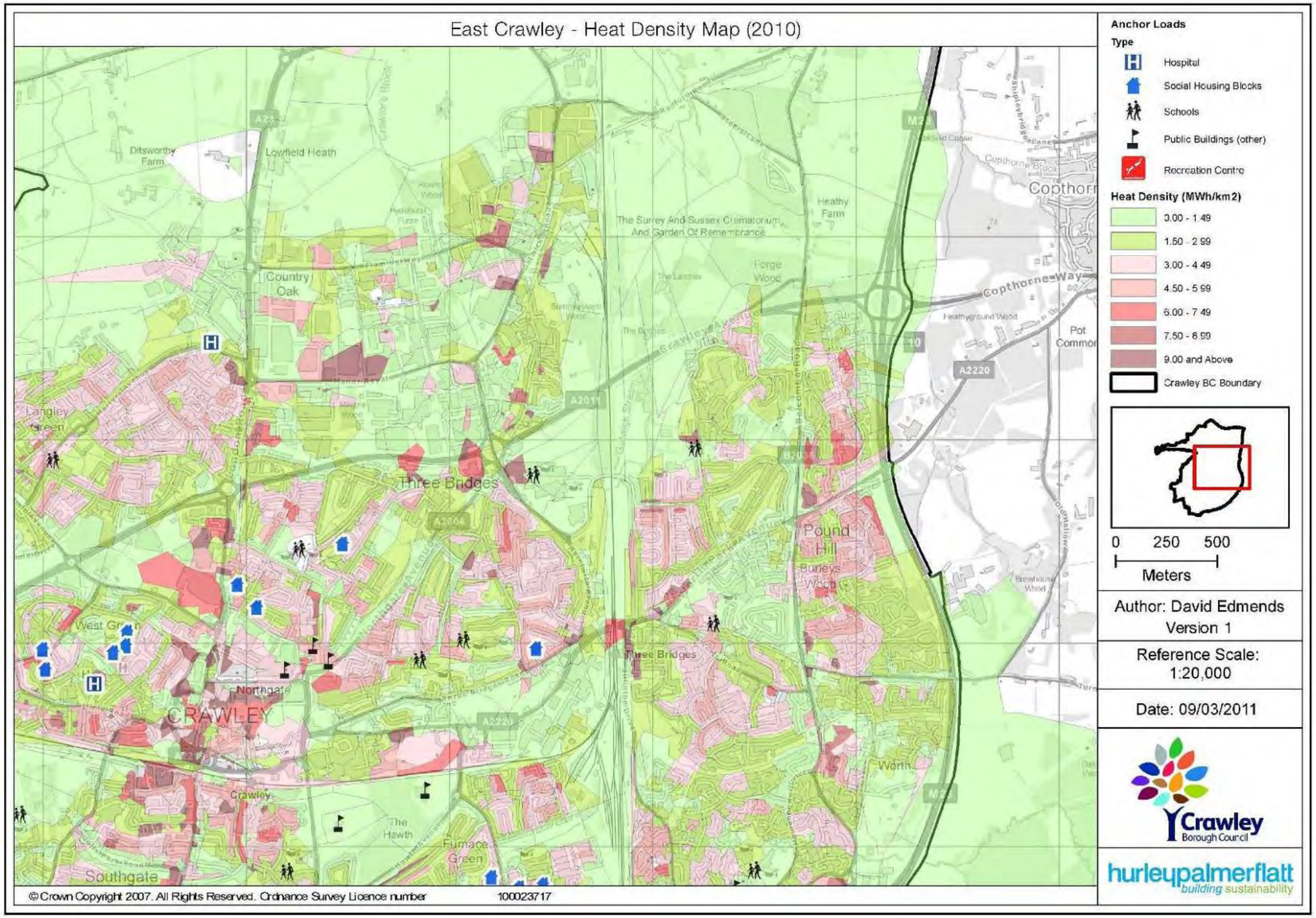


Figure 27: East Crawley – Heat Density Map (2010)

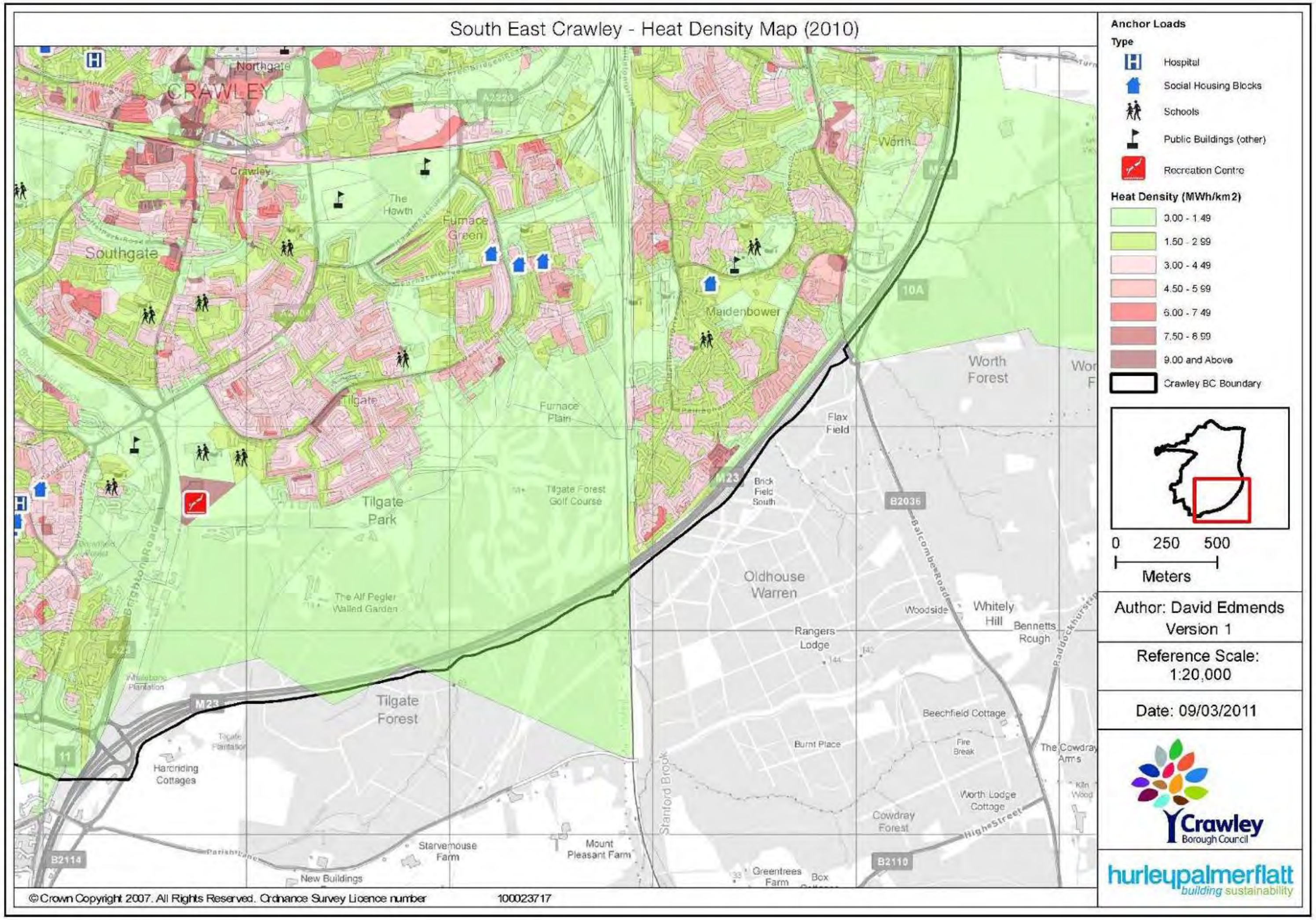


Figure 28: South East Crawley – Heat Density Map (2010)

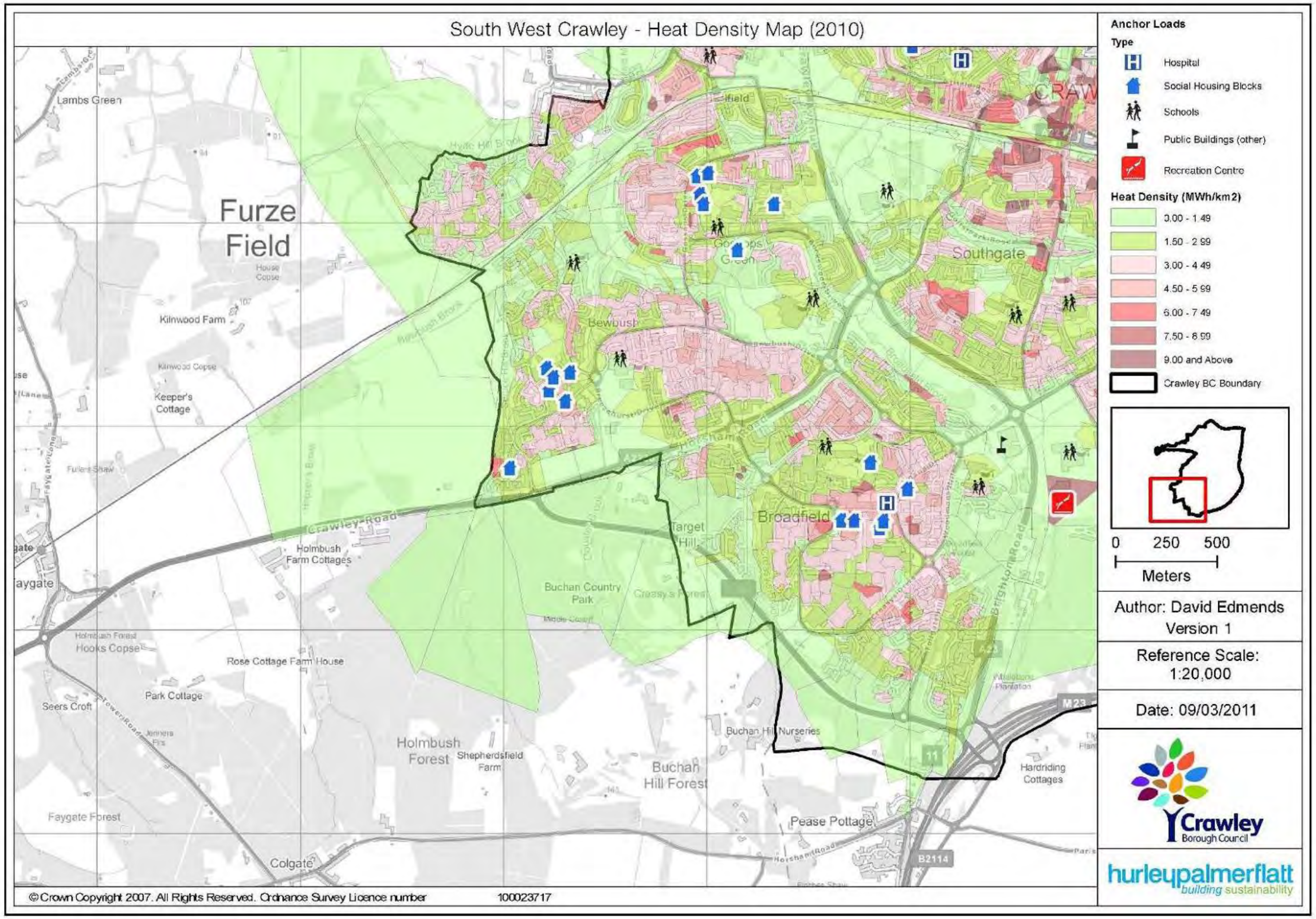


Figure 29: South West Crawley – Heat Density Map (2010)

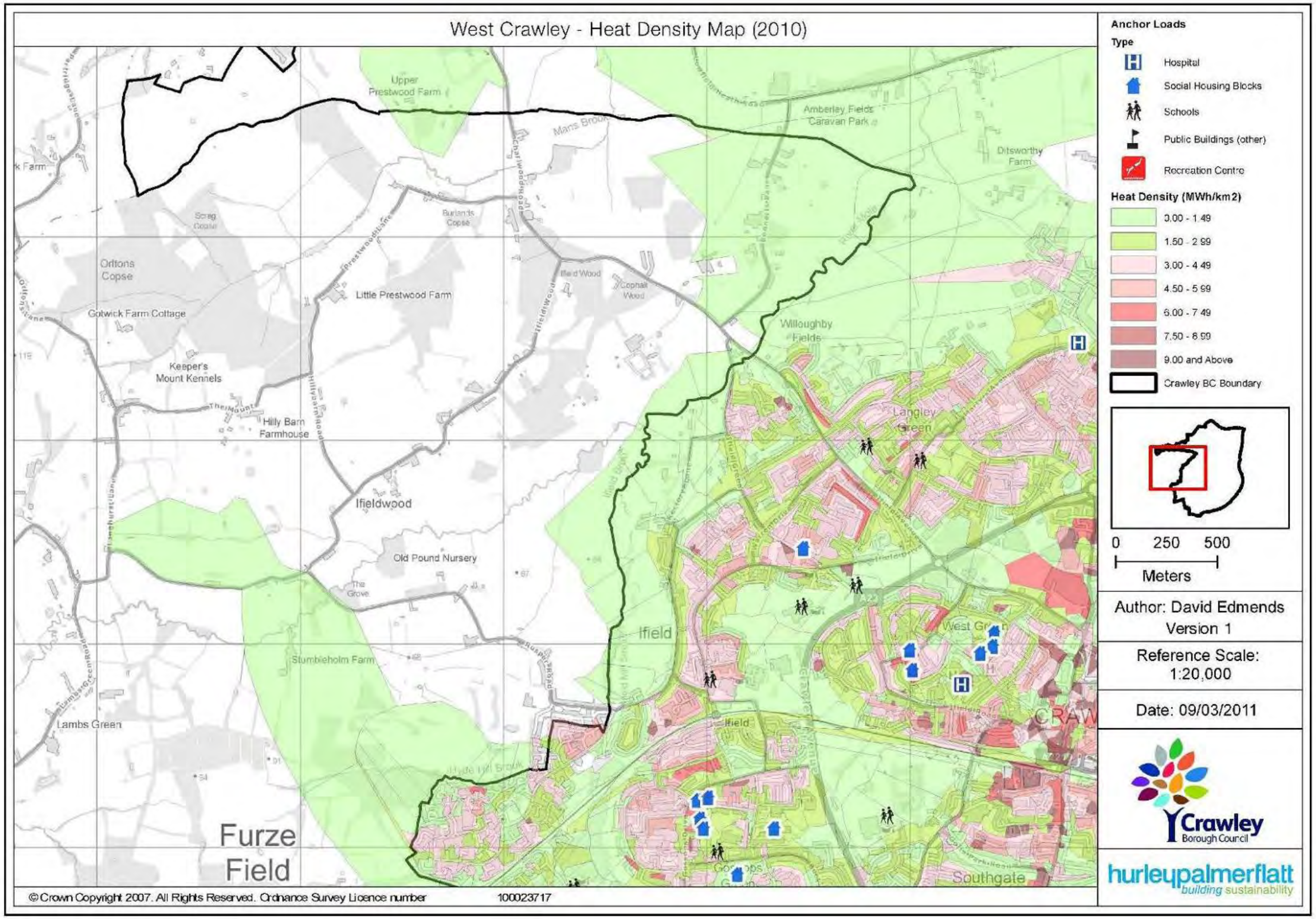


Figure 30: West Crawley – Heat Density Map (2010)

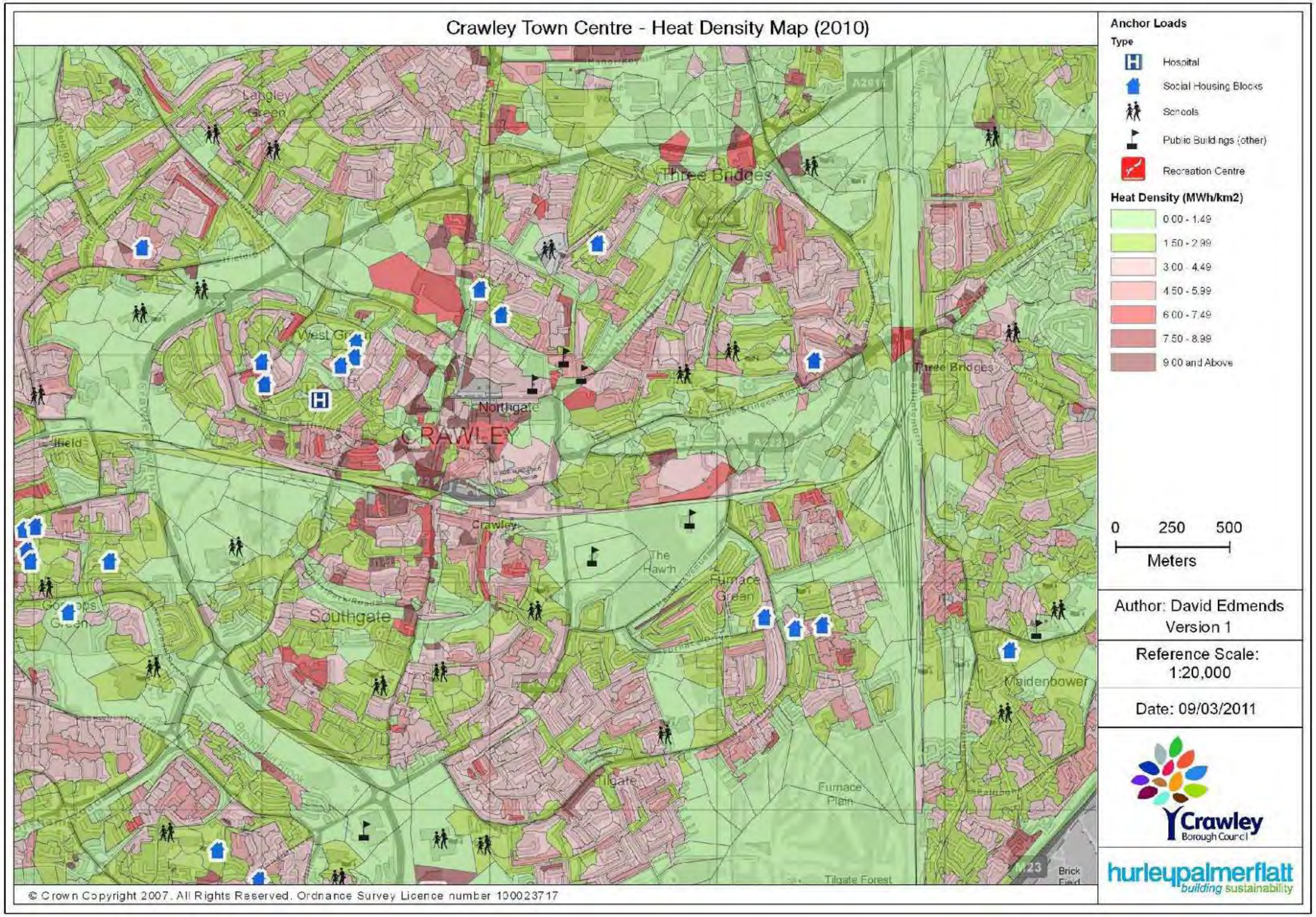


Figure 31: Crawley Town Centre – Heat Density Map (2010)

6.5.5. Crawley Heat Maps – 2025

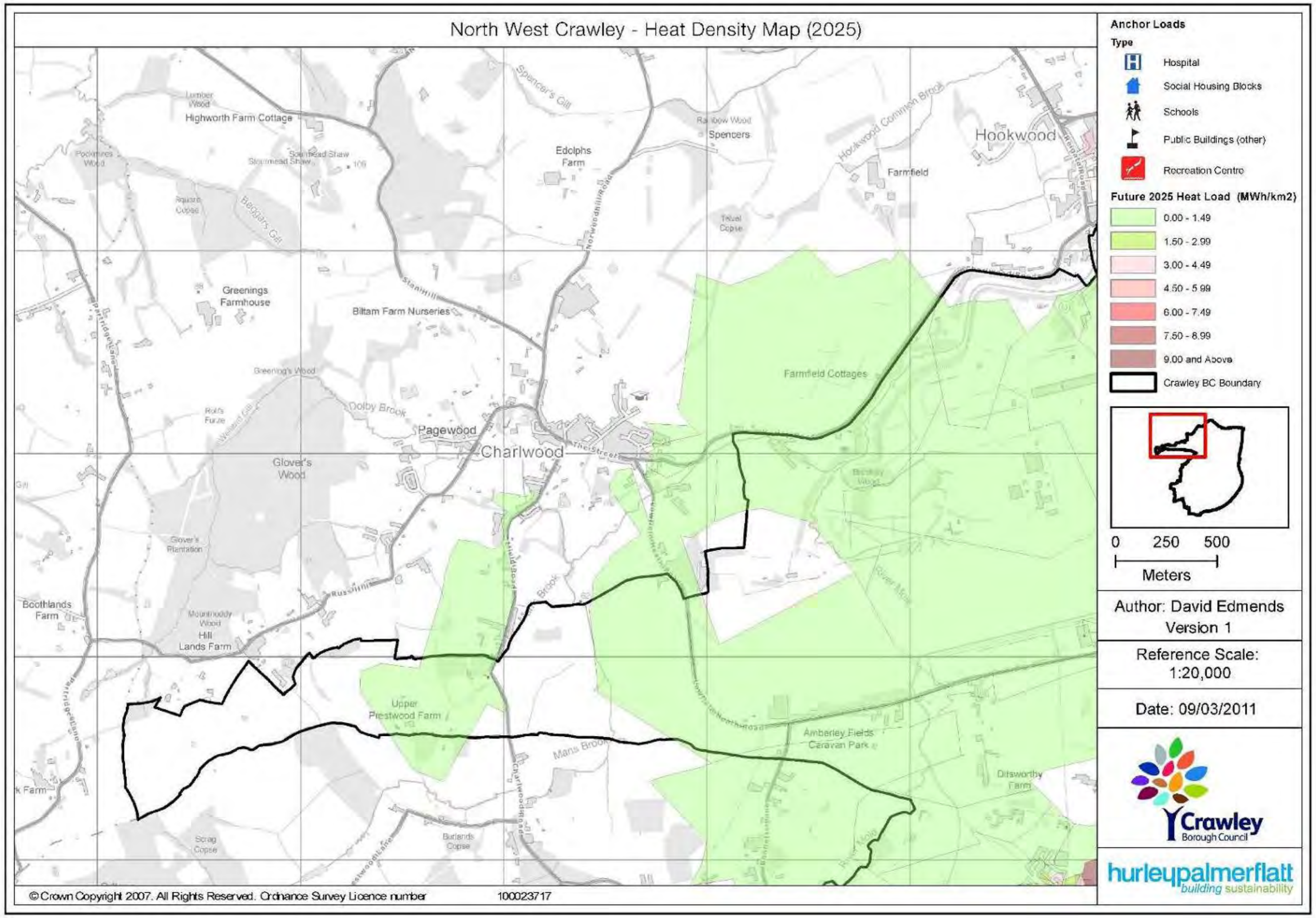


Figure 32: North West Crawley – Heat Density Map (2025)

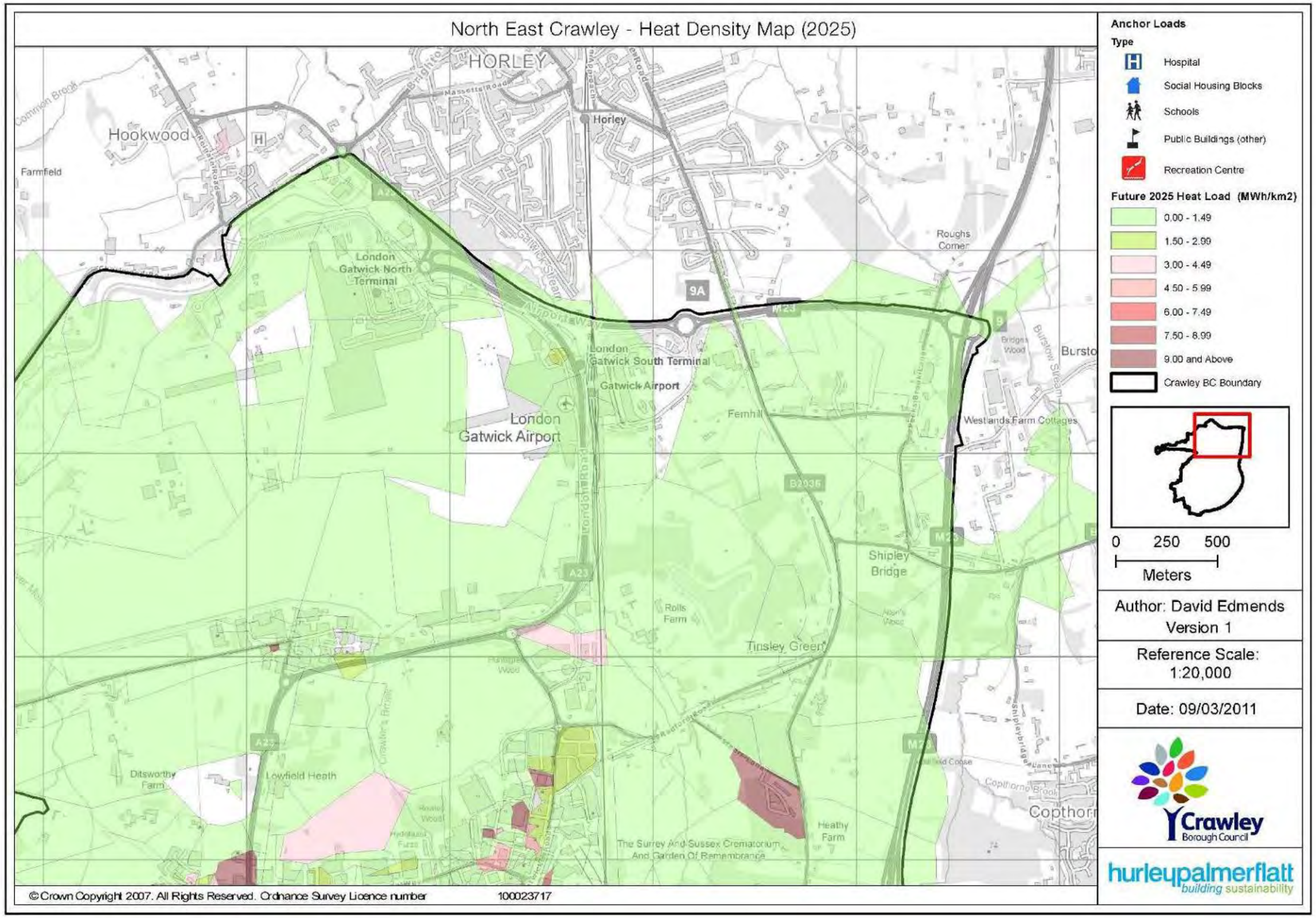


Figure 33: North East Crawley – Heat Density Map (2025)

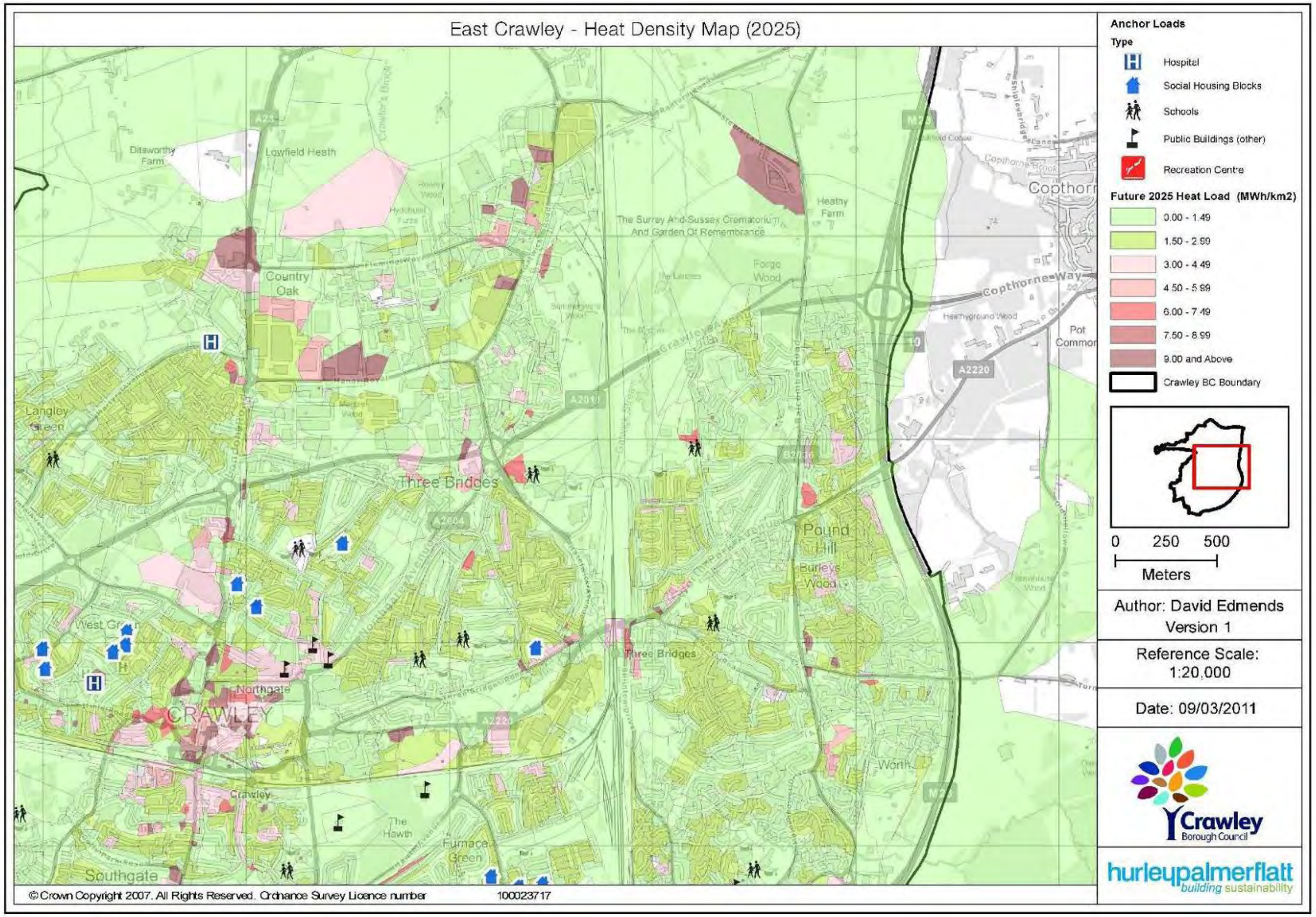


Figure 34: East Crawley – Heat Density Map (2025)

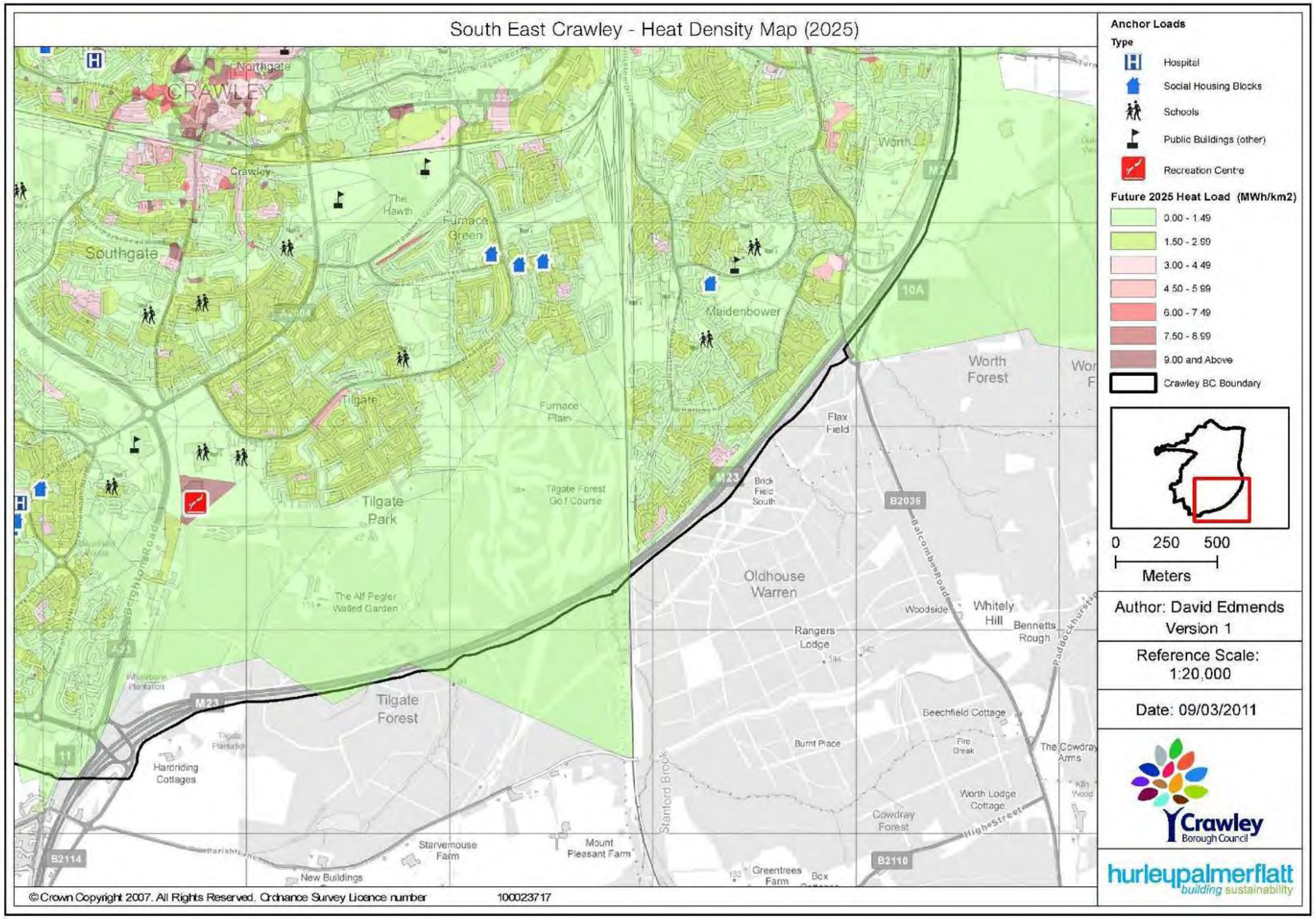


Figure 35: South East Crawley – Heat Density Map (2025)

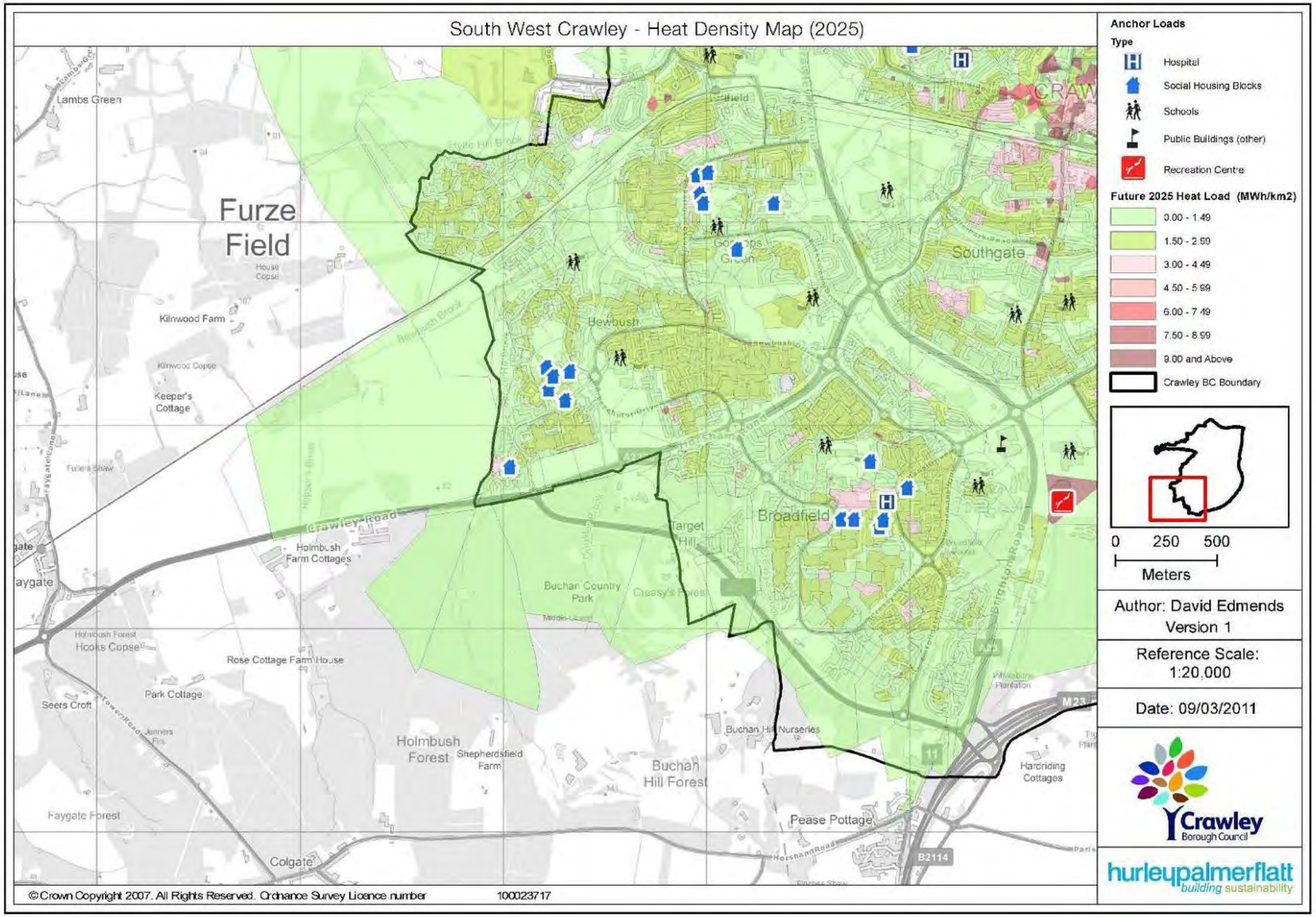


Figure 36: South West Crawley – Heat Density Map (2025)

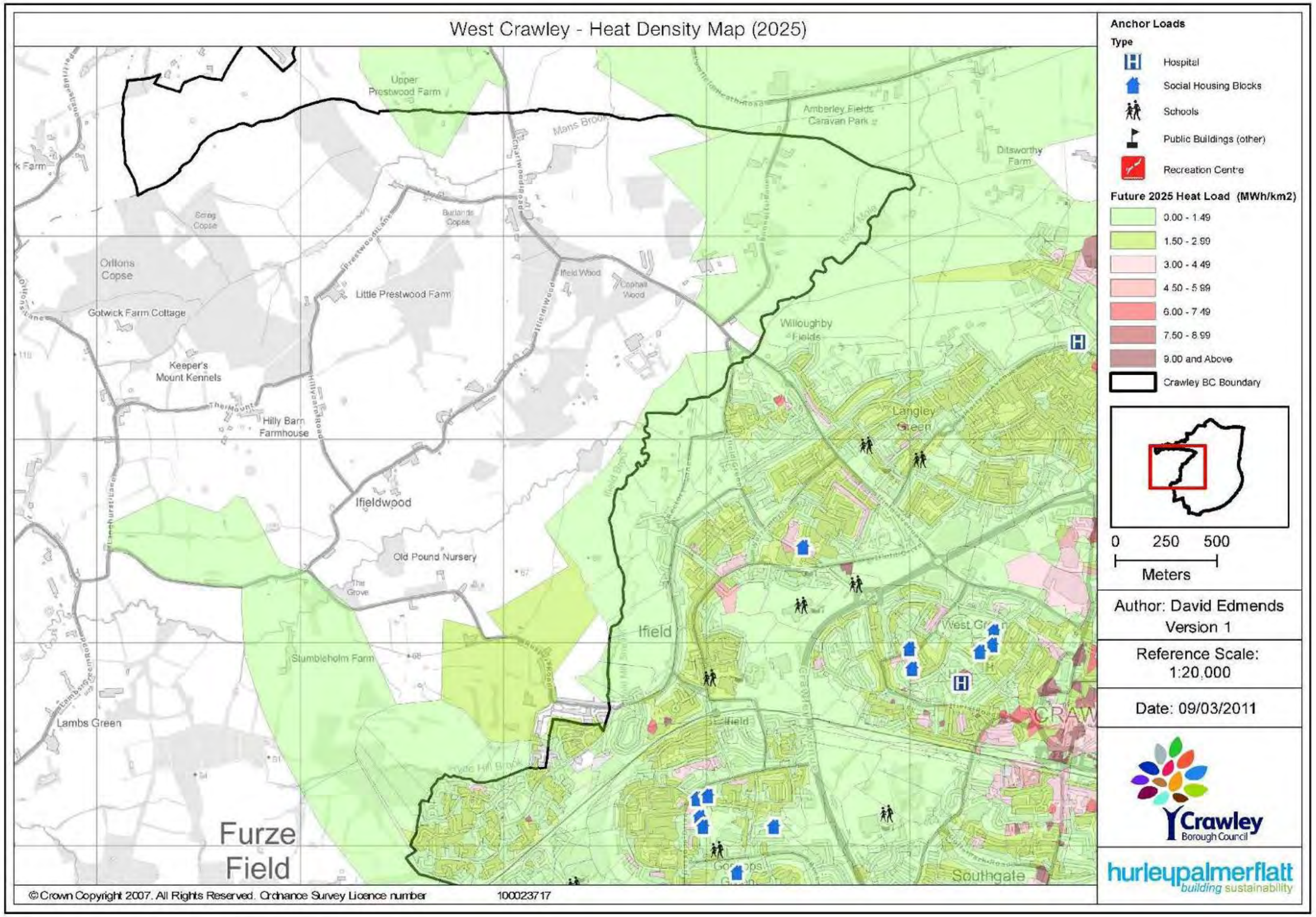


Figure 37: West Crawley – Heat Density Map (2025)

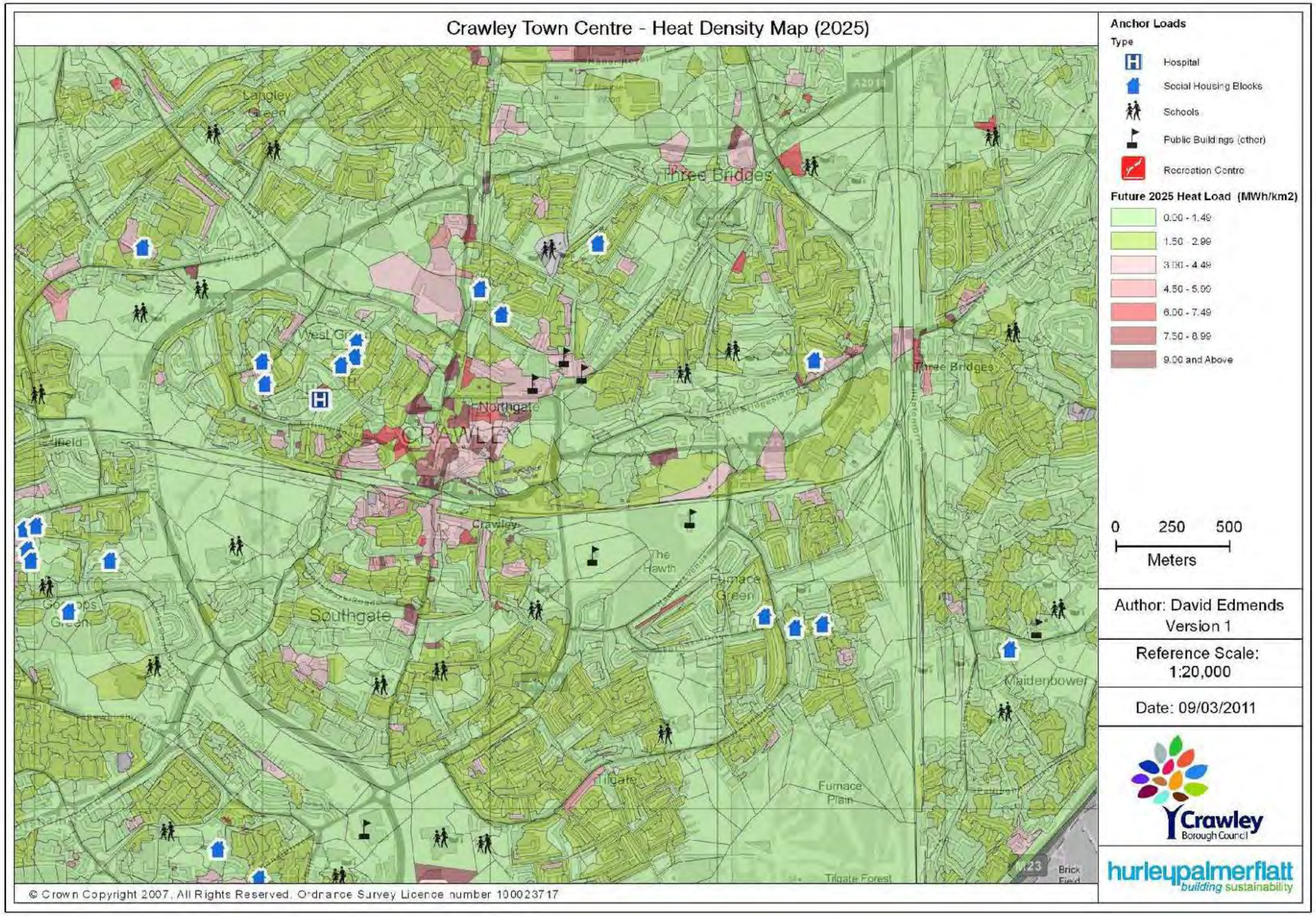


Figure 38: Crawley Town Centre – Heat Density Map (2025)

6.5.6. Crawley Potential Clusters for District Heating

From the review of the heat maps and following the principles established in section 6.3, the following clusters have been identified as potentially suitable for the development of a district heating network. The financial viability of these clusters has been modelled and results presented in the following sections.

1. Town Centre Cluster
2. Gossops Green Cluster
3. Bewbush Cluster
4. K2 Leisure Centre Cluster
5. Manor Royal / North East Sector Cluster

6.6. Viability of District Heating Clusters - Approach

Once the clusters had been identified, the feasibility of installing a district heating network was evaluated for each of these areas based on a test of financial viability.

The evaluation assumes that heat and electrical energy is generated by a gas CHP engine with back up boilers to meet peak heating loads, although renewable energy generation has been also reviewed in line with the findings of the opportunities for LZC technologies investigated in section 5.0. The analysis comprised the following steps:

1. Sizing of generation systems
2. Sizing of the distribution network
3. Costing
4. Financial modelling

6.6.1. Sizing of Generation Systems

The economics of district heating networks and CHP are also determined by technical factors including the size of the CHP engine and annual hours of operation (or base load). It is estimated that a CHP should operate a minimum of 4,500 hours per year for financial viability. In order to maximize the number of hours of operation, CHP units are typically sized on the base heat load. The remaining heat demand will be provided by gas boilers which will be sized to meet the peak heat load and will also be located within the energy centre..

To determine the peak and base loads of each cluster, profiles have been created for each building type present which have then been combined into a single cumulative profile – see appendix B for details of the profiles.

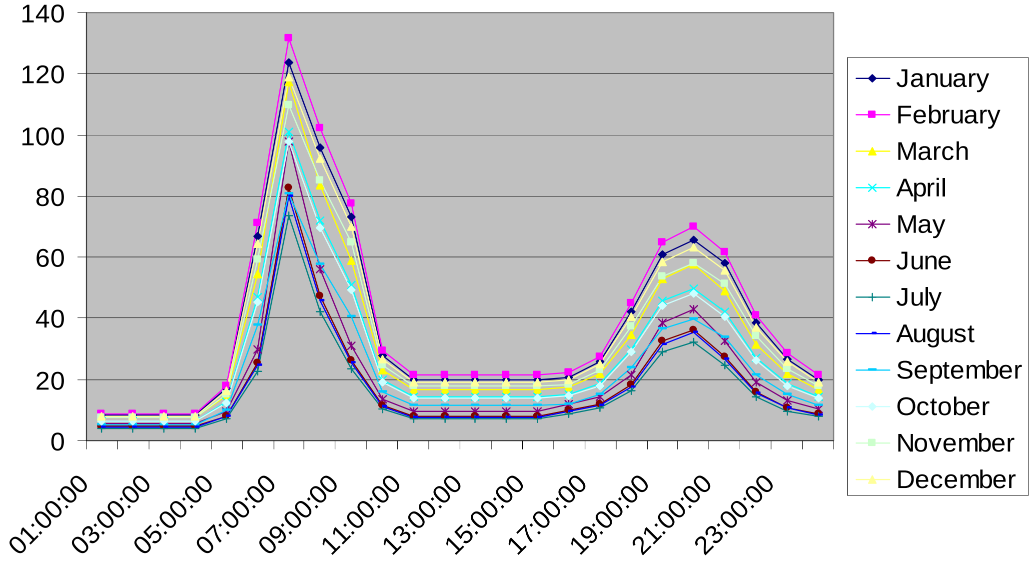


Figure 39: Typical Residential Profile

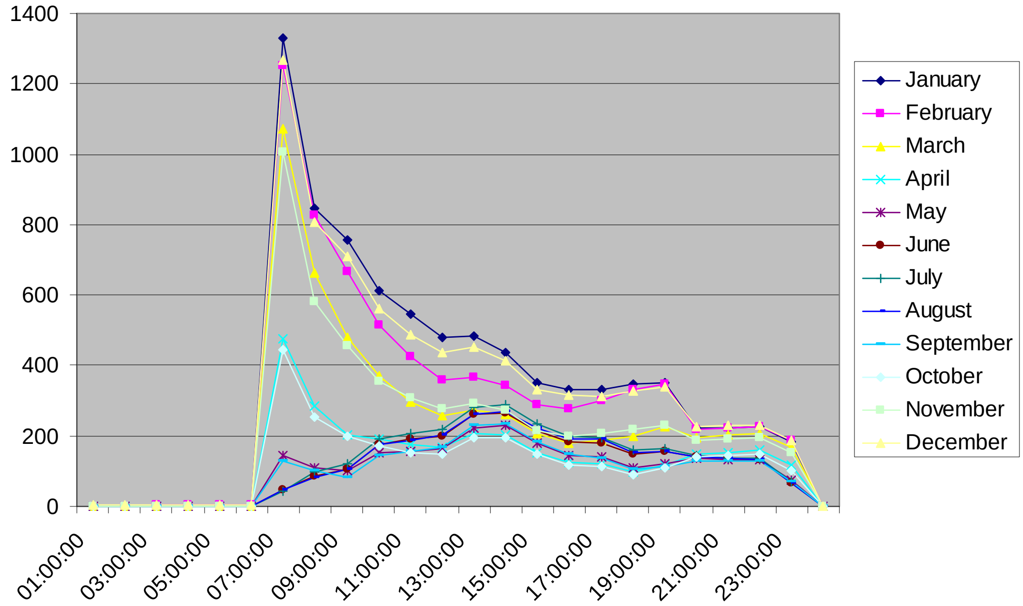


Figure 40: Typical Offices Profile

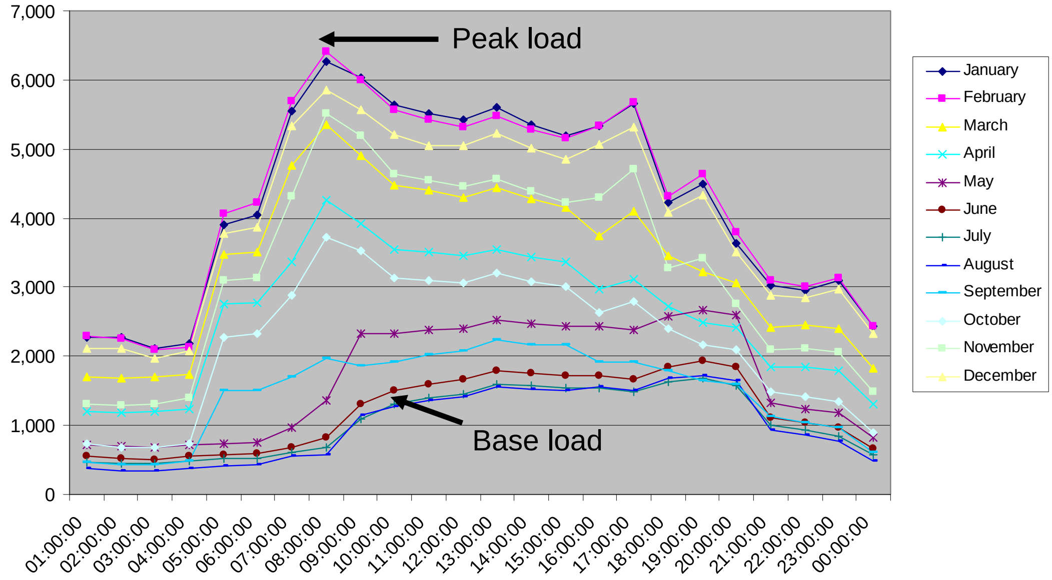


Figure 41: Cluster Combined Heat Profile

It has been assumed that a thermal storage will be provided allowing the CHP to run constantly at maximum output.

6.6.2. Sizing of the Distribution Network

Two key parameters are required to determine the cost of the distribution network: the length of the pipe and the diameter.

Pipe Length

The length of the pipe is determined by the distance between the selected buildings and by the road network. This distance has been accurately measured in the GIS maps.

Pipe Diameter

The diameter of the pipe depends on the flow rates of hot water and therefore on the amount of heat to be distributed. Pipe diameters have been calculated for each cluster in line with CIBSE Guide C2 for the following assumptions:

- Maximum speed: 3m/s
- Maximum pressure drop: 300Pa/m
- ΔT (in the HIU) = 30 °C

Where available information has not been sufficient to allow accurate sizing, reasonable estimations of the pipe diameters have been made.

6.6.3. District Heating Costs

Three main cost types have been included in the costing exercise: system costs (capital cost), systems maintenance costs and energy/fuel costs. Figures have been sourced as follows:

- **System costs**: A cost consultant was appointed to investigate the different costs associated with district heating systems. Cost details have been provided for various types/sizes of plant, pipework, heat meters, trenching and energy centre enclosures.

- **Maintenance costs**: Maintenance costs have been considered for generation systems which have been sourced from the report on district heating costs by Poyry[20].

- **Fuel costs**: Gas costs have been taken from the Department of Energy and Climate Change fuel price statistics. For non-domestic buildings, the latest data available corresponds to the 3rd quarter of 2010. This data accounts for the gas cost variations for different types of consumer based on the annual energy consumption. For residential developments the average of the last 2 years for an 'Average Great Britain Direct Debit Customer', from the DECC publication, Quarterly Energy Prices December 2010, have been taken.

  Climate Change Levy has been excluded for the gas consumed by the CHP since, as a low carbon technology, a CHP system is exempt of this tax.
  As a base case, it has been assumed that the cost of energy will increase by 1% over inflation. This is a conservative estimation based on our understanding of possible future energy prices. We would expect it to grow faster, but since there is a great level of uncertainty we have taken a conservative approach. A sensitivity analysis has also been undertaken to evaluate the impact of a higher inflation rate of gas and electricity prices – please see section 6.8.

  It has been assumed that biomass cost will follow the cost of the gas.

  An allowance of ~ 11% of the capital cost of the project has also been made for engineering design soft costs associated with the design of the district heating network.
  The lifetime of the plant and infrastructure has been assumed as follows:

  - CHP ~ 15yrs
  - Boilers ~ 30yrs
  - Pipe & Energy Centre ~ 60yrs
  - Heat Interfaces & Meters ~ 15yrs

6.6.4. Building Connection Costs

As explained in section, buildings connect to a district heating network through a HIU. Provision of meters is also required in order to quantify the energy consumed by each building for monitoring and billing purposes. Assuming that the gas back up boilers will be located in the decentralised energy centre, a building connected to the district heating network will not require the installation of a boiler. Therefore it can be considered that a HIU is a direct replacement of a

[20] UK Potential for District Heating networks: Technology Assumptions. 30th October 2008

gas boiler. This specially relevant in new developments where the contractor will typically assume these costs.

For a residential building, the cost of installing an individual boiler or a metered HIU in each dwelling is very similar.

Table 11: Individual Boiler Cost vs. Metered HIU for a Residential Building[21]

Individual boilers (£/dwelling)	HIU and heat meter[22] (£/dwelling)
2500	£2,300

The table below compares the standard gas boilers cost with the HIU costs for commercial buildings where the connection to the district heating network is cheaper option.

Table 12 Individual boiler cost vs. HIU and meters for individual commercial buildings[23]

kW	Gas boilers	Heat Exchangers[24]	Meters[25]	Total
500	30,000	5,000	2,500	7,500
1,000	58,000	5,250	2,500	7,750
1,500	85,500	6,525	2,500	9,025
2,000	110,000	6,500	2,500	9,000
2,500	137,500	7,500	2,500	10,000

6.6.5. Financial Modelling

The financial modelling has been undertaken for each potential cluster identified with the aim of analysing the performance, identifying the best options for CBC and minimizing the risks.

A number of financial indicators including: simple payback, Net Present Value (NPV) and Internal Rate of Return (IRR) have been calculated for each scenario over a period of 20 years. It has been assumed that for a no risk scenario, an ESCO would seek a minimum IRR of 7% (based on hurleypalmeflatt discussions with ESCOs involved in district heating) and therefore this has been set as the viability threshold. When a lower IRR has been achieved, the potential public contribution required to make the project attractive for an ESCO has been calculated. Higher IRR might be required for projects with associated risks such as uncertainty of connection of buildings. A sensitivity analysis has been undertaken to evaluate the public contribution required for these scenarios.

[21] UK Potential for District Heating networks: Technology Assumptions. 30th October 2008
[22] Includes £1,600 HIU, £200 for heat meter, and £500 for installation
[23] Quantem cost consultants
[24] Capital costs include supply and installation of heat exchanger plant including services contractors' preliminaries and excludes valves, fittings, accessories and commissioning setting to work.
[25] Capital costs include supply and installation of a heat meter onto the district heating system including services contractor preliminaries. It assumes pipe sizes to be between 100mm & 300mm.

The model assumes that consumers will be offered a minimum 5% discount over the baseline energy rates as an incentive for connection to the district heating network.

6.7. Crawley Heat Network Clusters - Financial Viability

6.7.1. Town Centre Cluster

The Town Centre is a high heat density area with a mix of commercial and residential properties, including anchor loads, which offers a high potential for the development of a district heating network. Additionally, the Town Centre North area will undergo a major redevelopment which could act as a catalyst for a wider heat network within the Town Centre. We recommend that the project is started with a simple pilot scheme, a small but robust cluster containing anchor loads and existing buildings which could be started in the near future as a pilot scheme. This would constitute the first step of a network which could be extended to supply future developments planned for the Town Centre.

Consideration was given to siting an energy centre within the proposed Sussex House development as an initial pilot scheme which could be expanded to serve the future development within the town centre;

The principal reasons for not developing this option are:

- The heat load as a result of future development is as yet unknown and therefore the capacity and size of the energy centre cannot be accurately predicted.
- Given the uncertainty over the timescales of the Town Centre North redevelopment, it is unlikely that the developer of TCN would contribute towards an energy centre within the Sussex House development.

Opportunities for the Sussex House site that should be discussed at the pre-planning stage include designing heating distribution systems within the buildings to allow for connection to any future Town Centre heat networks. In addition, the developer could consider the feasibility of low carbon heat sources within the development that could contribute towards a wider heat network e.g. gas CHP. Section 6.3.3 details proposals for a guide on heat networks in Crawley that could be used to inform development that is being planned prior to adoption of specific planning policy relating to development of heat networks.

The opportunity for a Town Centre heat network has been assessed based on the following phasing assumptions:

Phase 1 – The Pilot Scheme: In order to reduce the risk, the pilot scheme needs to contain anchor loads located within the vicinity which could be linked by a district heating network. These buildings also need to be in a location which will allow the proposed network to be extended to supply new developments in the area. The Central Sussex College and the library meet this criterion. The County Mall is located in close proximity to the library and therefore could also be connected. These three buildings will be daytime energy consumers. The Arora hotel, located to the south of the County Mall, will require heating mainly during the night and therefore will have a complementary demand. For this reason it is proposed that the network is extended to the south to allow connection of this building.

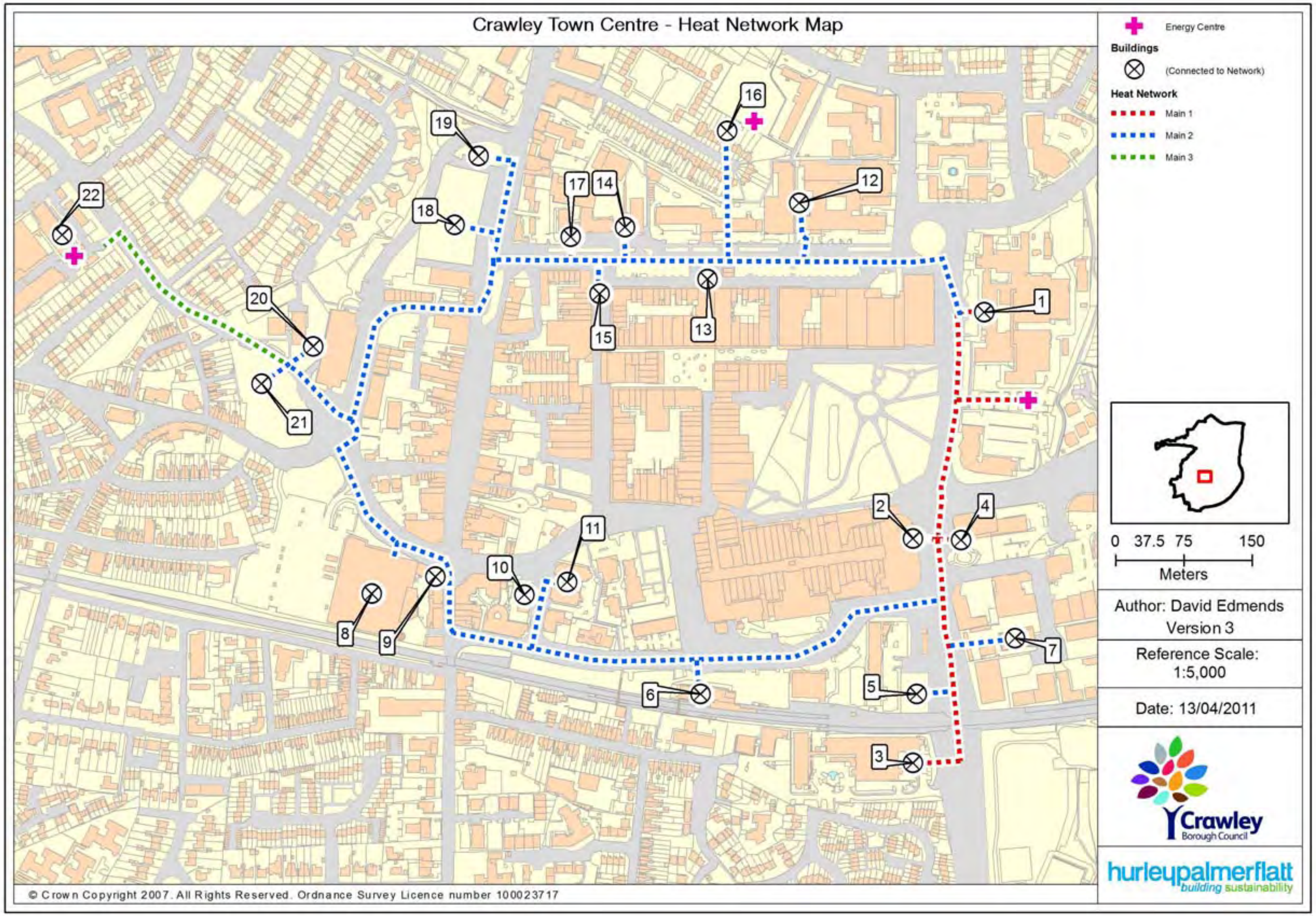
The Central Sussex College is anticipated as the most suitable area for the development of the energy centre due to the public ownership and the higher availability of land. This energy centre could be oversized to partially supply the extended network.

Phase 2 – Two main areas have been considered for the extension of the district heating network: The Boulevard and Station Way. Station Way comprises a number of large existing buildings with different uses such as offices, a supermarket and residential with complementary energy demands. The northern branch of the network would run along The Boulevard, which will be subject to a major redevelopment to include a mix of public and privately owned commercial buildings. The exact locations of the buildings are unknown at the time of writing this report and therefore assumptions have been made in line with the proposed Crawley Town Centre North Indicative Masterplan. Additionally, two new residential developments are expected to the West of the Town Centre: the Fairfield House which will comprise 100 dwellings and the Southern Counties to provide 218 dwellings. By connecting these buildings, in addition to increasing the night time demand, the district heating network can be closed, creating a loop which will provide greater resilience.

Phase 3 – Once phase two is completed, the district heating network could be expanded to link to the Crawley Hospital.

Table 13: Summary of Buildings Included in the Town Centre Cluster Proposed Network

Ref	Building Name
1	Central Sussex College
2	County Mall
3	Arora Hotel
4	Crawley library and register office
5	Brunel Hall
6	Overline House
7	Telford Place
8	ASDA supermarket
9	25 High Street – Robinson House
10	Job Centre
11	The Galleria (Virgin Holidays)
12	Possible? TCN Department store
13	Additional retail (proposed)
14	A3 restaurant (proposed)
15	Cinema
16	Possible? New Town Hall
17	Management Suite
18	Supermarket (Sussex House site)
19	TCN Hotel
20	Fairfield House
21	Southern Counties
22	Hospital


Crawley Town Centre - Heat Network Map
Energy Centre
Buildings
(Connected to Network)
Heat Network
Main 1
Main 2
Main 3
0 37.5 75 150
Meters
Author: David Edmends
Version 3
Reference Scale:
1:5,000
Date: 13/04/2011
Crawley
Borough Council
hurleypalmerflatt
building sustainability
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The table below summarizes the results of the cumulative financial modelling of the project at each of the stages.

Table 14: Summary of Financial Viability for the Town Centre Cluster

Phase	Simple Payback	Capital cost (£)	IRR (%)	NPV(7%discount rate)	NPV) (5% discount rate)	Public contribution for IRR 7%	CO_2 savings[26] (tonnes)
1	12	1,666,352	6.38%	-£92,083	£237,854	£92,000	847(23% reduction)
1+2	12	5,604,780	6.49%	£254,616	£868,714	£255,000	2,400(24% reduction)
1+2+3	9	6,409,276	9.90%	£1,720,421	£3,372,122	-	3,322(25% reduction)

The table above shows the results of the financial modelling for the three scenarios proposed. The results are cumulative rather than per phase. On this basis, the second scenario considers phase 1 and 2 being build and the third considers the development of the whole proposed network. If all the proposed network was developed, the project would have an IRR close to 10% and therefore no public funding would be required; however if only phases one or one and two were implemented public contribution would be required as a financial supplement to the capital cost in order to make the project viable with £92,000 contribution being required in the first case and £255,000 in the second.

The overall simple payback of the project assuming that all the proposed network will be developed and all the buildings connected will be 9 years.

The results also indicate that the connection of Crawley Hospital has a large positive impact on the viability of the scheme. It is our understanding that the hospital is looking at plant replacement in the near future and therefore it is recommended that discussions are held at the earliest opportunity to ensure that any new plant is designed to allow for future connection to a heat network.

The figure below shows the public contribution required for higher levels of IRR. The evaluation has been made for the overall project including phases 1, 2 and 3.

[26] Against business as usual

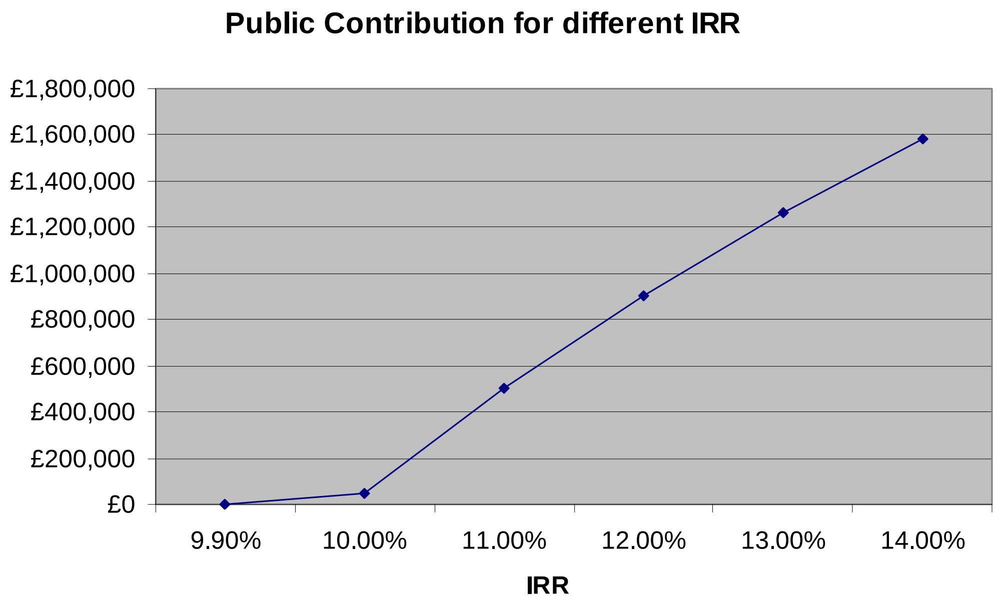

Figure 42 Financial Contributions Required to Achieve Different Target IRR (Based on the Town Centre Cluster – Phase 3)

6.7.2. Gossops Green Cluster

This area offers the possibility of connecting the Gossops Green Primary School with Capel Lane, Gossops Parade and Woodhurstlea Close social housing which have complementary energy demand profiles. It has been assumed that the energy centre would be located within the school grounds.

Ref	Building Name
1	Gossops Green Sheltered Scheme – Capel Lane
2	Gossops Green Sheltered Scheme – Gossops Parade
3	Woodhurstlea Close
4	Gossops Green Primary School

Whilst Capel Lane and Woodhurstlea Close are currently electrically heated, the opportunity to retrofit these buildings with wet heating systems that could connect to a district network has been assessed. This is particularly applicable given the high cost associated with electric heating. It should be noted that we have considered the cost of the primary network only and not the cost of converting the electric heating systems to wet systems.

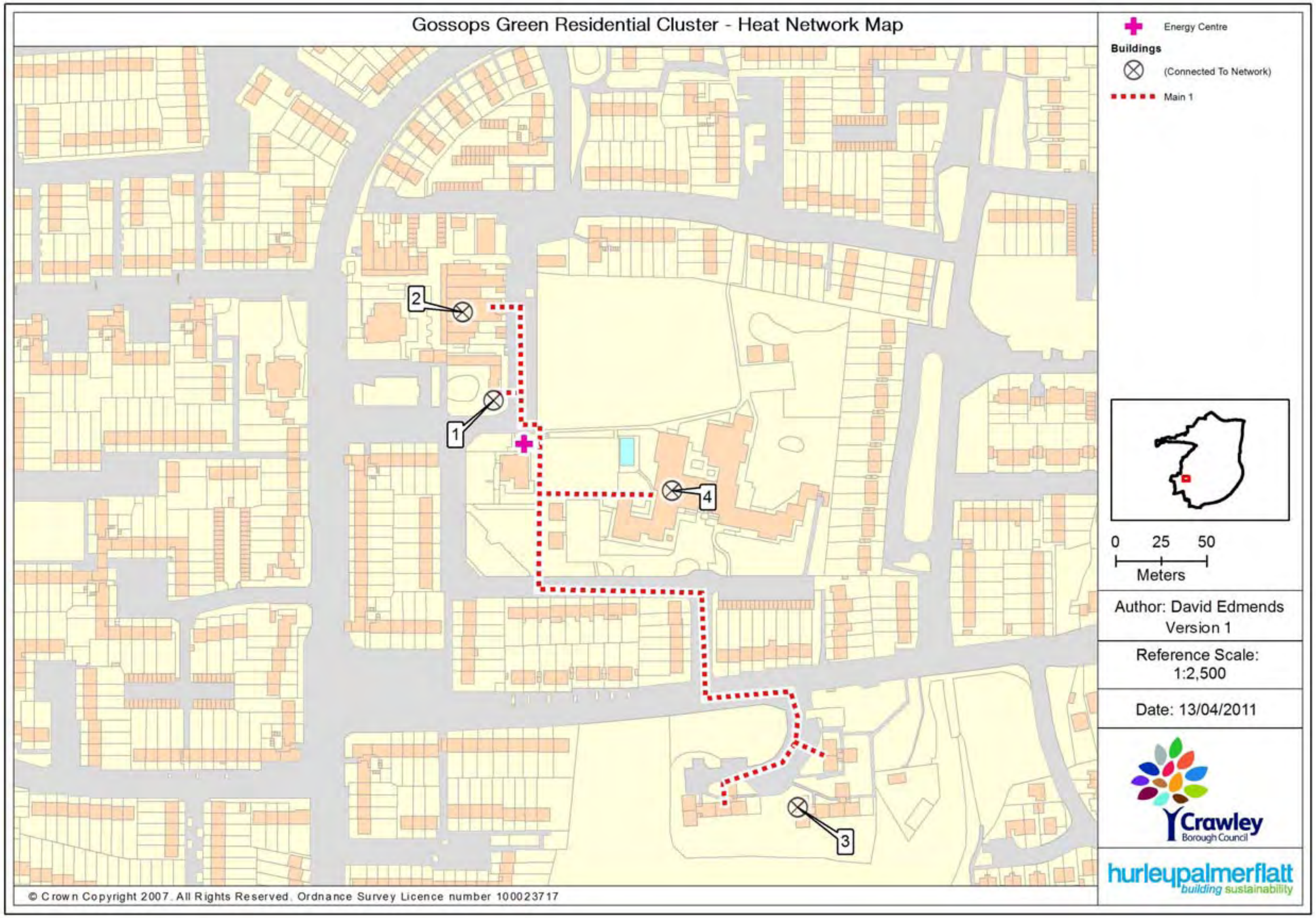
Gossops Green Residential Cluster - Heat Network Map
Energy Centre
Buildings
(Connected To Network)
Main 1
1
2
3
4
0 25 50
Meters
Author: David Edmends
Version 1
Reference Scale:
1:2,500
Date: 13/04/2011
Crawley
Borough Council
hurleypalmerflatt
building sustainability
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Table 15: Summary of Financial Viability for the Gossops Green Cluster

Capital cost (£)	Simple Payback	IRR (%)	NPV[27] (7%discount rate)	NPV) (5% discount rate)	Public contribution for IRR 7%	CO_2 savings[28] (tonnes)
£572,251	No payback	-3.87%	-£519,684	-£490,786	519,700	12 (13% reduction)

The results show that the installation of a district heating network in this area is economically unviable. The heating demand is very limited and as a result the annual revenue would be similar to the maintenance costs. It is therefore recommended that the installation of a district heating network is ruled out. An alternative solution could be a communal gas or biomass/biofuel CHP. This could be delivered through an Energy Performance Contract (EPC) where an ESCO will install and operate a communal system with additional savings made through the ESCO investing in energy efficiency initiatives e.g. glazing replacement, cavity wall insulation, etc.

The figure below shows the public contribution required for higher levels of IRR.

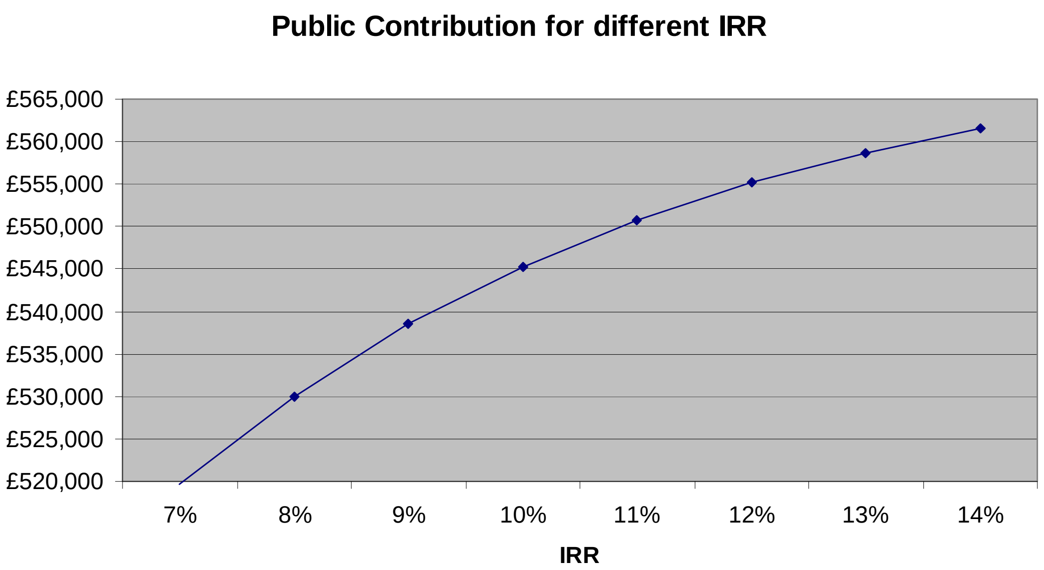


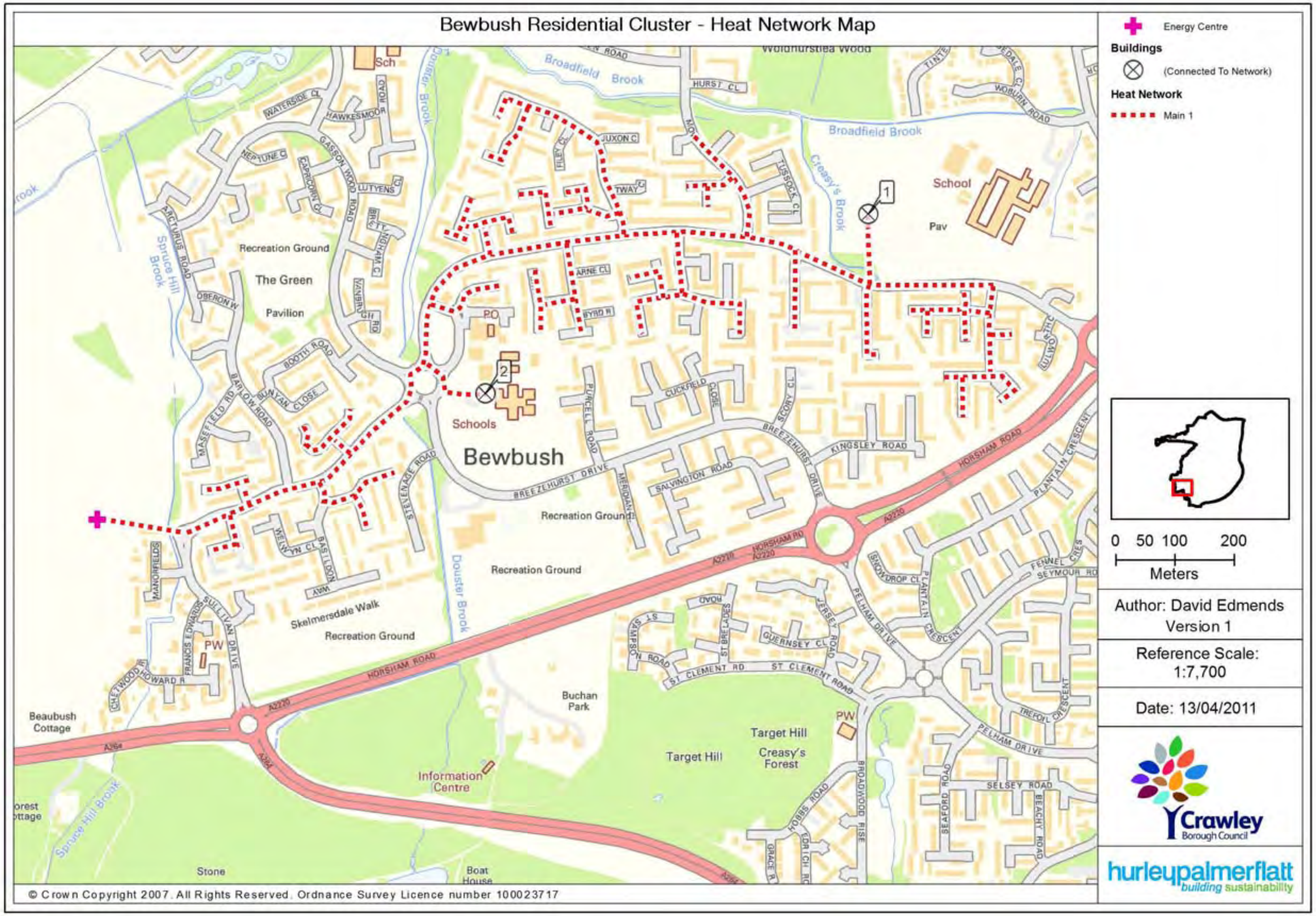
Figure 43 Financial Contributions Required to Achieve Different Target IRR

[27] Over 20 years
[28] Against business as usual

6.7.3. Bewbush Cluster

The Bewbush area includes a number of anchor loads with over 223 social houses and two schools. Additionally, a new residential development is expected to the West of Bewbush, just outside of Crawley Borough. This area, although not included in the calculations due to the uncertainty over the development layout, could be developed with a central energy centre which could form the basis of a district heating network linking both the new development and existing social housing.

Ref	Building Name
1	Bewbush Community Primary School
2	Holy Trinity School


Bewbush Residential Cluster - Heat Network Map
Energy Centre
Buildings
(Connected To Network)
Heat Network
Main 1
0 50 100 200
Meters
Author: David Edmends
Version 1
Reference Scale:
1:7,700
Date: 13/04/2011
Crawley Borough Council
hurleypalmerflatt building sustainability
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Bewbush
Schools
School
Recreation Ground
The Green
Pavilion
Buchan Park
Target Hill
Creasy's Forest
Information Centre
Broadfield Brook
Douster Brook
Spruce Hill Brook
HORSHAM ROAD
BREEZEHURST DRIVE
KINGSLEY ROAD
PELHAM DRIVE

Table 16: Summary of Financial Viability for the Bewbush Cluster

Capital cost (£)	Simple Payback	IRR (%)	NPV[29] (7%discount rate)	NPV) (5% discount rate)	Public contribution for IRR 7%	CO_2 savings[30] (tonnes)
£5,164,325	No payback	-1.90%	-£3,995,167	-£3,588,869	£3,995,000	271 (27% reduction)

The results of the financial modelling show that the development of a district heating network is unviable in this area. The main reasons are the long lengths of pipe work required due to the low density of social housing in the area, in addition to the long length of pipework that would be required to connect existing housing to the proposed residential development to the West of Bewbush. It is currently considered that only the existing social housing within Bewbush will be connected to the district heating network. Viability would improve if existing private properties were also connected increasing the heat density; however, this would be an option with a higher risk due to the higher level of uncertainty of connection associated with private properties.

As per previous cluster, Energy Performance Certificates could be an alternative viable solution for the existing social housing.

The figure below shows the public contribution required for higher levels of IRR.

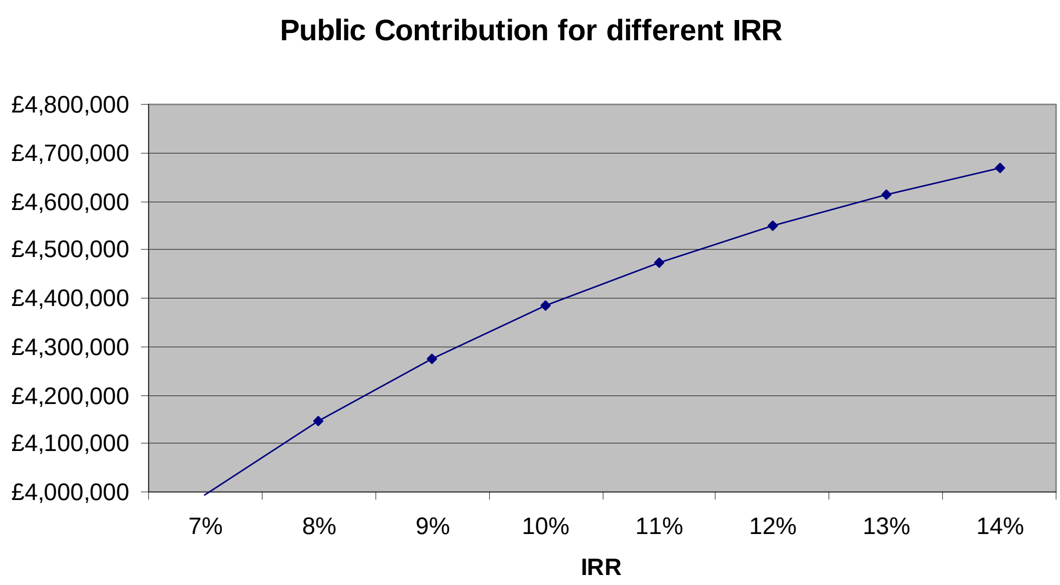

Figure 44 Financial Contributions Required to Achieve Different Target IRR

6.7.4. K2 Leisure Centre Cluster

The proximity between K2 Leisure Centre, Desmond Anderson School and Thomas Bennett Community College creates a very simple and attractive cluster for the installation of a district heating network where the amount of pipe required

[29] Over 20 years
[30] Against business as usual

would be minimal. The operators of K2 Leisure Centre (Freedom Leisure), which has an existing CHP engine to heat the building, are considering the installation of a larger unit which could be easily oversized to supply the two schools. Additionally, a new residential development is expected to the East of the leisure centre with 80-100 new homes which could be designed to connect to the network.

The possibility to extend the network towards the Broadfield area to link to the Broadfield Health Care Centre and Broadfield Football stadium has been explored; however it has been deemed unviable due to the length of the pipe required. Additionally, there was a level of uncertainty regarding the future of the Broadfield Health Care Centre which would increase the risk of the project being unviable.

Two phases were therefore identified for the heat network:

- Phase 1: Pilot Scheme connecting K2 Leisure Centre, Desmond Anderson School and Thomas Bennett Community College
- Phase 2: Expansion of the network to link to the proposed residential development to the east of the leisure centre.

Ref	Building Name
1	K2 Leisure Centre
2	Desmond Anderson School
3	Thomas Bennett Community College
4	Proposed New Residential development

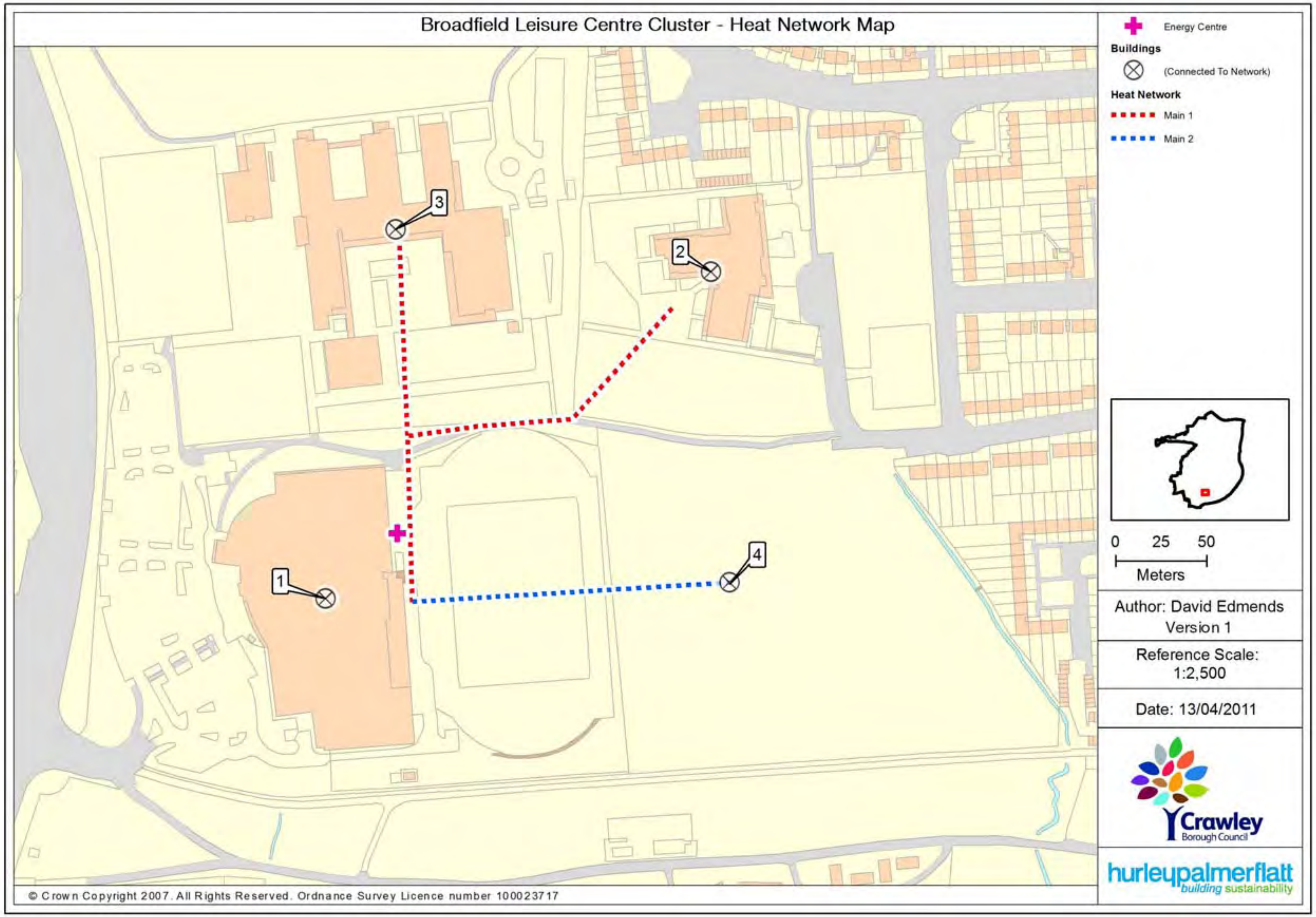
Broadfield Leisure Centre Cluster - Heat Network Map
Energy Centre
Buildings
(Connected To Network)
Heat Network
Main 1
Main 2
1
2
3
4
0 25 50
Meters
Author: David Edmends
Version 1
Reference Scale:
1:2,500
Date: 13/04/2011
Crawley
Borough Council
hurleypalmerflatt
building sustainability
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Table 17: Summary of Financial Viability for the K2 Leisure Centre Cluster

Phase	Capital cost (£)	IRR (%)	NPV[31] (7%discount rate)	NPV) (5% discount rate)	Public contribution for IRR 7%	CO_2 savings[32] (tonnes)
1	£562,774	11.07%	£217,793	£377,478	-	342(29% reduction)
1+2	£917,274	7.62%	£51,003	**£250,984**	-	405(29% reduction)

As per the town centre, the results in the table above are cumulative and therefore the second scenario represents the development of the whole network.

The results show that the proposed district heating network to connect the existing buildings will achieve an IRR significantly higher than the minimum recommended threshold of 7% and would therefore be a very secure investment. The connection of the new residential development would reduce the IRR due to the additional length of pipe to be installed, however it will remain above the 7% threshold. Additionally the new development could be designed so that heat density is maximised and the pipe length reduced.

Also, the combination of school, leisure centre with swimming pool and residential developments offers a good potential for adjusting the heating demand profiles to maximise the operational hours of the CHP system. For example, heating for the swimming pools could be scheduled to avoid peak demand periods of the residential development and schools.

The figure below shows the public contribution required for higher levels of IRR. The evaluation has been undertaken for the project including phase 1 and 2.

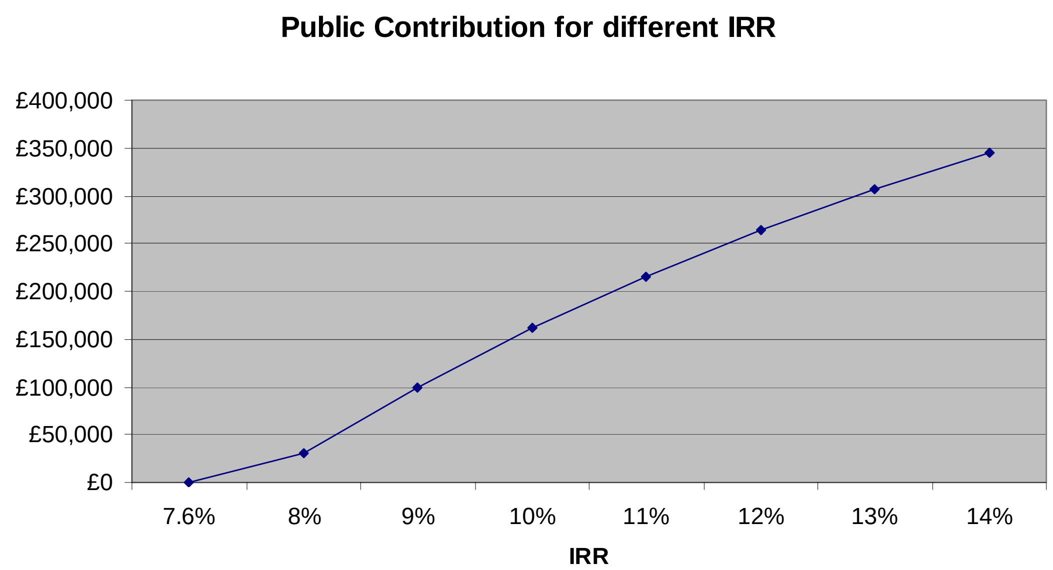

Figure 45: Financial Contributions Required to Achieve Different Target IRR

[31] Over 20 years
[32] Against business as usual

6.7.5. Manor Royal Cluster

Manor Royal comprises a significant number of large energy consumers including offices, industrial units and hotels. Two district heating networks have been modelled:

Option A – This initial network would link a number of major businesses in Manor Royal identified during a site visit. It is proposed that the network also links with Langley Green hospital which is located adjacent to the business district and which, together with the Ibis hotel, would provide a night time energy demand. The Premier Inn Hotel was initially considered, however, it has been confirmed that the building is electrically heated and therefore it is unlikely to connect to the network. The network is proposed to be designed in a closed circuit with a pipe connecting the north and south branches for additional resilience.

Option B - The area to the north-east of the proposed network (North East Sector) is expected to be redeveloped to include 1,900 new homes, 5,000m^2 of commercial space, 2,500m^2 of retail space, a new community centre and a new school which could be required to include a district heating network though planning policy. This option evaluates the viability of common network to supply Manor Royal Industrial park and the new developments on the North East sector. Since there is no available data on the location and density of the new residential areas an assumption has been made of 32 dwellings per hectare.

The size of this district heating network and the agricultural land located to the north offer possibilities to explore alternative generation options. The following solutions have been investigated for network A:

Option A1 – The heating required during the summer is very limited and therefore the base load represents the domestic hot water demand only. With the exception of the hospital and the hotel, Manor Royal comprises mainly industrial buildings and offices. These types of buildings have very low domestic hot water requirements and therefore have a very limited base load. A CHP sized to meet this load will have a very low contribution across the year. The use of a modular system with more than one unit connected in series would allow a greater proportion of the annual heat load to be met with CHP resulting in greater CO_2 savings. During periods of low heating demand the smallest CHP engine would be operational with the other engines coming on line as the demand increases during the cooler periods of the year. A system has been modelled that would provide half of the annual heating demand.

Option A2 and A3 – The biomass opportunities mapping indicated that grade 3 and grade 4 agricultural land is available to the North of Manor Royal which could potentially provide biomass to this cluster, minimizing transportation of the fuel. The viability of biomass-based generation has been explored for a biomass boiler (Option A2) and a biomass CHP (Option A3).

Ref	Building Name
1	Doosan
2	Thales
3	Edwards
4	Presteigne Charter / Masters (London)
5	Victory House
6	Siemens
7	Boeing – Jeppesen
8	Virgin
9	Haas (Aeropia House)
10	Bridisco
11	Thales
12	Creative Technology Ltd
13	Air Partner (Platinum House)
14	Monier Ltd
15	Ibis Hotel
16	First Choice House
17	Astral Towers
18	Oxford Aviation
19	Elekta
20	DPD
21	Froy and Sons Ltd
22	Pasta Reale
23	Virgin Atlantic (The Base)
24	Diamond Point (ITW)
26	Tui Travel
27	The Satellite Business
28	Pasta Reale
29	Quiagen
30	Davis Industrial Plastics
31	Haulotte
32	Ventaxia
33	Strand Lighting
34	Howdens
35	The Explorer Building
36	Thales
37	Langley Green Hospital
A	Residential (1,900 units @ 32 units per hectare)
B	Commercial B1, B2 + B8 (5,000m^2)
C	Retail (2,500m^2)
D	Community Centre (~350m^2)
E	Primary School (~750m^2)

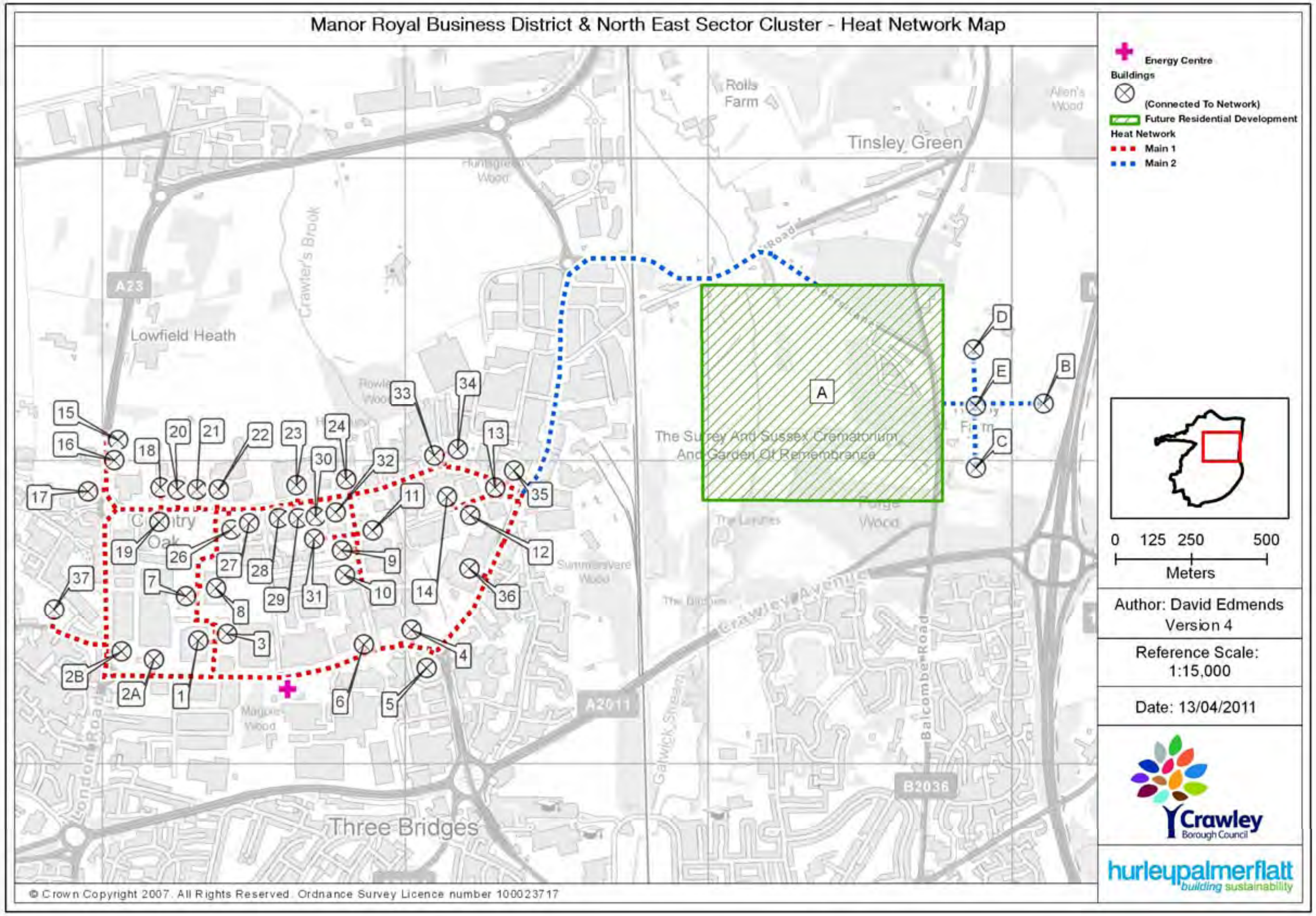
Manor Royal Business District & North East Sector Cluster - Heat Network Map
Energy Centre
Buildings
(Connected To Network)
Future Residential Development
Heat Network
Main 1
Main 2
0 125 250 500
Meters
Author: David Edmends
Version 4
Reference Scale:
1:15,000
Date: 13/04/2011
Crawley
Borough Council
hurleypalmerflatt
building sustainability
Tinsley Green
Rolls Farm
Lowfield Heath
Three Bridges
The Surrey And Sussex Crematorium And Garden Of Remembrance
Crawley Avenue
A23
A2011
B2036
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Table 18: Summary of Financial Viability for the Manor Royal Cluster

Network Option	Simple Payback	Capital cost (£)	IRR (%)	NPV[33] (7%discount rate)	NPV) (5% discount rate)	Public contribution for IRR 7%	CO_2 savings[34] (tonnes)
A	No payback	£7,585,157	-0.38%	-£4,920,860	-£4,152,186	£ 4,922,000	342(29% reduction)
A1	No payback	£8,450,614	2.86%	-£3,135,228	-£1,876,844	£3,135,000	2,198 (28% reduction)
A2	No payback	£7,895,614	0.9%	-£2,195,528	-£3,086,724	£3,985,000	1,977(52% reduction)
A3	No payback	£11,572,489	-3.76%	-£9,415,478	-£8,815,566	9,415,000	3,059(55% reduction)
A+B	No payback	£33,147,346	-1.06%	-£23,165,376.55	-£20,178,301	23,160,000	405(29% reduction)

The table above summarizes the results obtained for each scenario. The following can be concluded:

- The installation of a district heating network to serve Manor Royal with energy to be generated from a CHP sized to meet the base load is economically unviable.
- If a modular system was used, the IRR would increase by 3%, but would still be financially unviable requiring a significant contribution of capital from CBC or other partners.
- Biofuel based heating systems such as biomass boilers and biomass CHP have a higher capital cost and therefore reduce the IRR; however they could provide over 50% carbon emissions reductions.
- The connection of the North East Sector to the Manor Royal Network reduces the IRR and therefore is not recommended; however, this area could constitute an attractive cluster in its own right if the development is designed with a suitable density to minimize the length of pipe required. This option is reviewed in the following section.

Business Parks such as Manor Royal, are generally areas with low space heating and DHW demands resulting in long lengths of pipe required for a comparatively low demand. This makes district heating an unviable solution if designed to provide space heating and DHW only. The heat density of this area would be significantly increased if process heating was considered. Industrial buildings often require high grade heat for industrial processes, which are a constant yearly demand. This energy can be provided by a centralised energy system such as a CHP and distributed through a district heating network if suitably designed. Process energy requirements depend on the type of process and therefore a suitable design needs a good understanding of the activities of each building. It is recommended that the production of process energy is further investigated and the technical and economic viability evaluated.

[33] Over 20 years
[34] Against business as usual

The figure below shows the public contribution required for higher levels of IRR. Since it has been demonstrated that the North East sector should be considered as an independent cluster, this area has not been considered in the analysis and will be separately reviewed in the next section.

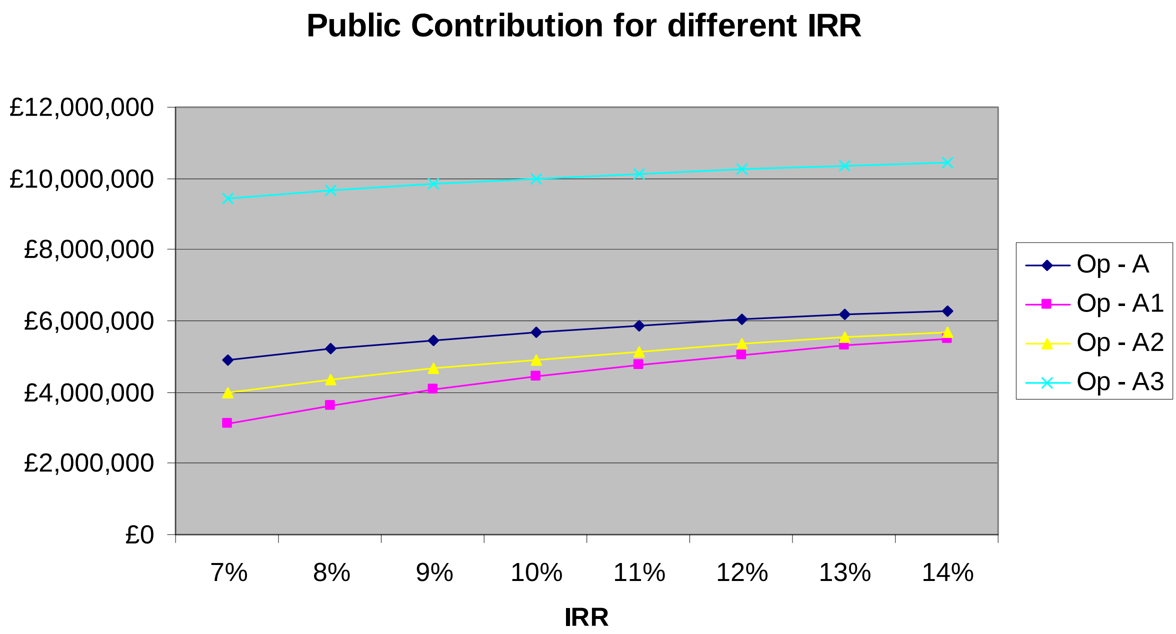


Figure 46: Financial Contributions Required to Achieve Different Target IRR

6.7.6. The North East Sector

This section reviews the financial viability of a district heating network on the North East sector as an independent cluster. Since a development layout has not been developed for the residential area, this exercise aims to determine the approximate length of pipe per dwelling which will result in an IRR of 7%. A ratio 2:1 has been assumed for the secondary : primary pipes where the primary pipes will be mains with capacity to deliver the total heating load of the development and the secondary smaller branches assumed to have a diameter of less than 100mm. This ratio can vary significantly depending on the layout of the development.

It has also been assumed that whilst the ESCO will pay for the network, the energy centre and the primary and secondary network, the contractor will assume the costs of the HIU since they are a direct replacement of the gas boilers.

After a number of interactions it has been determined that in order to achieve an IRR of 7%, the maximum length of primary pipe per dwelling would be 0.5m with 1m secondary pipe.

Table 19 Summary of Financial Viability for the North East Sector Cluster

Simple Payback	Capital cost (£)	IRR (%)	NPV[35] (7%discount rate)	NPV) (5% discount rate)	Public contribution for IRR 7%	CO_2 savings[36] (tonnes)
12	£4,864,818	7.04%	£16,309	£1,056,929	-	1,476(28% reduction)

The figure below shows the public contribution required for higher levels of IRR.

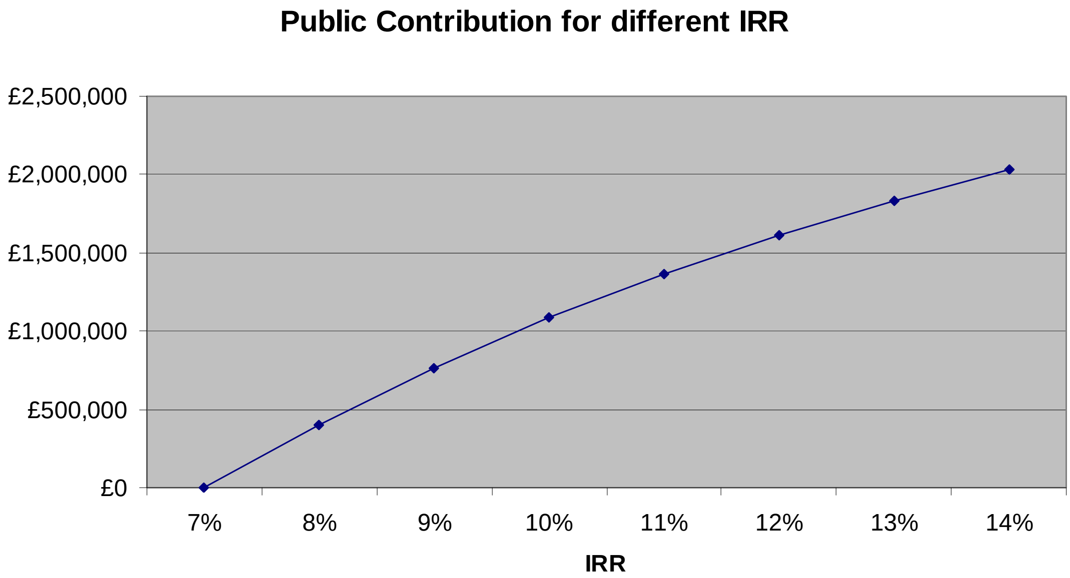


Figure 47: Financial Contributions Required to Achieve Different Target IRR

6.8. Sensitivity Analysis – IRR vs. Energy Cost Increase

6.8.1. IRR Variation with Energy Cost Increase

The financial evaluation of network clusters in the previous section has been based on the assumption of energy cost increasing at 1% above inflation. According to current energy cost predictions, this is a conservative assumption which therefore represents a worst case scenario from a financial viability perspective. The graph below shows the results of a sensitivity exercise undertaken for the Town Centre Cluster (incorporating all the phases). The IRR is proportional to the energy cost and therefore, the benefits of installing a CHP would be significantly improved with higher inflation of primary energy costs. The same principle will apply to the other clusters.

[35] Over 20 years
[36] Against business as usual

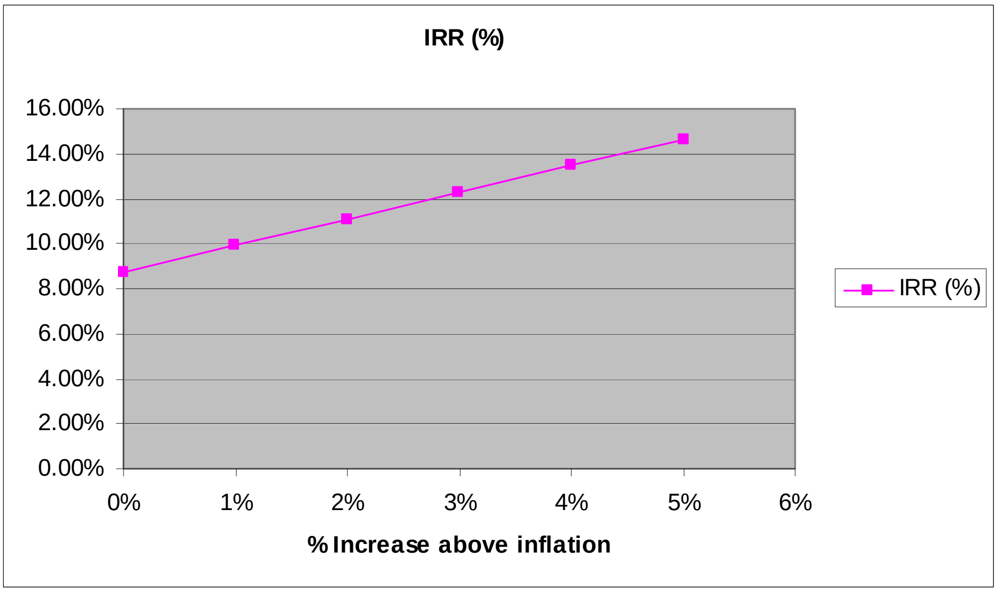


Figure 48: IRR (%) Variation for Energy Cost Increase above Inflation (Gas and Grid

7.0 DELIVERING DISTRICT HEATING

7.1. Introduction

Whilst the viability of a number of district heating network opportunities has been investigated as part of this study, two pilot schemes have been identified that would allow the Council to set up the mechanisms for delivering and operating decentralised energy schemes in the Borough. These are:

- Town Centre Pilot Scheme - based around developing a heat network that connects to Central Sussex College, the Library and to other private sector buildings including the Arora Hotel and County Mall

- K2 Leisure Centre Pilot Scheme – based around developing a heat network that connects K2 leisure centre to Desmond Anderson School and Thomas Bennett Community College

These schemes provide different opportunities and challenges to the Council as detailed below:

Network Scheme	Opportunities	Key challenges
Town Centre Pilot Scheme	Provides a small scale pilot scheme that provides the Council with the opportunity to develop a suitable ESCO structure for delivering a strategic heat network within the Town Centre. Provides the catalyst for development of a strategic heat network that links existing and new development across the Town Centre Requires involvement and buy-in of the public and private sector, helping to develop the delivery structures including billing structures and potential for private sector capital contributions.	Identifying suitable locations for the energy centre. Getting buy-in from private sector building owners to connect Identifying a suitable ESCO structure for delivery of the network Funding availability

Network Scheme	Opportunities	Key challenges
K2 Leisure Centre Pilot Scheme	All buildings are under public ownership – little financial or operational risk Freedom Leisure are currently considering opportunities for installing an additional CHP at the K2 leisure centre. Potential to procure the heat network / additional CHP located in the leisure centre through Freedom Leisure (not for profit trust)	Desmond Anderson School and Thomas Bennett Community College are both operated by BAM (formally HBG) under a PFI framework (not due to expire until 2025) – would require contractual agreement with BAM Funding availability

The following sections discuss the approaches to delivering heat networks in Crawley with particular focus on considerations and options for the two identified pilot heat network schemes. The key areas covered include:

- What are the key difficulties in delivering heat networks
- The role of planning in developing robust planning policy that encourages connection to or development of heat networks in new development.
- Options for procuring heat networks including different arrangements for Energy Services Companies (ESCOs).
- Potential sources of funding and financial incentives for district heating.
- Roles and responsibilities for delivering heat networks.

To provide context, a number of examples of heat networks that have been delivered in the UK have been included in section 7.13.

7.2. Difficulties in Delivery Heat Networks

In the UK the image of district heating has suffered from the legacy of the 1960's and 70's when poor quality systems were installed on large new housing estates and mixed use developments. The district heating industry has now matured and the technology has advanced significantly off the back of the experience and investment in mainland Europe. There are however a number of difficulties that can impede the development of district heat networks and which need consideration from an early stage to ensure project success. The difficulties can be broken down into three broad categories as detailed in Table 20.

Table 20: Summary of Difficulties in Setting up District Heating (Source: HCA – Low Carbon Community Event, Dec 2009)

Institutional Difficulties	Financial Difficulties	Technical Difficulties
Most Difficult to Tackle	**Difficult to Tackle**	**Easiest to Tackle**
Moving target as policies change – leading to no strategic policy Perception of the public funding district heating Funding rules and liabilities – the need to investigate and mitigate risks and balance Achieving a balance between the level of risk you are happy with versus the level of control you wish to retain	Large upfront costs Investigating different funding/structure options Medium to long term paybacks – not the traditional route for private sector (or public sector) Legal issues and liabilities Procurement process – can be costly and time consuming Grant availability	Knowledge gap (Local Authority) Best practice Requirement for due diligence Lack of knowledge of the energy market

The following sections discuss the implications of each of the above key points on delivering heat networks within Crawley.

7.3. The Role of Planning

7.4. Planning Policy Framework (New development)

A suite of planning policies is recommended to assist in delivering heat networks. In identifying and appraising policy options we have started from the basis that meeting the challenges of climate change and increasing low and zero carbon energy capacity cannot and should not be delivered through planning alone. Understanding the role of planning as part of a wider set of national, regional and local delivery mechanisms is crucial. That said, planning is unique in being the only activity that is able to build up a comprehensive spatial understanding of the opportunities and constraints for decentralised renewable and low carbon energy including district heating.

Using the outputs from the heat mapping and low and zero carbon energy opportunities assessment, recommended policy wording has been developed (see Appendix D). The policy is based broadly around the energy hierarchy as adopted within the London Plan[37] and sets out requirements for new development to consider reducing energy consumption and carbon emissions through:

1. Energy Efficiency
2. Decentralised Energy Networks
3. Renewable and low carbon energy

The suggested planning policy wording should be developed and included in a Development Plan Document (DPD) as required by the draft consultation PPS

[37] http://www.london.gov.uk/thelondonplan/

‘Planning for a Low Carbon Future’. The key principles of the proposed planning policy are:

- It aligns itself to the policies detailed in the draft consultation PPS ‘Planning for a Low Carbon Future’ (see section 4.04.3)
- Given that targets for carbon reduction in new development which are being driven through Building Regulations Part L will become increasingly demanding, no authority wide targets above those required for building regulations have been proposed. This policy is supported by the latest Planning Policy Statement on Climate Change (see section 4.04.3)
- The policy focuses on maximizing development of district energy networks including heating and cooling.
- The policy aligns itself with national policy on allowable solutions (see section 4.0 for a definition) in support of the zero carbon homes and buildings policy.
- The policy refers to the evidence base for renewable and low carbon energy within the borough including opportunities for wind, biofuel supply, biogas, hydro energy and district heating.

To encourage the delivery of district heating networks, the policy should refer to heat network opportunity areas through reference to the ‘District Heating and Cooling Priority Areas’ plan (See Appendix D). This map identifies broad areas where district heating networks could be viable as a result of the work undertaken as part of this study, in addition to areas of proposed new development where there are potential opportunities for district heating. The plan provides a focal point for heat network development. Greater focus should be placed on requiring new development in these areas to connect to, or develop district heating networks. The draft planning policy wording in Appendix D (proposed Policy C) recommends that the ‘District Heating and Cooling Priority Area plan’ is referenced within any future planning policy, with the map sitting within an SPD that would allow the Council to periodically update the plan in-line with any newly identified network opportunity areas or newly installed networks.

It is recommended that the plan is reviewed every two years and updated where new opportunities have been identified (e.g. new development has been proposed that could link into district heating/cooling networks or where district heating/cooling networks have been installed). Where major new development is proposed (as defined within the proposed planning policy wording), the Council would require developers to assess the feasibility/viability of district heating including consideration of future potential for expansion into surrounding communities (both new and existing). This provides a good evidence base which would feed into any future updates of the plan, reducing the requirement for the Council to commission or undertake their own feasibility/viability assessments.

7.5. Carbon Offset Fund – an Approach

The policy recommendations also introduce the concept of a ‘Carbon Offset Fund’ which would allow new developments to balance the additional carbon emissions that their use will produce by making a ‘carbon buy-out’ (or local carbon offset) payment into a fund for investment in low and zero carbon infrastructure within the Borough.

7.5.1. Policy Context

National policy dictates that new development must meet the prevailing building regulation requirements to reduce on-site CO_2 emissions that its use will generate. However, the development may not be able to meet the emissions targets 'on' or 'near' site' after – the balance termed 'residual' emissions.

From 2016 (or 2019 for non-domestic buildings) new development is expected to be made 'zero carbon' with a requirement on developers to address residual emissions through one or more 'Allowable Solutions' (as detailed within 'Definition of Zero Carbon Homes and Non-Domestic Buildings: Consultation' (DCLG, 2008) – see section 3.7.3.).

7.5.2. Planning Policy Requirements

Payment into the low carbon infrastructure fund would be applicable only where developers can demonstrate that they cannot meet these emissions targets on site. This could be particularly relevant for development in 'energy constrained' areas that do not have significant opportunity for renewable energy.

The fund contribution would be equal to: the 'residual emissions' of the development, multiplied by a nominal asset lifetime (30 years is sensible), and by the carbon 'buy-out' price for Crawley (see below).

Possible mechanisms for a low carbon infrastructure fund
The following are a set of potential mechanisms that could be used to create a low carbon infrastructure fund into which developers would be required to contribute:

Section 106 Planning Obligations – rather than setting up a fund, section 106 agreements could be used on a development by development basis (or possibly as part of a framework agreement) to require payment towards low carbon infrastructure linked to the development. Developers' contributions, towards the low carbon infrastructure component of such S106 agreements, are set equal to the lifetime residual emissions from their development, multiplied by the Crawley buy-out price;
Community Infrastructure Levy – payment of a community infrastructure levy by the developer (at a level equal to the lifetime residual emissions from the development, multiplied by the Crawley buy-out price) the spending from which is prioritised for low carbon infrastructure;
Buy-out fund – a Crawley Borough Council (or third party) administered fund is set up specifically for the purpose of investing in low carbon infrastructure in the Crawley area. Developers are required to pay into the fund an amount equal to the lifetime residual emissions from their development, multiplied by the Crawley buy-out price.

7.5.3. Setting the Carbon 'Buy-Out' Price

The 'buy-out' price that developers would be required to contribute against each tonne of residual emissions could be set either: on the basis of the cost to the authority to make an equivalent carbon reduction in the Crawley area; or with reference to a national or international carbon price. Potential benchmarks for setting a carbon 'buy-out' price include:

- Investment cost to make alternative carbon savings through low carbon infrastructure in the Crawley area:
- Commercial scale onshore wind development (c. £75 - £105 /tCO_2);
- Solar PV panels (c. £150 - £280 /tCO_2);
- Solid wall insulation in existing homes (c. £75 - £190 /tCO_2);
- Town centre district heating network phase 1 (c. £100 /tCO_2);
- Town centre district heating network phase 1&2 (c. £230 /tCO_2);
- K2 Leisure Centre district heating network phase 1&2 (c. £115 /tCO_2)

National or international carbon price:

- UK Government's Shadow Price of Carbon (c. £27 - £38 /tCO_2);
- EU ETS price (variable with market conditions; historically c. €10-25 /tCO_2);
- UK Government's prospective market price of carbon (£16/tCO_2 from 2013/14 rising to £30/tCO_2 by 2020);
- The Renewable Obligation Certificate (ROC) price (c. £100 /tCO_2);
- The ROC for emerging renewable technologies (c. £200/tCO_2).

In all cases the price given is per tonne of CO_2 saved over the life of a project (i.e. not £ per tonne CO_2 saved per year). The residual emissions against which the buyout price is paid should be the lifetime residual emissions of the development (calculated by multiplying asset life by residual emissions per year).

7.5.4. Management and Enforcement

Control of the fund could be through a Council ESCO or energy agency which could use the funds to invest in identified energy infrastructure projects (e.g. the Town Centre Heat Network), to support energy efficiency improvements in existing and social housing across Crawley, and/or to develop renewable energy installations on Council owned land.

Enforcement could be through planning, with technical support provided by Building Control – who are required to review and sign off evidence showing compliance with Building Regulation Part L. As proposed under planning policy 'A', developers would be required to produce an energy assessment prior to planning, setting out how the development will meet proposed targets. Where the developer can demonstrate that the Building Regulations emissions targets cannot be met on site, the Energy Statement would set out the annual residual emissions (in tonnes CO_2), against which the buy-out price would be applied.

7.5.5. Integration with a Future Central Government Allowable Solutions Framework

Detail of future Government policy on zero carbon buildings and allowable solutions is currently unclear. Recent announcements suggest that a 'zero carbon homes and non-domestic buildings' regulation is likely to be implemented and that the policy will benchmark the cost to developers of allowable solutions against the Government's market price of carbon (expected to be: £16/tCO_2 from 2013/14 rising to £30/tCO_2 by 2020).

It is unclear at this stage what level of autonomy the government will allow local authorities in future in setting their own policy in this area: it is possible central government will cap the cost which allowable solutions funds will be able to place upon developers. In either case Crawley Borough Council should be able to develop its own solution in this area now, and adapt to future central government policy as or when this is necessary.

7.5.6. Carbon buyout fund – Case studies

Milton Keynes Council 'Carbon Offset Fund'

Milton Keynes Council (through their planning policy D4) has adopted a 'carbon offset fund'. Developers are required to make a one off contribution, based on the in use carbon emissions to be generated by the development, by means of a section 106 agreement or unilateral undertaking. The fund is managed by a third party energy agency on behalf of the Council, and is used to reduce carbon emissions by cutting energy use or producing renewable energy elsewhere in Milton Keynes.

Waveney District Council 'Carbon Buy-Out Fund'

Waveney District Council (Suffolk) has adopted in its 'Policy DM05 Carbon Emissions and Carbon Compliance' a requirement on new developments to achieve a 15% reduction in residual emissions after building regulations. Where this is not achieved through onsite measures a development is required to pay into a carbon buyout fund at £100 per tonne of residual CO_2 expected to be emitted over 30 years. The fund is to be implemented through section 106 agreements and/or the Community Infrastructure Levy.

7.6. Influencing Connection to District Heating/Cooling Networks in Existing Buildings

Planning has limited influence over the behaviour and use of existing buildings. The Council can however support the connection of existing buildings to district heating/cooling networks through guidance (see Section 7.7) and Building Regulations enforcement. Building Regulations Part L1B and Part L2B (Conservation of fuel and power) that apply to existing domestic and non domestic buildings includes the requirement for 'Consequential Improvements' where:

- A building is extended (where the existing building has a floor area of greater than 1000m^2)
- There is the initial provision of fixed building services (e.g. heating/cooling systems)
- There is an increase in the installed capacity of any fixed building services (e.g. heating and cooling systems)

Consequential improvements require that functionally and economically feasible improvements are made to the existing building to improve its energy efficiency. Whilst this could include upgrading the thermal performance of the building (e.g. adding insulation), guidance could be provided to building owners on the potential advantages and opportunities of connecting to district heating networks to encourage opportunities for connection. This could be in the form of a guide on 'District Heat Networks in Crawley' (see 'short term measures' in section 7.7)

7.7. Interim Planning Measures to Assist Delivery of District Heating

Whilst the planning policy recommendations in the previous section provide a framework for new development to deliver energy efficiency and low/zero carbon energy, it is unlikely that any Development Plan Documents (including the Core Strategy) will be adopted before 2014. Consideration should be given to interim measures that could help to assist new development to consider and integrate low carbon energy measures including district heating. The proposals are split between short measures that provide guidance before adoption of Development Plan Documents and/or Supplementary Planning Documents, and medium term measures that would provide planning guidance prior through Supplementary Planning Documents.

Short Term Measures

There is a need to provide guidance to new development proposals to ensure that they are designed to maximise the opportunities for and connection to heat networks. Prior to the adoption of planning policy, the Council should develop a guide on 'District Heat Networks in Crawley' that could be issued to developers at the pre-application stage: The guide would:

- Identify opportunity areas for district heating including incorporation of the District Heating / Cooling Priority Area plan.
- Set out the Council's aspirations and proposals for developing heat networks within Crawley including the development of a Council led ESCO
- Set out the key benefits of district heating (new and existing buildings)
- Identify opportunities for existing buildings to meet 'Consequential Improvement' requirements through the connection to district heating/cooling networks, as required by Building Regulations Part L1B/2B.
- Provides links to technical guidance on how to design building heating and cooling systems to connect to energy networks. Reference should be made to technical guidance including The International Energy Agency District Heating and Cooling Connection Handbook, May 1999.

The guide should make specific reference to adopted supplementary planning documents that enforce the requirement to consider decentralised energy schemes including heat networks. This includes the Crawley Town Centre North Development Principles – Revised Supplementary Planning Document (Jan 2009) that sets out the requirement for developers, alongside the Borough Council, to evaluate the feasibility of district heating systems (as detailed in section 4.5)

Medium Term Measures:

Crawley Borough Council should consider the development of Supplementary Planning Documents that provide guidance on local planning matters. Supplementary Planning Documents are not required to have a specific link to or 'hang off' a Development Plan Document policy, although they must be consistent with national planning policy and relevant regional plans[38] (e.g. PPS 1

[38] www.pas.gov.uk

supplement or draft consultation 'Planning for a Low Carbon Future in a Changing Climate')

Supplementary Planning Documents could be either area based (e.g. development briefs that refer to a specific parcel of land) or topic based (provide additional information on a specific local issue such as a design guide). Options available to the Council include:

Development Brief

This would provide additional guidance for a specific geographical area or site. The development brief could contain reference to the evolving planning policy relating to district heating networks and provide guidance on the type and location of any energy infrastructure including energy centres. Reference should be made to Planning Policy Statement 'Planning for a Low Carbon Future in a Changing Climate - Consultation, March 2010, with particular reference to policy LCF7 which states that "Where there are existing, or firm proposals for, decentralised energy supply systems with capacity to supply new development, local planning authorities can expect proposed development to connect to an identified system, or be designed to be able to connect in future'. The brief should also state how the Local Authority are considering opportunities for district heating and refer to specific opportunities identified through this study.

Issue Based Document / Design Guide

This document would provide additional information on a specific theme including guidance on developing heat networks. This may include a revision to the existing SPG14 (Sustainable Design). As with the development brief, the document could contain reference to evolving planning policy relating to district heating along with details of specific opportunities identified as part of this study.

To ensure that proposed development is designed to accommodate future connection to district heating networks, reference should be made to comprehensive guidance documents on district heating (e.g. International Energy Agency District Heating and Cooling Connection Handbook, May 1999)

Whilst developing Development Plan Documents and Supplementary Planning Documents play an important role on ensuring that future development consider district heating as part of their design strategies, a proactive role by the Local Authority in identifying and leading on decentralised energy systems will undoubtedly improve the likelihood of district heating networks being developed within the Borough. This approach allows us to take advantage of the distinct merits of the planning system in promoting decentralised renewable and low carbon energy without unnecessarily stretching its remit where other regulatory or support regimes may be better placed to take a lead (e.g. Building Regulations). Importantly, the focus on delivery mechanisms also allows us to address the difficult issue of developer viability by potentially shifting much of the additional cost burden away from developers and onto third parties (e.g. a Council led ESCO).

An additional benefit of an SPD would be to remove any specific details from the Development Plan Document that are likely to require updates to reflect changes to development and infrastructure within the Borough of Crawley. This would include the following:

- District Heating / Cooling Priority Area plans: As new development comes forward and district heating schemes are developed, there will be a requirement to update this map to add additional priority areas.

- Wind, biomass, biogas and hydro opportunity and constraints plans: As Crawley evolves, opportunities and constraints for renewable and low carbon energy may also change (e.g. relaxation of the 5km buffer around airports for commercial scale wind turbines)

The following provide links to good practice SPDs and energy assessment guidance developed by other Local Authorities:

Southwark Sustainable Design and Construction SPD:

http://www.southwark.gov.uk/info/200151/supplementary_planning_documents_and_guidance/1254/sustainable_design_and_construction_spd/1

GLA Guidance on Planning Energy Assessments

http://www.london.gov.uk/publication/guidance-planning-energy-assessments

7.8. Procurement Options

Whilst the assessment of the technical and financial viability of a district heating network can be relatively straightforward, the decision as to who ultimately delivers the project in terms of its design, construction, operation and management can be complicated. This section explains the options available in terms of Energy Services Companies (ESCOs) including public and private sector delivery. Reference has been made to the report 'Low Carbon Energy Infrastructure: Crawley's Level of Involvement (ECSC, July 2008) which details the different levels of involvement that the Local Authority could take in establishing heat networks in Crawley.

7.8.1. Energy Services Companies (ESCOs) - Definition

Whilst the term Energy Services Companies (ESCOs) is used extensively in association with delivery of District Heating Networks, in practice, there is no set definition of an ESCO. Typically an ESCO is a commercial business providing a broad range of energy solutions that can include design and implementation of energy savings projects, energy conservation, energy infrastructure outsourcing, power generation and energy supply, and risk management. The document 'Making ESCOs Work: Guidance and Advice'[39] details five different groupings (see Table 21).

[39] Making ESCOs Work: Guidance and Advice, London Energy Partnership, February 2007

Table 21: Forms of Energy Services Companies

ESCO Type	Risk	Control
Wholly public sector	Retention of risk ↑	Greater control ↑
Public sector driven with private sector design and build		
Public sector but procured and operated by private sector		
Public or private sector and operated on Energy Performance Contracting (EPC) principles		
Private sector driven – contract energy management	↓ Transfer of risk	↓ Less control

The key factors that usually decide which ESCO approach to adopt in delivering a heat network scheme come down to the Local Authority's attitude to risk, availability of capital, and the level of control that they wish to maintain over the delivery of energy services in the future. The 'hands-off' option is that the scheme is entirely developed by a third party developer or ESCO, and the public sector provides support to this commercial organisation. The other more 'hands-on' option is that the public sector (most likely the Local Authority) becomes the ESCO itself, and develops and operates the scheme, selling heat and power. Table 22 illustrates the key advantages and disadvantages of Private Sector and Public Sector led ESCO models.

Table 22: ESCO Models – Advantages and Disadvantages

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

A more common option is where the Local Authority forms a partner in a joint venture for developing heat network schemes, becoming a partner in an arm's length company which owns and operates the schemes. The advantages of this are that the Local Authority maintains a degree of ownership and control over the scheme, and private sector finance and expertise can be leveraged. One example of this is the Aberdeen CHP scheme which was set up initially to deliver heat and power to high rise blocks of flats containing a mix of social and private housing – see Section 7.13 which provides a number of examples of district heating schemes in the UK including details of the ESCO approaches.

7.8.2. Why Should Crawley Establish an ESCO?

The benefits of CBC establishing an ESCO with public sector involvement (either in part or fully) are numerous. The report 'Low Carbon Energy Infrastructure: Crawley's Level of Involvement (ECSC, July 2008) sets out the principal benefits. The primary purpose would be to provide a delivery mechanism through which the Council can progress its policies and corporate plan objectives including carbon emissions reduction within the Borough, with particular focus on delivering decentralised energy supplies including district heating. The other benefits include:

- Providing a dedicated entity with the primary purpose of delivery of the Council's climate change and low carbon energy infrastructure objectives
- Providing an entity that can operate with a focus that is not available to existing council services.
- Creating a commercial environment outside the Council's existing services that may generate new revenue streams.
- The creation of an ESCO provides an additional level of flexibility to the Council for directing financial investment into its climate change objectives. This could include contributions from S106, the Climate Change Levy or 'Allowable Solutions'.

As discussed in section 7.8.1, the Council will need to determine which is the most suitable ESCO structure for delivering district heating networks within the Borough. The key factors that need to be considered include:

- The capital cost of developing district heating schemes
- The availability of funding
- The attitude of the council to risk
- The purpose of the ESCO – i.e. will it be setup to deliver and operate a single heat network scheme, or will it cover a broader set of objectives (e.g. role out of energy efficiency measures)
- The commitment of the Council to put money and resource into developing and running the ESCO
- The level of knowledge and experience within the Council

7.9. Roles and Responsibilities

A strong political commitment and leadership from the Local Authority is essential in successfully delivering district heating networks. Political commitment should form the starting point for action at a number of levels[40]:

<u>Corporate:</u> Establishing a corporate commitment to carbon reduction across the council's building stock, housing and property investments. This should include

[40] Community Energy: Urban planning for a low carbon future, TCPA & CHPA 2008

performance targets, policies for engagement with private sector partners and wider strategic projects to develop supply chains.

Planning: Highlighting the need for a strong planning framework at a district level to secure carbon reductions from development and associated energy infrastructure. County Councils and regeneration agencies e.g. HCA have an important role to play including the provision of guidance.

Community: Engaging with stakeholders to increase acceptance of the need for action, generate projects and embed climate change action in Sustainable Community Strategies. Counties and city-regional groupings have the potential to bring together partnerships to take forward strategic projects.

Delivering the proposed CBC ESCO will require the Council, along with other stakeholders, to commit a range of people to the project to ensure successful delivery. Key is the development of a Working Group that comprises key individuals from the Local Authority and external partners including developers, building owners and ESCOs/utilities companies as illustrated in Figure 49.

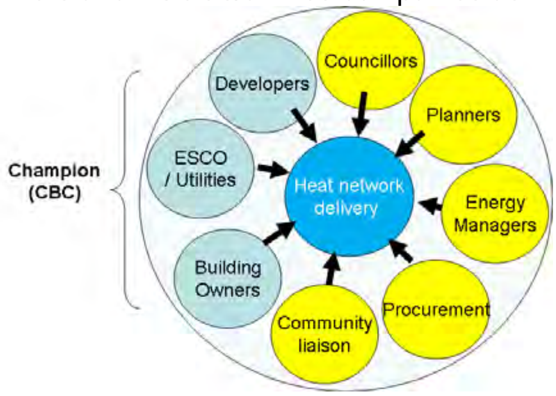


Figure 49: District Heating Working Group - Key Individuals / Groups

The working group should be headed by a Champion who helps create and own the vision for the project and provides the Local Authority with the support through its development. The key roles of other Local Authority members are:

- Councillors – Provide community leadership, lead for energy and environment or member of planning committee

- Planners – Develop planning framework for district heating and liaison with developers

- Energy managers – Make business case for district heating, collating heat load data and take responsibility for the operations and maintenance of the systems once installed

- Procurement – Identify appropriate contract frameworks to recognise the agreed level of risk between partners (e.g. public/private sector). Liaison with legal consultants in drawing up contracts

- Community liaison – Engage with residents and businesses around issues such as siting of energy centres, benefits (PR) and management of disruption (e.g. digging up roads)

The setting up of a Working Group and identification of the project champion should be undertaken at the start of the project.

7.10. Recommended Approach for Town Centre Pilot Scheme

7.10.1. Town Centre - Forming an ESCO

The report 'Low Carbon Energy Infrastructure: Crawley's Level of Involvement (ECSC, July 2008) sets out a number of ESCO options for delivering heat networks within Crawley, with particular focus on options for a heat network linked to the Town Centre North redevelopment. The options were evaluated by assessing the costs, benefits, risks and rewards of each option.

The recommended delivery option for the Town Centre is for the Council to take a partner role in an ESCO. The Council would set up a subsidiary company (ESCO) that is wholly or partly owned by the Council with the objective of delivering heat networks, initially within the Town Centre.

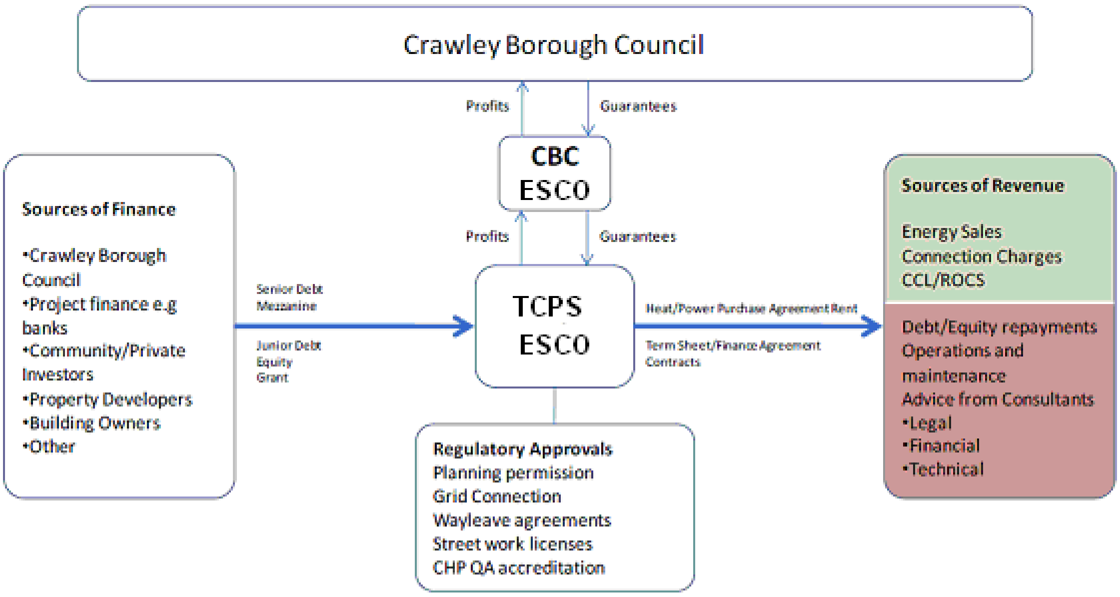


Figure 50: Proposed ESCO Structure (Source: Low Carbon Energy Infrastructure: Crawley's Level of Involvement (ECSC, July 2008))

The Council would create a subsidiary company ('CBC ESCO') which would have a financial stake in project specific companies that would deliver specific schemes e.g. the Town Centre pilot scheme ('TCPS ESCO'). The TCPS company would draw in sources of finance from a variety of partners (in the way that any private sector company can) with a view to these sources of finance funding the capital costs of energy infrastructure detailed. The CBC/TCPS ESCO company would generate revenues from conventional heat and power sales, connection charges and also the "green" premiums on conventional heat and power sales including the Climate Change Levy (CCL).

The Council would take a lead role in the project in order to manage the project including negotiating legal and financial obstacles. The approach would use CBCs Well-Being Power which helps local Authorities to exercise their role as strategic leaders in their communities. The extent to which CBC can use this power and level of involvement in an ESCO depends on the style of financial contribution. As a partner, CBC could take ownership of the heat network, and energy centre, and charge connection fees and a heat/power tariff for buildings that connect to the network. The nearest example is Woking Borough Council's Thameswey joint venture which was set up to deliver large scale district heating (see Section 7.13 for further details)

Whilst the CBC ESCO could deliver the Town Centre Pilot Scheme through the TCPS ESCO company, it could also be used to deliver a number of other specific projects which are delivered through separate companies (Heat networks associated with new development e.g. North East Sector)

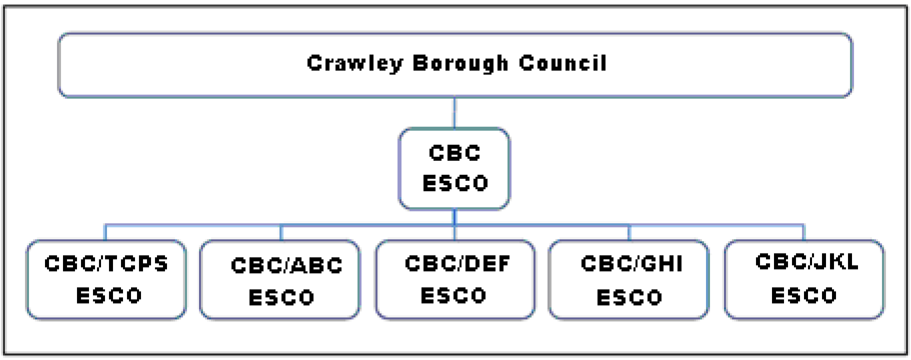


Figure51: Delivery Structure of Project Specific ESCOs

7.10.2. Town Centre - Key Next Steps

The following sets out the key steps that should be taken by CBC to develop a Council owned ESCO and develop the Town Centre Pilot Scheme. The steps are broken down into three distinct stages:

1. Detailed feasibility stage
2. ESCO set up and delivery partner procurement stage
3. Implementation stage

The following tables detail the key tasks that should be undertaken at each stage, the approach/outcome and the resource required to deliver each task. A pathway for setting up the CBC ESCO has previously been suggested within the report Low Carbon Energy Infrastructure: Crawley's Level of Involvement (ECSC, July 2008). This has been used as the basis for identifying the key tasks for the ESCO setup stage. Table 20 provides details of an indicative programme for each task.

Please note that recommended third party resource outside of the Council has been highlighted in red.

Detailed Feasibility Stage

Ref.	Task	Approach	Outcome	Resource
1.1	Set up Heat Network Working Group	The Council should set up a working group (the CBC Heat Network Working Group' with named members who represent key departments and groups within the Council (e.g. planning, councillors etc – as detailed in Section 7.9). The group should meet regularly (at least every 2 months) to review the status of the project and agree next steps.	CBC Heat Network Working Group setup	Representatives from each department / group within the Council

Ref.	Task	Approach	Outcome	Resource
1.2	Identify 'Champion'	The Council should identify a 'Champion' to head up the Heat Network Working Group and who helps create and own the vision for the project and provides the Local Authority with the support through its development.	Champion identified	CBC Heat Network Working Group
1.3	Council to learn from other local authority ESCOs	The CBC working Group should visit other UK based ESCOs. This would be particularly useful for securing officer and member "buy in" and provide comfort that other local authorities have successfully managed to deal with low carbon energy infrastructure issues. Examples include; Kirkleees, Aberdeen, Southampton, Southwark, Woking	Other case study and anecdotal advice provide to the Council	CBC Heat Network Working Group
1.4	Develop a high level brief setting out the key steps to setting up an ESCO and implementing the Town Centre Pilot Scheme	The brief should contain details of the key steps to be taken at each stage (detailed feasibility, ESCO setup stage and delivery partner procurement and Town Centre Pilot Scheme implementation stage). The brief will include the key objectives of the ESCO, timescales, roles and responsibilities from within and external to the Council and an overview of the proposed Pilot Schemes (Town Centre Pilot and K2 Leisure Centre) and expansion of the networks to supply future development (e.g. Town Centre North redevelopment)	High level brief	CBC Heat Network Working Group
1.5	Engage with building owners who could connect to the pilot scheme and future network(s)	Initiate meetings with building owners who could connect to the Town Centre Pilot Scheme and other stakeholders who could potentially connect to future networks (e.g. Land Securities / Grosvenor). This may include buildings that were not included as part of the viability assessments undertaken as part of this study. The meetings would explain the CBC approach to heat networks in the Town Centre, the benefits of connecting to the heat network, the proposed ESCO approach and identify any constraints / risks that the building owners might foresee to connect.	Sell the idea of a heat network to potential building owners that could connect and identify any key risks	Planning Technical consultant

Ref.	Task	Approach	Outcome	Resource
1.6	Soft market test Town Centre pilot scheme with potential delivery partners	The Town Centre pilot scheme should be designed, delivered and operated by a 3rd party delivery partner. Examples of organisations who could provide this service include: CES (www.cesenergy.ie) Dalkia (www.dalkia.co.uk) Mitie (www.mitie.com) Clear Power (www.clearpower.ie) Vital Energi (www.vitalenergi.co.uk) Prior to commencing a formal tender process with potential delivery partners, the Council should undertake soft market testing with 2-3 organisations. The Council should employ a technical consultant to oversee this process. The key objectives of the testing will be to present the high level brief and to gauge the appetite for providers to partner with the Council within a Council led ESCO. At this stage, the Council should discuss the level of equity investment that the partner would be willing to invest based on a design, build, operate basis.	Test appetite for 3rd party delivery partners to partner with the Council to design, install and operate a Town Centre Heat Network.	CBC Heat Network Working Group Technical consultant
1.7	Detailed technical and financial feasibility study for the Pilot Scheme	Undertake a detailed technical and financial feasibility study for the Pilot Scheme and any future phasing. The study would include: ▪ Site surveys of potential buildings including collation of detailed heat load information, heating systems installed in existing buildings, locations of plant room for connection. ▪ Survey and design of utilities connections ▪ Identify different options for phasing the networks including detailed assessment of costs and viability ▪ Review the options with potential delivery partners to gauge feedback	Detailed feasibility study based on building survey data to identify network options for the pilot study and future phases	CBC Heat Network Working Group Technical consultant
1.8	Develop detailed business plan for Town Centre Network	Develop a detailed business plan that sets out the scheme description, budget projection and costs and an action plan to take the scheme forward. The plan should include identification of the proposed ESCO approach (see ESCO structure stage). The business plan should be presented and signed off prior to implementation	Detailed business plan for sign off by Council	CBC Heat Network Working Group Technical consultant

Indicative third party costs for technical consultancy during the detailed feasibility stage are £25,000 to £50,000

ESCO Setup and Delivery Partner Procurement Stage

Ref.	Task	Approach	Outcome	Resource
2.1	Determine role of CBC in delivering networks	Level of involvement on the following activities that the ESCO can carry out is based on a preliminary assessment of the Councils existing level of expertise. Key skills that are required include: • Design, construction and operation of the infrastructure (CBC led through 3rd party partner) • Financing and finance raising (CBC led) • Ownership of energy infrastructure (CBC led) • Operation/Management of energy infrastructure (CBC led through 3rd party partner)	Appropriate level of involvement for CBC	CBC Heat Network Working Group
2.2	Determine level of equity investment in the capital costs of the TCPS heat network	Depending on the Council's attitude to risk and reward the level of this equity investment can range from 0% to 100%. Typically the level of this equity investment is driven by the market i.e. how much debt can the project bear. As an example if the market (i.e. project finance banks or CBC prudential borrowing) will allow the ESCO to borrow 70% of the capital costs of the project (i.e. 70% of £1.666m = £1.166m). This means that the TCPS project requires an upfront investment of £0.5m. The CBC ESCO can invest 0-100% of this amount. If the ESCO chooses to invest 30% (i.e. £150k) the remainder of this equity could be provided by an equipment supplier or other partner e.g. the operators of the Arora Hotel. It is likely that the £150k would be "borrowed" or obtained from the Council. As an example the Council would treat this as an equity investment and would seek an annual return on this investment. The Council could also treat this investment as a loan or grant if it chooses to. Advice should be sought from legal consultants to assess the level of equity input that the Council can contribute.	CBC determine amount and style of its financial investment in the ESCO	CBC procurement Economic Development Legal Consultant
2.3	Apply for grant funding	Liaison with potential sources of grant funding. The Carbon Trust could be party to these discussions given recent experience on similar projects.	Grant funding	CBC Heat Network Working Group + Delivery partner Carbon Trust

Ref.	Task	Approach	Outcome	Resource
2.4	Determine how revenues and "profits" are to be realised and used/invested	The financial model will detail the predicted running costs of the ESCO and will allow the Council to see what its annual return on investment and an indication of the likely profits. The Council then needs to decide what the profits (which are likely to be minimal in the early years) should be used for, examples include; • re invest into the ESCO for use on other projects within the Borough which require low carbon energy • Offer item specific projects e.g. free boiler replacements and insulation to elderly residents in the Borough to alleviate fuel poverty • Replace/refurbish Council's existing energy infrastructure e.g. boilers, controls etc to reduce the Council's carbon emissions in line with national indicators (e.g. NI185) infrastructure	Agreement on Councils required rate of return on investment and how profits should be distributed	CBC Heat Network Working Group
2.5	Determine appropriate company structure and levels of ownership	1. Crawley Borough Council (holding company and ultimate parent) 2. CBC ESCO (owned by Crawley Borough Council and has the remit to invest and promote low carbon energy infrastructure within the Borough) 3. CBC TCPS (a specific project delivery company owned by CBC ESCO and other partners e.g. delivery partner, building owners)	Defined company structure	CBC Heat Network Working Group
2.6	Determine who will sit on the board of the CBC ESCO	Public sector led ESCO - CBC representatives only with non executive directors if required The level of representation that the Council has at board level is important in terms of how much the Council can influence and control the agenda and the running of the ESCO	Nominated Board members	Economic Development Planning Procurement
2.7	Determine who will sit on the board of the CBC/TCPS ESCO	This will be determined largely by who the equity investors are and may include; • CBC representative • 3rd party delivery partner(s) • Owners of buildings that will connect to the network (e.g. Operators of the Arora Hotel and County Mall) • Operations and maintenance company representative • Other relevant "experts" as (non executive) Directors • Providers of finance e.g. banks or other providers of finance • Other relevant partners	Nominated Board members	CBC Heat Network Working Group
2.8	Procure 3rd party delivery partner for Town Centre North Pilot Scheme + initial scheme design	Undertake formal tender process for delivery partner (design, build, operate infrastructure). Undertake a two stage process including Pre-qualification questionnaire (PQQ) and Invitation to Tender (ITT). As part of the tender process, delivery partners would be expected to develop initial, costed scheme designs based on the detailed feasibility study and business plan.	Initial scheme designs developed Selection of preferred delivery partner	CBC Heat Network Working Group led by CBC Procurement

Ref.	Task	Approach	Outcome	Resource
2.9	Create CBC ESCO as a separate legal entity from the Council	CBC Legal and/or accounting department (or outsource to private sector) will need to; • draft memorandum and articles of association and file the relevant forms at companies house i.e. http://www.companieshouse.gov.uk/infoAndGuide/companyRegistration.shtml • determine how the ESCO is related to the Council	CBC ESCO company is created (as a subsidiary to CBC)	CBC Procurement Legal Consultant Financial Consultant
2.10	Create CBC / Town Centre Pilot Scheme ESCO (TCPS)	CBC Legal and/or accounting department (or outsource to private sector) will need to; • draft memorandum and articles of association and file the relevant forms at companies house i.e. http://www.companieshouse.gov.uk/infoAndGuide/companyRegistration.shtml • determine how the ESCO is related to the Council • liaise with other parties with a financial interest in the Town Centre Pilot Scheme ESCO (e.g. delivery partner, building owners)	CBC TCPS company is created	CBC Procurement Legal Consultant Financial Consultant
2.11	Implementation plan for the ESCO	From the detailed technical and financial feasibility study, running costs of the ESCO from a legal/financial perspective will have been predicted and also the actual operation and maintenance costs Once projects go “live” these costs need to be managed from a cashflow perspective and any agreements between different ESCO partners need to be adhered to and properly managed.	Implementation Plan followed	CBC Heat Network Working Group
2.12	Sign off on creation of ESCO	Members and the chief executive are likely to be required to sign off on the creation of the ESCO company	CBC ESCO has the necessary political support	Chief Exec Members
2.13	Set a CBC corporate timetable for delivery	In conjunction with relevant aspects of the Corporate Climate Change strategy notably in the following areas under the sustainable energy theme; • property and procurement • planning and building regulations, • legal &IT and democratic services • chief executive/communications/policy/emergency planning • economic development • HR and finance	Timetable for delivery	All relevant departments

Indicative third party costs for legal and financial consultants during the ESCO set up stage are £50,000 to £100,000

Implementation Stage

Ref.	Task	Approach	Outcome	Resource
3.1	Develop implementation plan	Develop programme for design and construction of network, identify specific roles, responsibilities		CBC Heat Network Working Group + Delivery partner
3.2	Develop draft heads of terms between ESCO and Building Owners	CBC Legal and/or accounting department (or outsource to private sector) will need to; • draft heads of terms between ESCO and Building Owners	Draft heads of terms	Procurement Legal Consultant
3.3	Develop detailed scheme design and costings	Delivery partner to develop detailed scheme design including liaison with building owners, utilities, highways etc.	Detailed scheme design	Delivery partner
3.4	Construction	Commence construction / operation of the scheme	Operational scheme	Delivery partner

Table 23: Indicative Programme of Tasks to Deliver the CBC ESCO and Town Centre Pilot Scheme

		2011			2012				2013				2014			
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1.0	**Detailed feasibility stage**															
1.1	Setup Heat Network Working Group															
1.2	Identify 'Champion'															
1.3	Council to learn from other local authority ESCOs															
1.4	Develop a high level brief for the ESCO and Town Centre Pilot Scheme															
1.5	Engage with building owners															
1.6	Soft market test the Town Centre Pilot Scheme with potential delivery partners															
1.7	Undertake a detailed technical and financial feasibility study															
1.8	Develop and finalise a detailed business plan															
2.0	**ESCO set up and Delivery Partner procurement stage**															
2.1	Determine role of CBC in delivering networks															
2.2	CBC to determine level of equity investment in the Town Centre Pilot Scheme															
2.3	Apply for grant funding															
2.4	Determine how revenue and "profits" are to be realised and invested															
2.5	Determine appropriate company structure and levels of ownership															
2.6	Determine who will sit on the board of the CBC ESCO															
2.7	Determine who will sit on the board of the TCPS ESCO															
2.8	Procure 3rd party delivery partner and develop initial scheme design															
2.9	Create CBC ESCO as a separate legal entity															
2.10	Create CBC/Town Centre Pilot Scheme ESCO															
2.11	Implementation plan for ESCO															
2.12	Sign off on creation of ESCO															
2.13	Set a timetable for delivery															
3.0	**Implementation stage**															
3.1	Develop implementation plan															
3.2	Develop draft heads of terms between ESCO and Building Owners															
3.3	Develop detailed scheme design and costings															
3.4	Construction															
4.0	**Monitor and review project**															

7.11. K2 Leisure Centre Pilot Scheme

The K2 Cluster could be delivered through a specific ESCO company in a similar way to that proposed for the Town Centre Pilot Scheme. The key advantage of this cluster is that the buildings are all in public ownership (CBC and West Sussex County Council), reducing the level of risk associated with connecting private sector development. The Council could take a lead role in setting up and financing the network and gas fired CHP engine, but with other partners delivering and operating the scheme (e.g. Freedom Leisure). Consideration would need to be given to the existing contractual arrangements with Thomas Bennett Community College and Desmond Anderson School as they are currently managed by BAM (formally HBG) under a PFI framework.

7.12. Financing Options

The financing of district heating schemes can appear to be one of the key challenges, particularly where a Local Authority cannot provide equity finance. Whilst Local Authorities can hand financial responsibility to the private sector, there are a number of financial incentives including capital loan schemes that can be accessed by public bodies. As for any energy technology, consideration needs to be given to all of the costs and benefits over the full lifetime of the project. For a district heating project, this would mean consideration of:

- Capital costs of the district heating network
- Capital costs of the energy source (CHP or other prime mover) including connection costs
- Capital costs of the energy centre
- Capital costs of the heat interface unit and metering within each building connected to the heat network
- The ongoing costs of operation and maintenance of a system
- The benefits associated with the scheme, including the income generated from selling heat and / or electricity to customers within the network or through the grid, and the money saved in comparison to an alternative way of supplying heat and power
- Other benefits, such as avoided costs of the EU Emissions Trading Scheme (ETS) or Carbon Reduction Commitment (CRC) or income from feed-in tariffs or the renewable heat incentive.

Appendix F provides a summary of the key incentives and capital loans available for district heating networks that are available to the public sector. The table below summarises each incentive / grant and identifies which technologies they would be applicable to.

Table 24: Financial Incentives / Loans / Contributions Applicable to Development of District Heating Infrastructure

	Type	Description	Applies to…
Climate Change Levy (CCL) Exemption:	Financial incentive	Good quality CHP is exempt from the levy on gas supplied and electricity generated	CHP
Renewable Obligation Certificates	Financial incentive	Renewable energy quality for ROCs which have a	Biogas form Anaerobic digestion, Biomass, Hydro electric power,

	Type	Description	Applies to…
(ROCs)		financial value	Wind Power, Landfill gas, Sewage gas
Renewable Heat Incentive (RHI)	Financial incentive	Introduced in March 11 -provides incentives for renewable heat.	Solid biomass, biogas (including CHP)
Feed-in tariff	Financial incentive	Provides incentives for renewable electricity	Anaerobic Digestion
Prudential borrowing	Capital loan	Local Authority debt financing from the Public Sector Works Board. Rates of interest are significantly lower than market rates.	Development of any energy related infrastructure
Developer contribution (through Part L 'Allowable Solutions', CIL or S106)	Developer contribution	Direct contributions towards infrastructure as a result of building regulation compliance contributions, CIL or S106	Development of energy related infrastructure
Jessica funding (Joint European Support for Sustainable Investment in City Areas)	Capital loan	Provide up to 50% of the capital required for a project in the form of equity, loans or guarantees – delivered by Urban Development Funds	Development of any energy related infrastructure

7.13. Example of District Heating Schemes in the UK

There are a number of large CHP and district heating schemes in the UK. Most of these have grown from heating systems supplied by energy from waste incinerators. These have been used to supply cheap base load heat to public buildings and large council housing estates – such as in Sheffield and Nottingham.

In the 1990s and 2000s gas engine and turbine CHP technology have been installed to supply large mixed use developments, with the most notable including Citigen in London (Eon), Southampton (Utilicom), Woking (Thameswey), Aberdeen (Aberdeen Heat and Power) and most recently Milton Keynes (Thameswey). The following provides a case study of the Aberdeen City Council district heat network.

7.13.1. Aberdeen City Council – Community Heating

Overview

In 1999, Aberdeen City Council (ACC) adopted a comprehensive Affordable Warmth Strategy to upgrade a large proportion of their housing stock, the primary objectives for these properties were to achieve affordable warmth for tenants and to reduce CO_2 emissions.

ACC decided to commission and fund an initial feasibility study into multi-storey community heating with combined heat and power (CHP) to determine whether this would be a suitable option for the seven multi-storey blocks of flats in the Seaton area of the city and how such a scheme would best be implemented. There were also seven additional blocks of flats nearby which would enable the scheme to be extended at a later date.

An energy centre was built close to one of the four multi-storey blocks. It houses a 210kWe gas fired reciprocating engine CHP unit and two 700kW (thermal) gas fired boilers for peak load and back-up.

Delivery

One of the recommendations was the creation of a not-for-profit organisation to fulfil the financing requirements for the heating of the multi-storey stock. The most appropriate structure for this company was identified by ACC staff from a number of departments. A legal agreement between ACC and the company Aberdeen Heat and Power Limited (AH&P) was then drawn up. The Board of AH&P consists of ACC representatives, tenant representatives and up to six unpaid independent directors with varied and relevant expertise. The separate company arrangement benefits ACC by facilitating capital investment in the stock, accelerating the refurbishment programme and spreading the capital cost over several years.

Financing

ACC successfully applied to the Government's Community Energy Programme for grant funding. This was available for up to 40% of the capital costs. Due to the annual contribution of ACC, AH&P were successful in securing a favourable rate of interest for a bank loan to cover the remaining 60% of the capital. ACC have also accessed Energy Efficiency Commitment (EEC) money.

7.13.2. Woking Borough Council's Thameswey Joint Venture

Overview

The Council set up an Energy Service Company (ESCO) to capitalise on its intellectual property in small scale community CHP to enable large scale district energy CHP to be implemented, primarily with private finance.

Due to the uncertainty of the legal issues surrounding public/private partnerships the Council received £25,000 from EST in 1998 to explore what was legally possible for local authorities to participate in energy services companies. Following leading counsel's opinion and discussions with the DETR and the DTI, the Council formed its wholly owned ESCO, Thameswey Ltd (TW), structured to comply with the legal advice. The purpose of TW is to enter into public/private joint ventures to deliver its energy and environmental strategies and targets (primarily energy, tackling fuel poverty, waste, water and green transport).

TW has set up an unregulated public/private joint venture Energy Services Company called Thameswey Energy Ltd (TEL) that brings together the local authority with the Danish company ESCO International A/S (wholly owned by Hedeselskabet Miljo og Energi A/S, a Danish green energy company). Its projects are financed with shareholding capital and private finance.

Woking Town Centre Heat Network

Thameswey Energy Ltd (TEL) operates one of the UKs first town centre CHP district energy system, The project comprises 1.46 MWe of CHP, 1.4 MW of heat-fired absorption cooling and 160 m3 of thermal storage distributed over 5 buildings in Woking town centre. Buildings are interconnected with heat and chilled mains and high voltage/low voltage private wire networks. The CHP system achieves a minimum of 130% sustainability in electricity - i.e. having satisfied its own demands, the site exports a minimum of 30% surplus power over the public wires to sheltered housing residents and other local authority buildings.

TEL provides customers with low carbon energy at less cost than their previous brown energy. TEL is able to do this, despite the higher cost of the green energy plant, due to the payback from the plant by the sale of heating, cooling and particularly electricity (where the full benefits of embedded generation are able to be obtained) to the customer. Each project is bespoke with TEL providing a potential customer with a breakdown on how the cost is worked out. A customer's current electricity unit price is normally matched and the energy services costs are assimilated into the heat and chilled water unit prices. The customer's electricity consumption will be reduced since electricity is no longer needed to generate cooling. The energy services prices agreed at the commencement of the long-term contract are indexed linked annually so the customer maintains the benefits of the contract throughout the length of the contract.

7.13.3. Slough Heat and Power

Slough Heat and Power is a multi megawatt power station based on Slough Trading Estate that generates electricity which is distributed to the National Grid providing about 2,500 homes with electricity and directly supplies about 400 commercial and industrial enterprises on the Trading Estate with electricity and heat.

Technology

The principal assets of Slough Heat and Power comprise: a combined heat and power (CHP) plant, with potential generating capacity of 101MW and a current generating capacity of around 80MW, which produces electricity plus heat which is distributed via a steam and water distribution network; around 100km of underground electricity network plus substations; and around 3,000 industrial, commercial and domestic energy customers.

The CHP plant is the UK's largest dedicated biomass energy facility and its main sources of fuel are wood chips, biomass and waste paper, although gas, gas oil and heavy fuel oil can also be used. The site has its own fibre fuel processing plant, which takes delivery of waste paper products and converts these into useable fuel.

Owner and Operator

Slough Heat and Power has been acquired by SSE (Scottish and Southern Energy plc) in January 2008.

The biomass is provided by different local suppliers such as TV Bioenergy .

Environmental Benefits

In addition to the carbon emissions savings resulting fro the use of biomass as fuel, the Slough Heat and Power station has a positive impact in the local economy since the fuel is sourced from local tree surgeons, foresters, contractors, existing short rotation coppice growers and Local Authorities.

Legislation

The conversion of the station from coal to biomass has been propitiated by the Renewables Obligation Order which came in to force in April 2002.

Financial Data

At the time of the acquisition from SSE, the asset was valued in around £50m.

Part of the plant is contracted under the Non Fossil Fuel Obligation and part of it produces over 200GWh of output qualifying for Renewable Obligation Certificates (ROCs), which is equivalent to around 90MW of wind generation. It also comes with an allocation of carbon emissions allowances for Phase II of the EU Emissions Trading Scheme.

8.0 NEXT STEPS

The following 'next steps' should be considered by Crawley Borough Council as a way of implementing the key findings and recommendations in this report:

Recommendation 1: Review opportunities to develop a CBC or West Sussex County Council led biomass supply chain based on the low and zero carbon energy opportunities mapping

- The recent introduction of a Renewable Heat Incentive will increase the uptake of low carbon heating systems including biomass boilers.
- Whilst there are two suppliers of woodchip in close proximity to Crawley, there is a good business opportunity to develop a supply chain of woodfuel from sources within the Borough.

Recommendation 2: Undertake a detailed feasibility study into the potential for heat off take from Tinsley Sewage Treatment plant that could supply the North East Sector or Gatwick.

- The study should be commissioned by Crawley Borough Council, with potential for Thames Water and Gatwick to contribute towards part or the full cost of the study.
- The assessment should be undertaken by a technical consultant with expertise in anaerobic digestion, combined heat and power and heat network design.
- The output would be a detailed appraisal of the technical feasibility, capital costs and financial viability of heat off take from the sewage plant.

Recommendation 3: Review ways that CBC can encourage uptake of photovoltaic and solar hot water including providing information to residents and businesses and working alongside local installers

- Manor Royal has a number of unshaded buildings with flat roofs suitable for the installation of solar renewable energy technologies. PV panels could be installed to provide electricity to the businesses which will reduce their carbon emissions. Additionally, with the Feed In Tariff, organizations could benefit from incentives which significantly reduces the payback period.
- Solar hot water could provide a low carbon retrofit solution for both social and private housing with suitable South East to South West facing roofs. The introduction of the Renewable Heat Incentive makes solar thermal a financially viable proposition. In addition, unit cost could be reduced where the Council install solar thermal on multiple units.

Recommendation 4: CBC should setup a District Heating Working Group, headed by a Project Champion and comprising members of staff from key groups within the Council (councillors, planning etc). Please refer to section 7.10 for details of how a working group could be set up alongside creation of an ESCO to deliver a Town Centre heat network.

Recommendation 5: CBC, headed by the working group should setup a CBC led ESCO with the objective of delivering heat networks within Crawley. Please refer to section 7.10 for details on a recommended approach.

Recommendation 6: Develop detailed proposals for delivering a Town Centre heat network based around an initial pilot scheme. Please refer to section 7.10 for details on a recommended approach.

Recommendation 7: Develop and finalise the business plan for connecting K2 Leisure Centre, Desmond Anderson School and Thomas Bennett Community College onto a district heating network supplied from a new gas fired CHP engine within K2 Leisure Centre:

- Liaise with Freedom Leisure and BAM to assess the appetite, roles and delivery options for the network
- Undertake a detailed feasibility study and viability assessment (alongside delivery partner) based on detailed building surveys

Recommendation 8: Undertake a further feasibility study into the opportunities for a communal steam network to supply industrial processes and space heating on Manor Royal Business District

- The feasibility study should be undertaken by a consultant with CBC supporting the dialog between the consultant and the business within Manor Royal to facilitate the collection of data.
- The study will require an understanding on the industrial processes undertaken in each of the business and will require site visits.
- CBC to initiate the dialogue with the business within Manor Royal and to present this study as an opportunity to gain a better understanding of what could be the benefits of connecting to a district heating network.

Recommendation 9: Crawley Homes to undertake a detailed feasibility study into the opportunities for communal gas, biomass/biofuel heat and/or CHP for installation into social housing blocks. This could be delivered under Energy Performance Contracting arrangement. Please refer to section 6.7

Recommendation 10: The planning team should develop and integrate the recommended planning policy wording relating to energy efficiency, district heating and renewable/low carbon energy technologies into the Core Strategy Please refer to section 7.4

Recommendation 11: The District Heat Network working Group, led by planning, should develop a guidance document on 'District Heat Networks in Crawley' to encourage new development to install or connect to heat networks Please refer to section 7.4

Recommendation 12: The planning team should consider creating Supplementary Planning Documents that support the development of district heating networks in Crawley prior to adoption of the Core Strategy. Please refer to section 7.4

APPENDIX A

HEAT CLUSTERS – MODEL INPUTS AND ASSUMPTIONS

APPENDIX A

HEAT CLUSTERS – MODEL INPUTS AND ASSUMPTIONS

CRAWLEY TOWN CENTRE CLUSTER

Pipe Length / Diameter

Main	Pipe Length (m)	Pipe Diameter (mm)
Phase 1 - Main (250mm)	343	250
Phase 1 - Main (125mm)	224	125
Phase 1 - Secondary	144	100
Phase 2 - Main	1719	250
Phase 2 - Secondary (125mm)	60	125
Phase 2 - Secondary	576	100
Phase 3 - Main to hospital	350	215

Size of Energy Centre

Phase 1 – College ~ 180 m^2
Phase 2 – New Town Hall ~ 115 m^2
Phase 3 – Hospital ~ 35 m^2 – No additional energy centre might be required if the building plant room can accommodate the systems.

Buildings

Ref	Building Name	Existing or Proposed ?	Building Type	Central Boiler?	Public Building?	Annual Heat Demand (Kwh)	Energy Data Assumption
1	Central Sussex College	E	College	Y	Y	2,786,524	Meter reading
2	County Mall	E	Retail	Y	N	2,359,040	Benchmark
3	Arora Hotel	E	Hotel	Y	N	3,920,384	Benchmark
4	New library and registry office	E	Library	Y	Y	173,888	DEC Certificate
5	Brunel Hall	P	New offices	Unknown	N	123,675	Benchmark
6	Overline House	P	Residential + Retail	Unknown (New)	N	170,794	Benchmark
7	Telford Place	P	Supermarket	Unknown (New)	N	510,000	Benchmark
8	ASDA supermarket	E	Supermarket	Unknown	N	1,385,500	Benchmark
9	25 High Street – Robinson House	E	Residential	Unknown	N	3,063,842	Benchmark
10	Job Centre	E	Office	Unknown	N	1,051,845	Benchmark
11	The Galleria (Virgin Holidays)	E	Office	Unknown	N	2,274,192	Benchmark
12	TCN Department store	P	Department store	Unknown (New)	N	1,829,795	Benchmark
13	Additional retail (proposed)	P	Retail	Unknown (New)	N	926,201	Benchmark
14	A3 restaurant (proposed)	P	Restaurant	Unknown (New)	N	34,464	Benchmark
15	Cinema	P	Cinema	Unknown	N	680,000	Benchmark

Ref	Building Name	Existing or Proposed ?	Building Type	Central Boiler?	Public Building?	Annual Heat Demand (Kwh)	Energy Data Assumption
				(New)			
16	New Town Hall	P	Office	Unknown (New)	Y	331,500	Benchmark
17	Management Suite	P	Office	Unknown (New)	N	98,707	Benchmark
18	Supermarket (Sussex House site)	P	Supermarket	Unknown (New)	N	144,522	Benchmark
19	TCN Hotel	P	Hotel	Unknown (New)	N	372,480	Benchmark
20	Fairfield House	P	Residential	Unknown (New)	N	170,000	Benchmark
21	Southern Counties	P	Residential	Unknown (New)	N	370,600	Benchmark
22	Hospital	E	Hospital	Y	Y	7,047,432	Meter reading

Costs

Item	Total Item Cost (£)	Notes
Total pipework	2,659,525	Including all phases
Energy centre	193,559	This cost accounts for the new energy centre in the college, in the redevelopment of the Boulevard and the extension of the hospital energy centre
Plant (CHP + Boilers)	2,056,954	Including all phases
Heat interface Unit & Meters	864,085	Including all phases

MANOR ROYAL BUSINESS DISTRICT CLUSTER

Pipe Length / Diameter

Main	Pipe Length (m)	Pipe Diameter (mm)
Primary – Manor Royal	4816	300
Secondary – Manor Royal	1,535	100
Primary – North East Sector	7,644	300
Secondary – North East Sector	17,700	100
Primary – North East Sector	7,644	300
Secondary – North East Sector	17,700	100

Size of Energy Centre

Excluding North East Sector ~ 315 m^2
Including North East Sector ~ 515 m^2

Buildings

Ref	Building Name	Existing or Proposed ?	Building Type	Central Boiler?	Public Building?	Annual Heat Demand (Kwh)	Energy Data Assumption
1	Doosan	E	Office	Unknown	N	651,840	Benchmark
2	Thales	E	Office + Industrial	Unknown	N	2,034,880	Benchmark
3	Edwards	E	Office	Unknown	N	335,232	Benchmark
4	Presteigne Charter / Masters (London)	E	Office + Industrial	Unknown	N	321,152	Benchmark
5	Victory House	E	Office	Unknown	N	372,480	Benchmark
6	Siemens	E	Industrial	Unknown	N	167,616	Benchmark
7	Boeing – Jeppesen	E	Office	Unknown	N	558,720	Benchmark
8	Virgin	E	Office	Unknown	N	1,191,936	Benchmark
9	Haas (Aeropia House)	E	Industrial	Unknown	N	147,200	Benchmark
10	Bridisco	E	Industrial	Unknown	N	141,312	Benchmark
11	Thales	E	Office + Industrial	Unknown	N	210,880	Benchmark
12	Creative Technology Ltd	E	Office + Industrial	Unknown	N	221,803	Benchmark
13	Air Partner (Platinum House)	E	Office	Unknown	N	148,992	Benchmark
14	Monier Ltd	E	Industrial	Unknown	N	211,968	Benchmark
15	Ibis Hotel	E	Hotel	Unknown	N	934,502	Benchmark
16	First Choice House	E	Office	Unknown	N	514,022	Benchmark
17	Astral Towers	E	Office	Unknown	N	993,280	Benchmark
18	Oxford Aviation	E	Office	Unknown	N	415,936	Benchmark
19	Elekta	E	Office	Unknown	N	341,440	Benchmark
20	DPD	E	Industrial	Unknown	N	206,080	Benchmark
21	Froy and Sons Ltd	E	Industrial	Unknown	N	157,798	Benchmark
22	Pasta Reale	E	Office + Industrial	Unknown	N	337,498	Benchmark
23	Virgin Atlantic	E	Industrial	Unknown	N	1,000,960	Benchmark

Ref	Building Name	Existing or Proposed ?	Building Type	Central Boiler?	Public Building?	Annual Heat Demand (Kwh)	Energy Data Assumption
	(The Base)						
24	Diamond Point (ITW)	E	Industrial	Unknown	N	588,800	Benchmark
26	Tui Travel	E	Office	Unknown	N	111,744	Benchmark
27	The Satellite Business	E	Office	Unknown	N	186,240	Benchmark
28	Pasta Reale	E	Office + Industrial	Unknown	N	158,607	Benchmark
29	Quiagen	E	Industrial	Unknown	N	1,000,960	Benchmark
30	Davis Industrial Plastics	E	Industrial	Unknown	N	88,320	Benchmark
31	Haulotte	E	Industrial	Unknown	N	259,072	Benchmark
32	Ventaxia	E	Office + Industrial	Unknown	N	600,192	Benchmark
33	Strand Lighting	E	Industrial	Unknown	N	76,544	Benchmark
34	Howdens	E	Industrial	Unknown	N	158,976	Benchmark
35	The Explorer Building	E	Office	Unknown	N	242,112	Benchmark
36	Thales	E	Industrial	Unknown	N	865,536	Benchmark
37	Langley Green Hospital	E	Hospital	Unknown	Y	703,812	Meter reading
A	Residential (1900 units @ 32 units per hectare)	P	Residential	Y (assumed)	N	9,690,000	Benchmark
B	Commercial B1, B2 + B8 (5,000 m^2)	P	Commercial	Y (assumed)	N	412,250	Benchmark
C	Retail (2,500 m^2)	P	Retail	Y (assumed)	N	78,625	Benchmark
D	Community Centre (~350 m^2)	P	Leisure	Y (assumed)	N	37,188	Benchmark
E	Primary School (~750 m^2)	P	School	Y (assumed)	N	72,038	Benchmark

Costs

Item	Total Item Cost (£)
Excluding North East Sector	
Total pipework	5,129,793
Energy centre	188,442
Plant (CHP + Boilers)	1,295,974
Heat interface Unit & Meters	219,266
Including North East Sector	
Total pipework	23,574,693
Energy centre	247,507
Plant (CHP + Boilers)	2,385,694
Heat interface Unit & Meters	3,654,581

BEWBUSH RESIDENTIAL CLUSTER

Pipe Length / Diameter

Main	Pipe Length (m)	Pipe Diameter (mm)
Primary	1782	125
Secondary	4072	100

Size of Energy Centre

~ 90 m^2

Buildings

Ref	Building Name	Existing or Proposed?	Building Type	Number of Buildings	Central Boiler?	Public Building?	Annual Heat Demand (Kwh)	Energy Data Assumption
1	Residential	E	Residential (CBC owned)	223	Y	Y	1,427,999	Demand based on DECC energy data for Bewbush
2	Bewbush Community Primary School	E	School	1	Y	Y	75,633	Meter readings
3	Holy Trinity School	E	School	1	Y	Y	665,274	Meter readings

Costs

Item	Total Item Cost (£)
Total pipework	3,951,450
Energy centre	54,638
Plant (CHP + Boilers)	230,812
Heat interface Unit & Meters	415,645

K2 LEISURE CENTRE CLUSTER

Pipe Length / Diameter

Main	Pipe Length (m)	Pipe Diameter (mm)
Option 1	302	<100
Option 2	334	<100

Buildings

Ref	Building Name	Existing or Proposed ?	Building Type	Central Boiler?	Public Building ?	Annual Heat Demand (Kwh)	Energy Data Assumption
1	K2 Leisure Centre	E	Leisure	Y	Y	2,029,598	Meter readings
2	Desmond Anderson School	E	School	Y	Y	49,624	Meter readings
3	Thomas Bennett Community College	E	School	Y	Y	215,939	Meter readings
4	New Residential development (80-100 units)	P	Residential	? (New)	N	423,300	Benchmark

Costs

Item	Total Item Cost (£)
Total pipework	429,300
Energy centre	49,588
Plant (CHP + Boilers)	245,532
Heat interface Unit & Meters	164,053

GOSSOPS GREEN CLUSTER

Pipe Length / Diameter

Main	Pipe Length (m)	Pipe Diameter (mm)
Primary	565	100
Secondary	-	-

Buildings

Ref	Building Name	Existing or Proposed?	Building Type	Central Boiler?	Public Building ?	Annual Heat Demand (KWh)	Energy Data Assumption
1	Gossops Green Sheltered Scheme - Capel Lane (RH118HJ)	E	Residential	Electric heated	Y	4,407	Benchmark
2	Gossops Green Sheltered Scheme - Gossops Parade (RH118HH)	E	Residential	Unknown	Y	4,407	Meter reading
3	Woodhurstlea Close (RH118QG)	E	Residential	Electric heated	Y	22,037	Benchmark
4	Gossops Green Primary School	E	Residential	Y	Y	267,350	Meter reading

Costs

Item	Total Item Cost (£)
Total pipework	381,375
Energy centre	18,385
Plant (CHP + Boilers)	31,254
Heat interface Unit & Meters	84,527

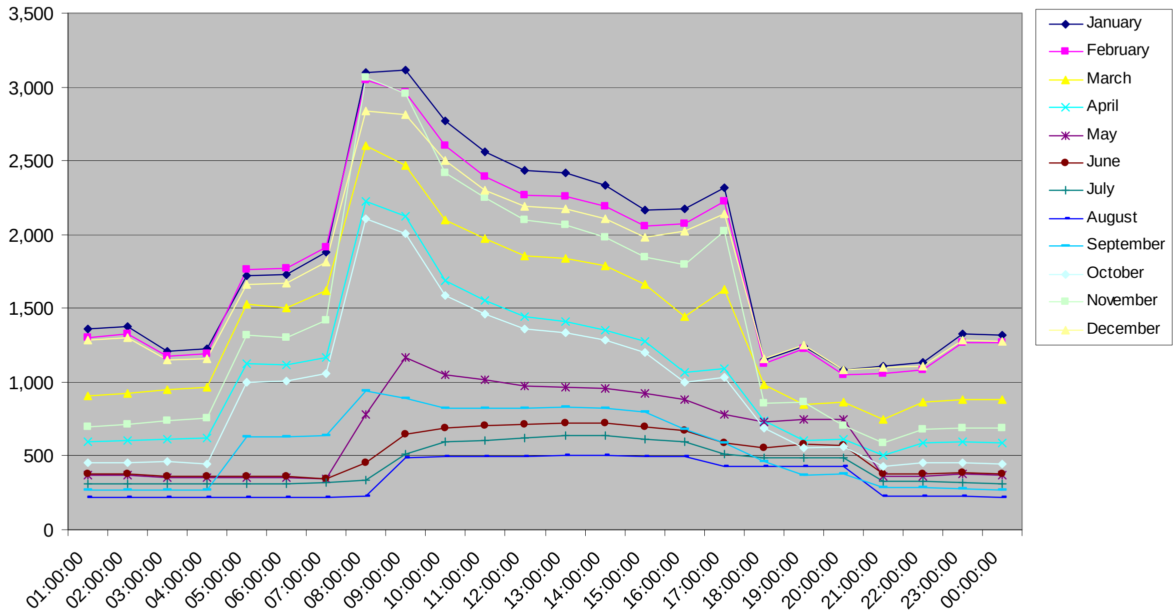
APPENDIX B

LOAD PROFILES

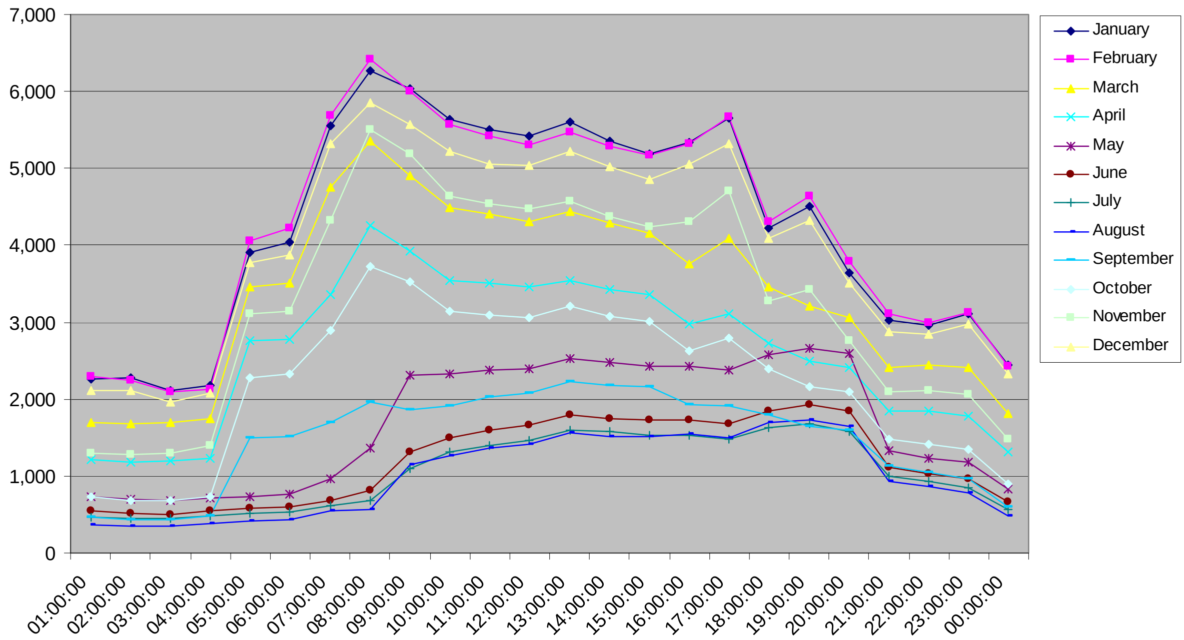
APPENDIX B

LOAD PROFILES

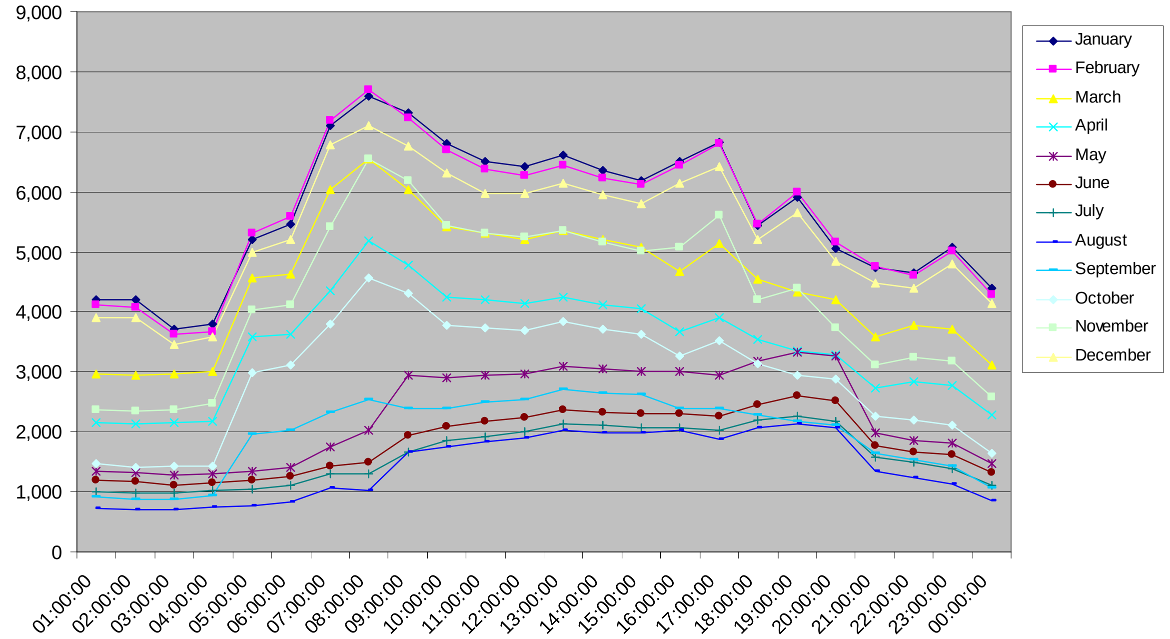
Town Centre Cluster – Phase 1



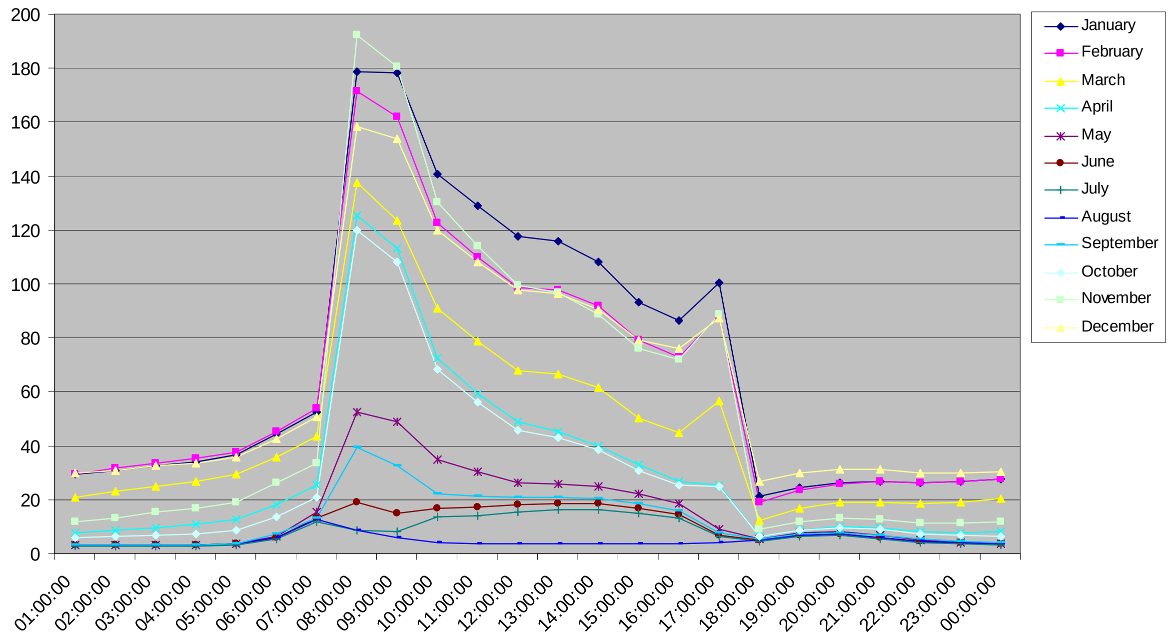
Town Centre Cluster – Phase 2 (Cumulative)



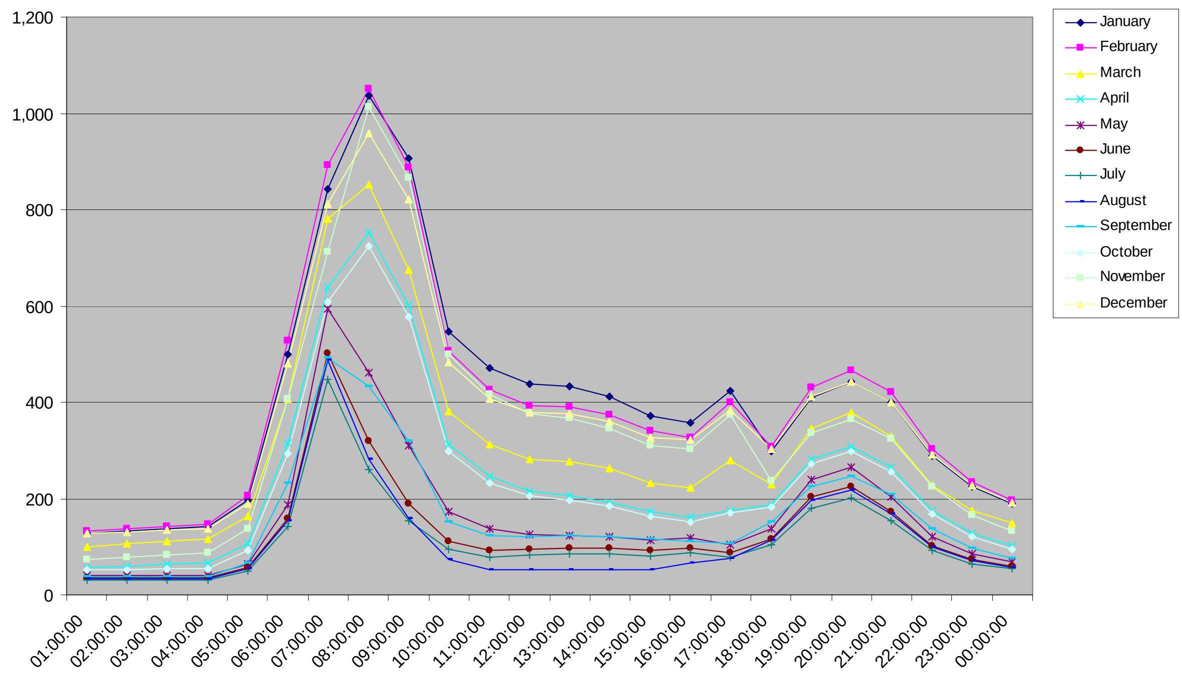
Town Centre Cluster – Phase 3 (Cumulative)



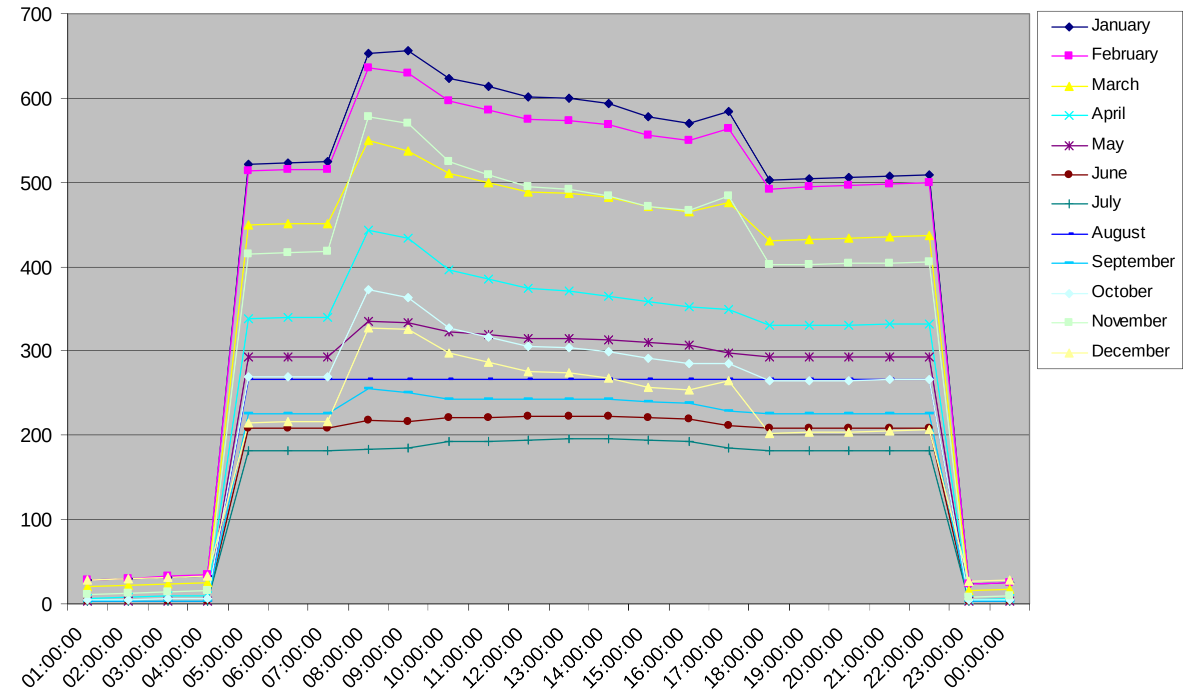
Gossops Green Cluster



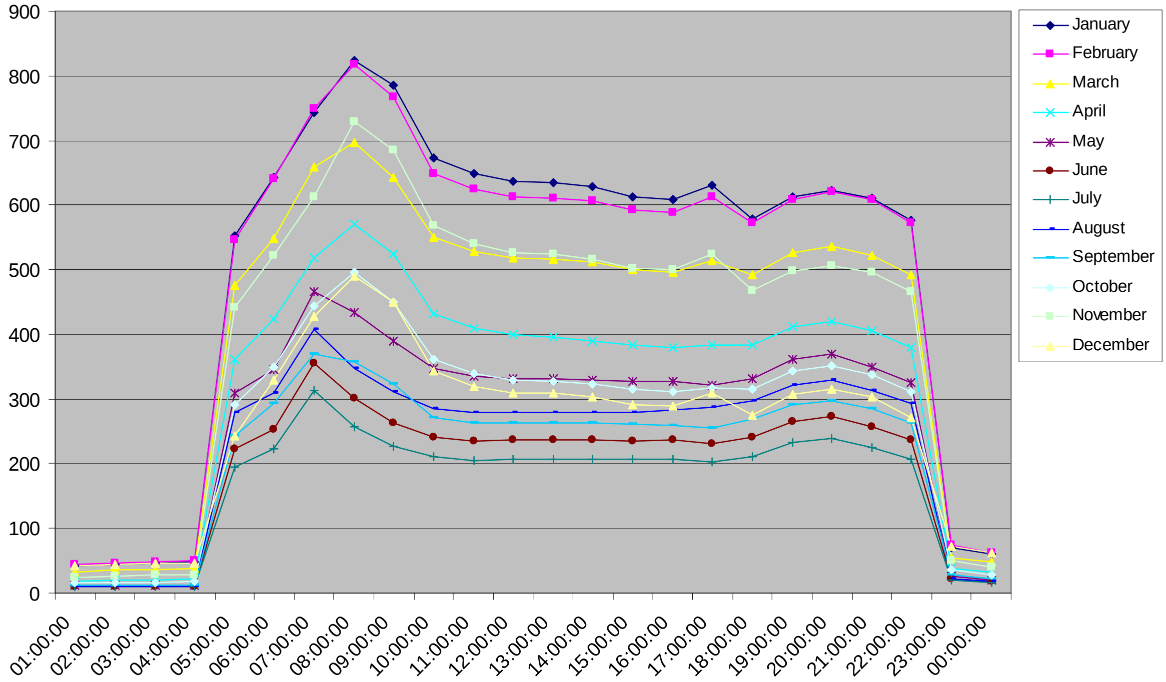
Bewbush Cluster



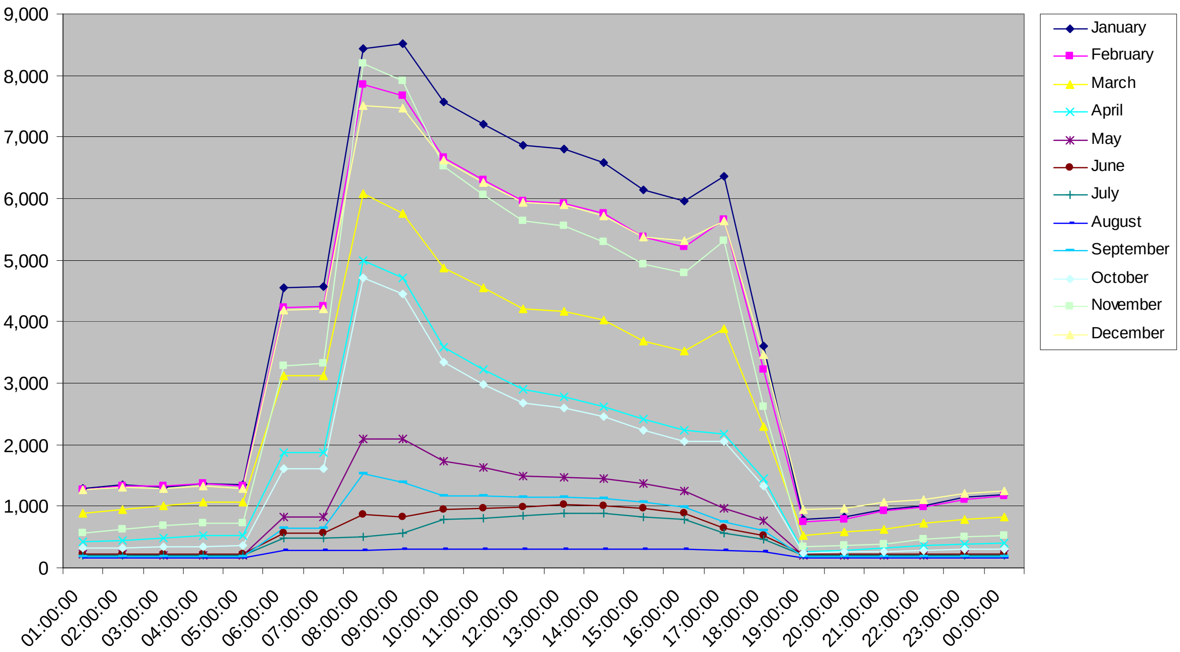
K2 Leisure Centre Cluster – Excluding New Residential Development



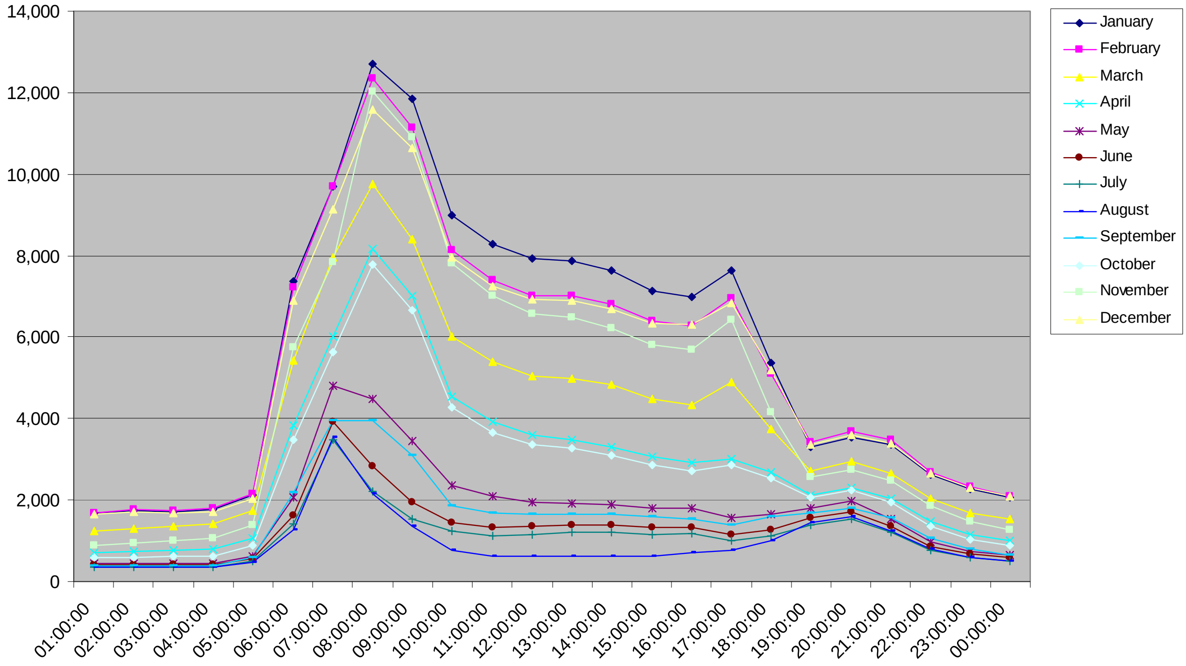
K2 Leisure Centre Cluster – Including New Residential Development



Manor Royal Cluster – Excluding North East Sector Development



Manor Royal Cluster – Including North East Sector Development



APPENDIX C

PLANT EFFICIENCY ASSUMPTIONS

APPENDIX C

PLANT EFFICIENCY ASSUMPTIONS

Gas CHP – New

	Efficiency	Source
Thermal	40%	Energ 500 (www.energ.co.uk)
Electrical	38%	Energ 500 (www.energ.co.uk)

Biomass CHP – New

	Efficiency	Source
Thermal	50%	POYRY[41]
Electrical	20%	POYRY

Gas Boilers

Building Type	Efficiency	Source
Existing buildings	80%	HPF assumption
New buildings	85%	HPF assumption
Communal gas boilers	85%	POYRY

Biomass Boilers

	Efficiency	Source
New	87%	POYRY

[41] UK Potential for District Heating networks: Technology Assumptions. 30th October 2008

APPENDIX D

PROPOSED PLANNING POLICY WORDING

APPENDIX D

PROPOSED PLANNING POLICY WORDING

Proposed Policy ‘A’: Planning Decisions

All development proposals should aim to minimise their carbon dioxide emissions by following the following energy hierarchy:

1. Be Lean: use less energy
2. Be Clean: supply energy efficiently
3. Be Green: Use renewable or low carbon energy

Planning applications for major development should include a detailed energy assessment as part of a design and access statement to demonstrate how the design has considered the energy hierarchy.

Major development is defined as residential developments of 10 dwellings or more and all new non domestic buildings of 1000 sqm or more.

As a minimum, energy assessments should include the following:

a. Calculation of carbon emissions (both regulated and non-regulated) for each step of the hierarchy. The calculation should be made using the Part L compliance methodology for each building type and using the appropriate approved software for building regulation compliance calculations (e.g. SAP, SBEM or equivalent)

b. Assessment should be made for each building type within the development that would require separate assessment for demonstration of building regulation Part L compliance.

c. The percentage saving over the building regulations applicable at the time of application should be stated

d. The energy assessment should clearly state the measures that have been adopted for each stage of the hierarchy with reference to planning policies B, C and D.

Where carbon dioxide emissions reductions in compliance with Building Regulation Part L cannot be met on site, any shortfall may be provided offsite, through contribution to a carbon offset fund or through any other allowable solutions detailed within the latest building regulations at the time of application.

An SPD will be prepared and will set out the approaches that developers might adopt to deliver these requirements *(to be confirmed - see section 7.7 on development options for an SPD to support the proposed policies)*

Proposed Policy ‘B’: Energy Efficiency

Before any mechanical systems are considered, the development should be made as energy efficient as possible by maximising the use of sunlight, thermal mass and the site’s microclimate to provide natural lighting, heating and cooling of buildings.

Buildings should be fitted with energy efficient lighting and appliances. Thermal performance of glazing and construction elements (walls, roofs etc) should be improved beyond building regulations where feasible and where it does not negatively impact the net annual carbon emissions of the building.

Proposed Policy 'C': Decentralised Energy Networks

Planning applications for major development should adopt the requirements of the following policy. Smaller developments (under 10 residential units or 1,000 sqm of commercial) should consider connection to available district heating / cooling networks. Where a district heating network does not yet exist, applicants are required to install heating and cooling equipment that is capable of connection at a later date.

In addition to meeting or exceeding the Target Emissions Rate required for Building Regulations compliance, major new developments are required to connect to district heating and/or cooling as the first option after maximizing opportunities from energy efficiency measures if within a District Heating/Cooling Priority Area. Where the applicant considers that district heating and/or cooling is not technically feasible / financially viable, the applicant must demonstrate why this is the case. This should be undertaken prior to application of the planning application to allow for dialogue with the Local Authority.

It is important to recognize that different development types will have different opportunities, therefore:

a. All new major development should seek to make use of available heat from existing or proposed district heating and/or cooling networks, including those supplied by heat from energy from waste, CHP, CCHP, gas fired or biomass/fuel fired plant.

b. Where this is not possible, major developments should consider installing a district heating and/or cooling network to serve the site. The ambition should be to develop strategic area wide networks and so the design and layout of site-wide networks should consider the future potential for expansion into surrounding communities (both new and existing).

c. Where this is not technically feasible or financially viable, applicants should install heating and cooling equipment that is capable of connection to district networks at a later date.

Where appropriate, applicants may be required to provide land, buildings and/or equipment for an energy centre to serve existing or new development.

New development should be designed to maximise the opportunities to accommodate a district heating and/or cooling solution, considering: density of buildings, mix of use, layout, phasing and specification of heating, cooling and hot water systems. Consideration of these factors should be detailed in an energy assessment included as part of the Design and Access Statement.

These requirements will apply to any major development, but particular emphasis will be placed on development located in a District Heating/Cooling Priority Areas or located close to potential sources of waste heat

Note: District Heating/Cooling Priority Areas

It is recommended that the District Heating/Cooling Priority Area plan, as shown in Figure 52, sits within a Supplementary Planning Document to allow for periodic updates of the plan following identification of new priority areas and building of new energy networks within Crawley that could be connected to by new development.

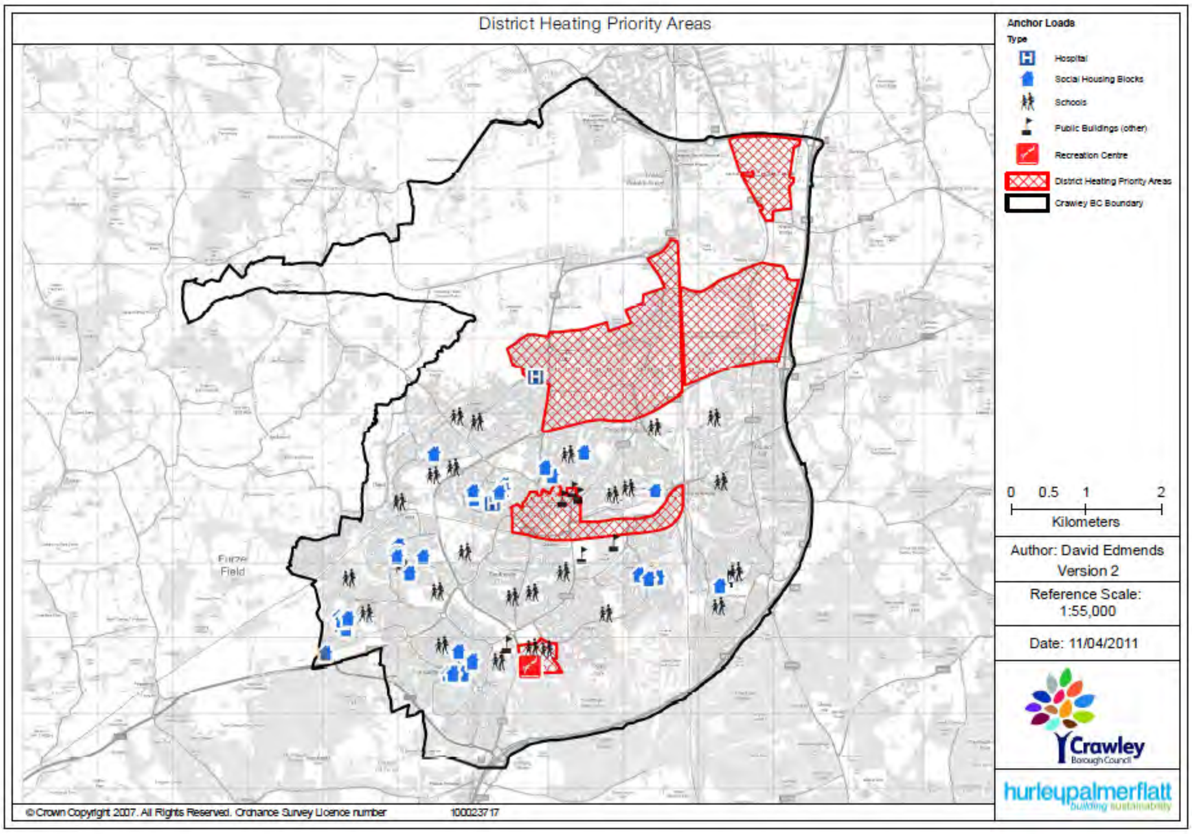


Figure 52: District Heating/Cooling Priority Area

In addition to supporting the development of heating and/or cooling networks, the Authority will actively support the connection of the following energy sources (in order of priority):

a. Connection to existing or proposed waste heat sources including existing CHP/CCHP which has a surplus of heat/cooling

b. Connection to biomass or biofuel powered plant including CHP/CCHP

c. Connection to gas fired plant including CHP/CCHP

Proposed Policy 'D': Renewable and low carbon energy

Crawley Borough Council is seeking to increase the proportion of energy generated from renewable and low carbon energy sources.

After consideration of the first two stages of the energy hierarchy, development proposals should provide a reduction in carbon dioxide emissions through the use of on-site renewable and/or low carbon energy generation, where feasible.

Chosen systems should be compatible with decentralised heating/cooling networks and CHP/CCHP

The following are preferred for on-site renewable and low carbon systems:

a. Solar thermal hot water
b. Wind turbines (in suitable locations)
c. Photovoltaic panels
d. Biofuels including solid, liquid and gas (subject to air quality standards)
e. Heat pumps
f. Hydro energy

Wind turbines have been shown to be not generally effective or feasible in Crawley, given the constraints imposed by the proximity to Gatwick and the urban nature of the Borough which impedes air flow. Applications for wind turbines will need to demonstrate that they will be effective talking into account site constraints. Accurate information on wind speeds through the site will be needed rather than regional estimates.

Consideration of the opportunities and constraints of each of the technologies should be detailed in an energy assessment (for major developments only). To assist with this, the Authority has undertaken an assessment of the likely opportunities and constraints of the following technologies as detailed in the Supplementary Planning Guidance (to be confirmed – see section 7.3 on development options for an SPD to support the proposed policies):

a. wind turbines (small and commercial scale)
b. hydro energy
c. biogas
d. biomass

APPENDIX E

DISTRICT HEATING: SOURCES OF FUNDING

APPENDIX E

DISTRICT HEATING: SOURCES OF FUNDING

Renewable Energy Certificates (ROCs)

A Renewables Obligation Certificate (ROC) is a green certificate issued to an accredited generator for eligible renewable electricity generated within the United Kingdom and supplied to customers within the United Kingdom by a licensed electricity supplier. One ROC is issued for each megawatt hour (MWh) of eligible renewable output generated. The types of technology that are eligible for ROCs are outlined in the table below. The value of a ROC fluctuates as it is traded on the open market but has an historical average of about £45 / MWh . ROC incentives for some technology types will be phased out with the introduction of Feed-in Tariffs (FIT) in 2010 and the Renewable Heat Incentive (RHI) which came into force in March 2011.

- Biogas form Anaerobic digestion
- Biomass
- Hydro electric power
- Tidal Power
- Wind Power
- Landfill gas
- Sewage gas
- Wave power

Feed-in tariffs (FIT)

Feed-in tariff's in the UK came into force in April 2010 for installations not exceeding 5 MW. The following low-carbon technologies are eligible:

- Anaerobic Digestion
- Hydro electric power
- MicroCHP (pilot trials)
- Photovoltaics (PV)
- Wind power

Feed-in tariffs are a per unit subsidy payment (p/kWh) for sub-5MW renewable electricity generation, Anaerobic digestion and micro CHP (pilot schemes only). The scheme does not support solid biomass technology which is supported under the Renewables Obligation scheme.

The objective of FITs is to contribute to the UK's 2020 renewable energy target through greater take-up of electricity generation at the small scale and to achieve a level of public engagement that will engender widespread behavioural change.

Payments under the FIT scheme include a Generation Tariff and an Export Tariff. The generation tariff will be fixed per kWh of energy generated. Electricity that is exported off site will also receive an income of 3p/kWh. The tariff will decrease over time to reflect the impact of increasing installation rates on end prices charged to consumers, the goal being to enable industries to "stand alone" at the end of the tariff period.

Renewable Heat Incentive (RHI)

Introduced in March 2011, this incentive follows a similar form to Feed-in Tariffs (see previous section). The following technologies are currently eligible for the tariff:

- Biogas on site combustion
- Bio-methane injection
- Solid biomass
- Ground source heat pumps
- Air source heat pumps
- Solar thermal

The Community Infrastructure Levy (CIL)

The Community Infrastructure Levy (CIL) is a local levy which local authorities in England and Wales can choose to levy on most new developments in their area in order to secure funding for vital local and sub-regional infrastructure. The CIL came into effect on the 6th April 2010 and unlike Section 106 contributions can be sought 'to support the development of an area' rather than to support the specific development for which planning permission is being sought. Therefore, contributions collected through CIL from development in one part of the charging authority can be spent anywhere in that authority area.

The broad powers for a CIL are included in the Planning Act 2008, with the detailed legislative framework contained in the Community Infrastructure Levy Regulations 2010, which gained parliamentary approval on 17 March 2010.

Prudential Borrowing and Bond Financing

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

Currently the majority of a council's borrowing will typically access funds via the 'Public Works Loan Board'. The Board's interest rates are determined by HM Treasury in accordance with section 5 of the National Loans Act 1968. In practice, rates are set by Debt Management Office on HM Treasury's behalf in accordance with agreed procedures and methodologies. Councils can usually easily and quickly access borrowing at less than 5%.
The most likely issue for local authorities will be whether or not to utilise Prudential Borrowing, which can be arranged at highly competitive rates, but remains 'on-balance sheet', or more expensive bond financing which is off-balance sheet and does not have recourse to the Local Authority in the event of default.

Local Asset-Backed Vehicles

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

The partnership may then use these assets as collateral to raise debt financing to develop and regenerate the portfolio. Assets will revert back to the public sector if the partnership does not progress in accordance with pre agreed timescales through the use of options.
Control is shared 50/ 50 and the partnership typically runs for a period of ten years. The purpose and long term vision of the vehicle is enshrined in the legal documents which protect the wide economic and social aims of the public sector along with pre agreed business plans based on the public sector's requirements.

Many local authorities are now investigating this approach, with the London Borough of Croydon being the first LA to establish a LABV in November 2008. LABVs are still feasible if adapted to suit the current macro economy. The first generation of LABVs were largely predicated on a transfer of assets from the public sector to a 50/50 owned partnership vehicle in which a private sector developer/investor partner invested the equivalent equity usually in cash.

There is now a need for a second generation of LABVs that deliver many of the recognised benefits of LABVs as set out above but protect the public sector from selling 'the family silver' at the bottom of the market.

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

JESSICA

JESSICA stands for Joint European Support for Sustainable Investment in City Areas. This initiative is being developed by the European Commission and the European Investment Bank (EIB), in collaboration with the Council of Europe Development Bank (CEB). Under new procedures, Member States are being given the option of using some of their EU grant funding, their so-called Structural Funds, to make repayable investments in projects forming part of an integrated plan for sustainable urban development. These investments, which may take the form of equity, loans and/or guarantees, are delivered to projects via Urban Development Funds and, if required, Holding Funds. The fund will recycle monies over time.

Intelligent Energy Europe

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

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

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

Biomass Grants (Growing Energy Crops)

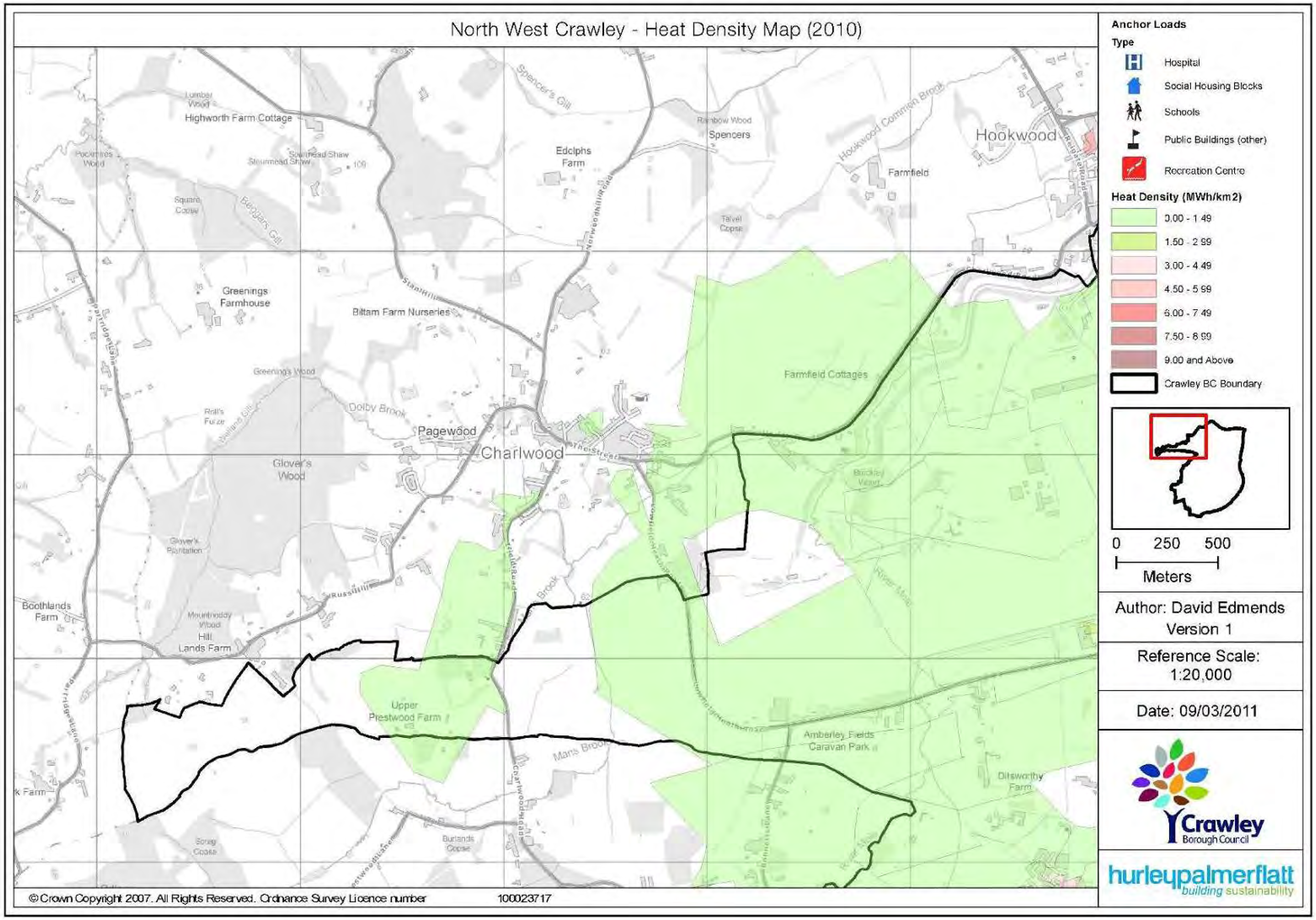
If grown on non-set-aside land then energy crops are eligible for £29 per hectare under the Single Farm Payment rules (set-aside payments can continue to be claimed if eligible). The Rural Development Programme for England's Energy Crops Scheme also provides support for the establishment of SRC and miscanthus.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

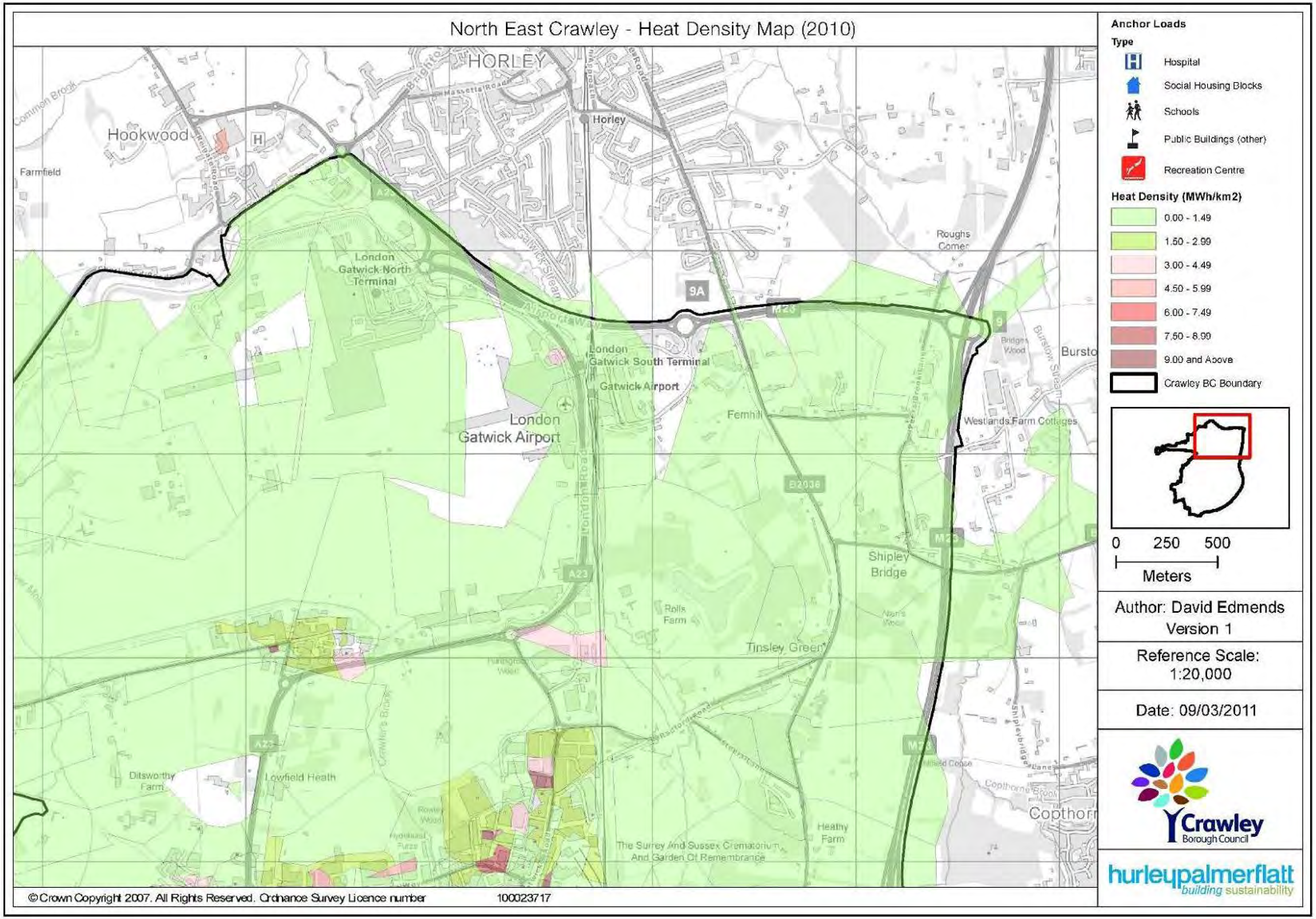
APPENDIX F

HEAT MAPPING: PRESENT AND 2025 MAPS

APPENDIX F

HEAT MAPPING: PRESENT AND 2025 MAPS

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Anchor Loads
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Schools
Public Buildings (other)
Recreation Centre
Heat Density (MWh/km2)
0.00 - 1.49
1.50 - 2.99
3.00 - 4.49
4.50 - 5.99
6.00 - 7.49
7.50 - 8.99
9.00 and Above
Crawley BC Boundary
0 250 500
Meters
Author: David Edmends
Version 1
Reference Scale:
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Date: 09/03/2011
Crawley
Borough Council
hurleypalmerflatt
building sustainability
HORLEY
Horley
Hookwood
Farmfield
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London Gatwick South Terminal
Gatwick Airport
London Gatwick Airport
Roughs Corner
Fernhill
Westlands Farm Cottages
Shipley Bridge
Rolls Farm
Tinsley Green
Lowfield Heath
Ditsworthy Farm
The Surrey And Sussex Crematorium And Garden Of Remembrance
Heathy Farm
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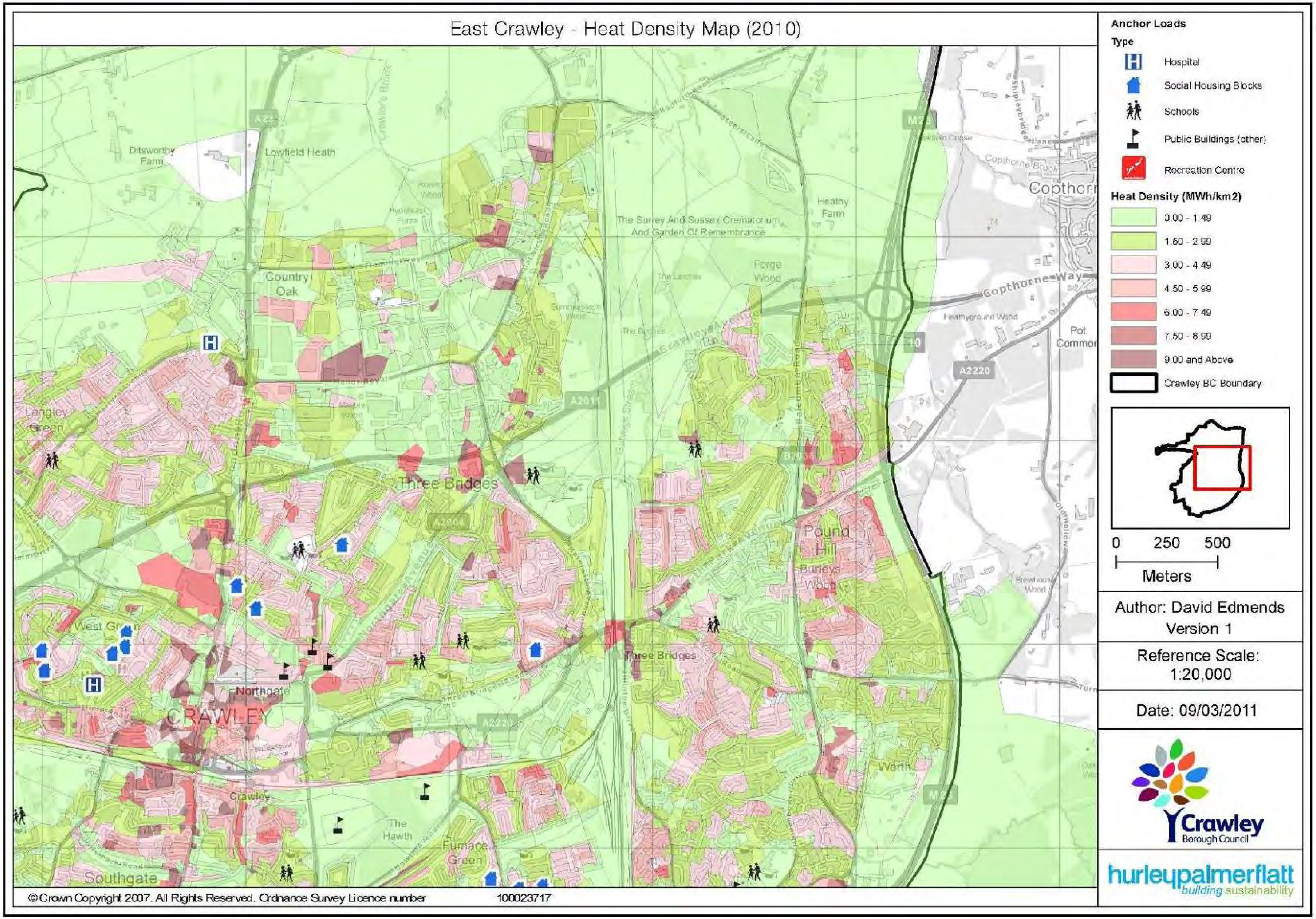
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Anchor Loads
Type
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Social Housing Blocks
Schools
Public Buildings (other)
Recreation Centre
Heat Density (MWh/km2)
0.00 - 1.49
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3.00 - 4.49
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7.50 - 8.99
9.00 and Above
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building sustainability
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West Green
Country Oak
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Worth
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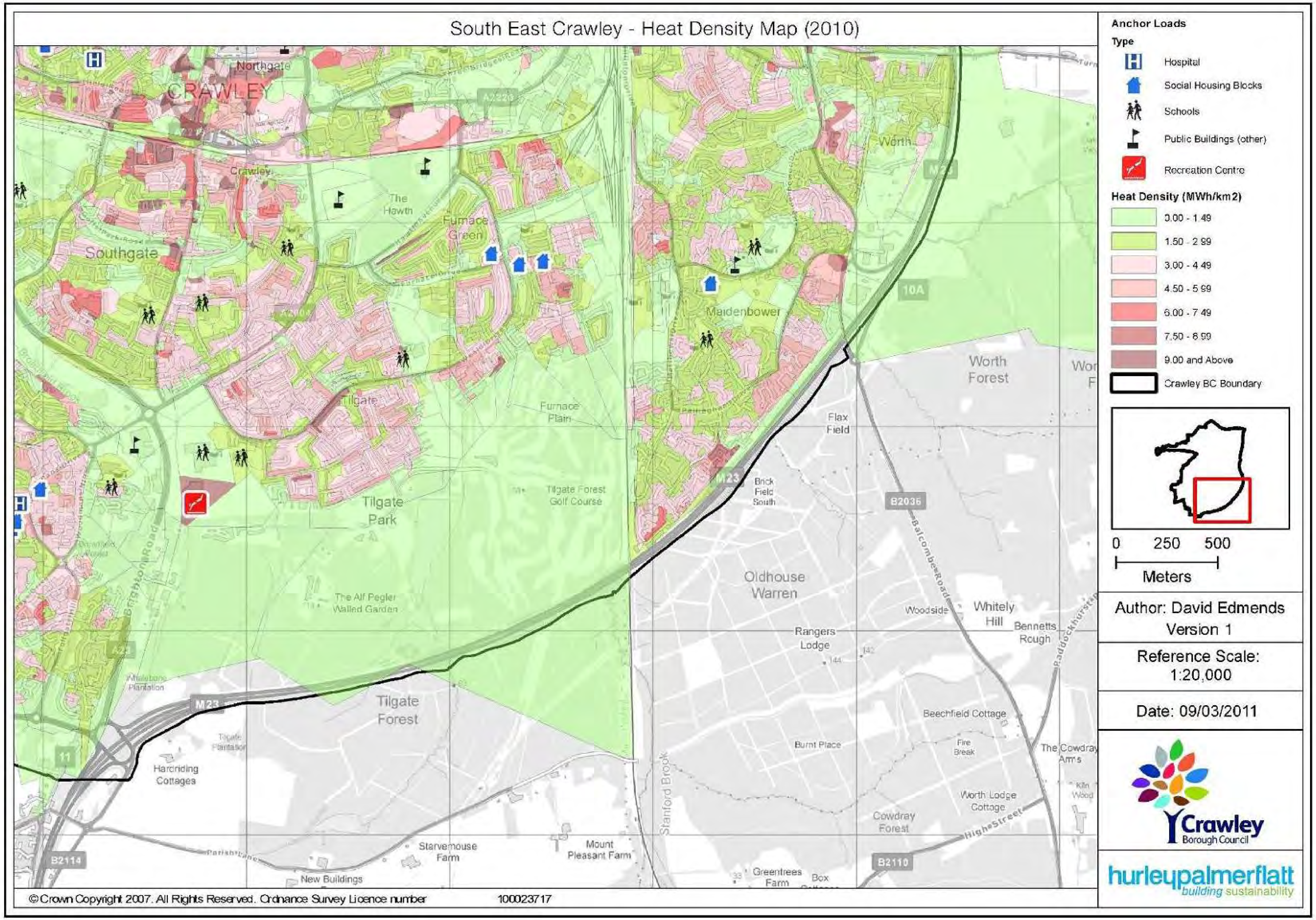
The Hawth
The Surrey And Sussex Crematorium And Garden Of Remembrance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Anchor Loads
Type
Hospital
Social Housing Blocks
Schools
Public Buildings (other)
Recreation Centre
Heat Density (MWh/km2)
0.00 - 1.49
1.50 - 2.99
3.00 - 4.49
4.50 - 5.99
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Southgate
Furnace Green
Tilgate
Tilgate Park
Maidenbower
Worth Forest
Oldhouse Warren
Tilgate Forest
Flax Field
Tilgate Forest Golf Course
The Alf Pegler Walled Garden
Whitely Hill
Bennetts Rough
Rangers Lodge
Beechfield Cottage
Burnt Place
Worth Lodge Cottage
Cowdray Forest
Starvemouse Farm
Mount Pleasant Farm
Greentrees Farm
New Buildings
Handcross Cottages
The Cowdray Arms
Woodside
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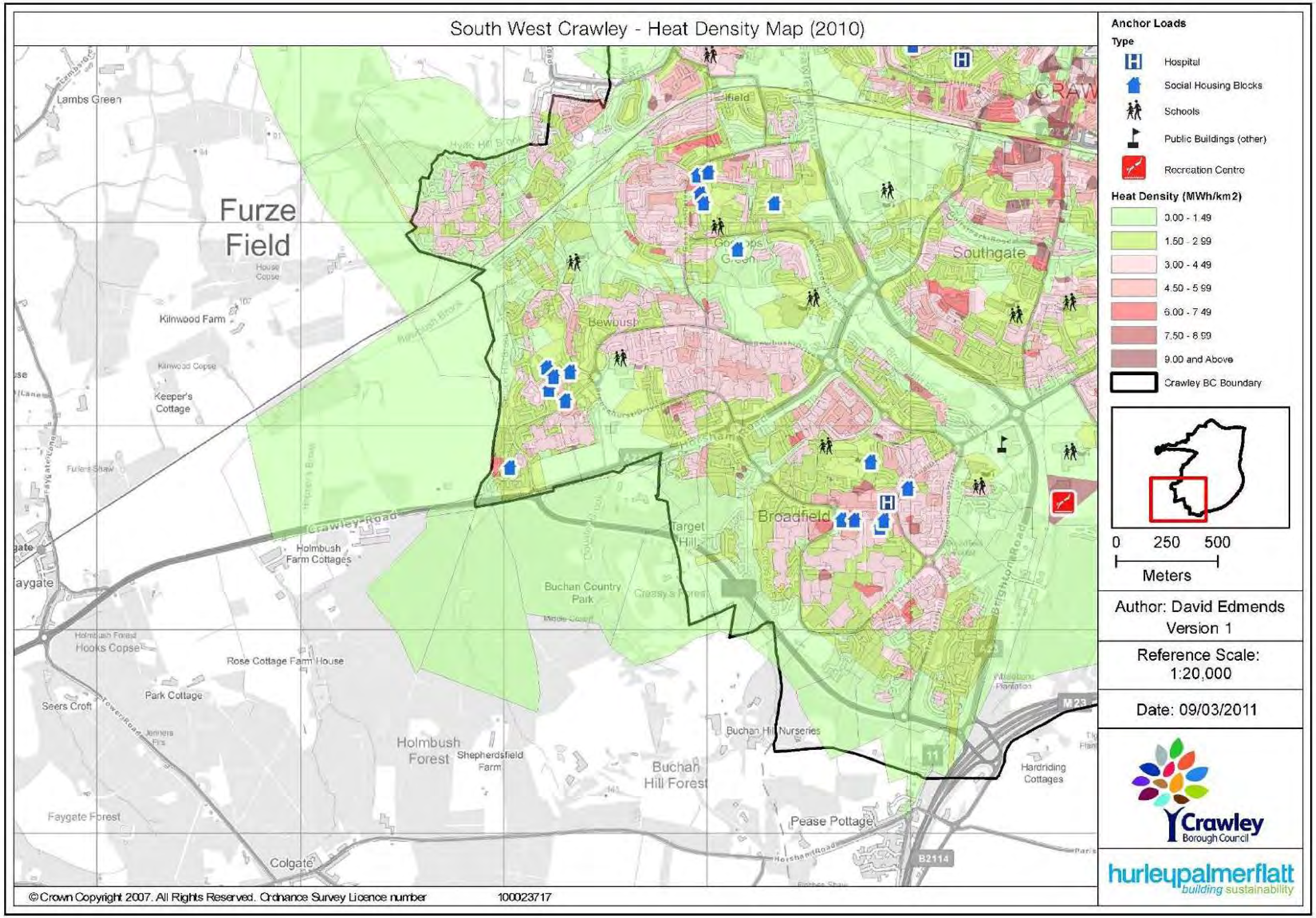

South West Crawley - Heat Density Map (2010)
Anchor Loads
Type
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Schools
Public Buildings (other)
Recreation Centre
Heat Density (MWh/km2)
0.00 - 1.49
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3.00 - 4.49
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Crawley
Borough Council
hurleypalmerflatt
building sustainability
Furze Field
Lambs Green
Kilnwood Farm
Keeper's Cottage
Holmbush Farm Cottages
Hooks Copse
Rose Cottage Farm House
Park Cottage
Seers Croft
Holmbush Forest
Shepherdsfield Farm
Buchan Hill Forest
Buchan Country Park
Buchan Hill Nurseries
Pease Pottage
Faygate Forest
Colgate
Bewbush
Southgate
Broadfield
Target Hill
Hardriding Cottages
Crawley Road
M23
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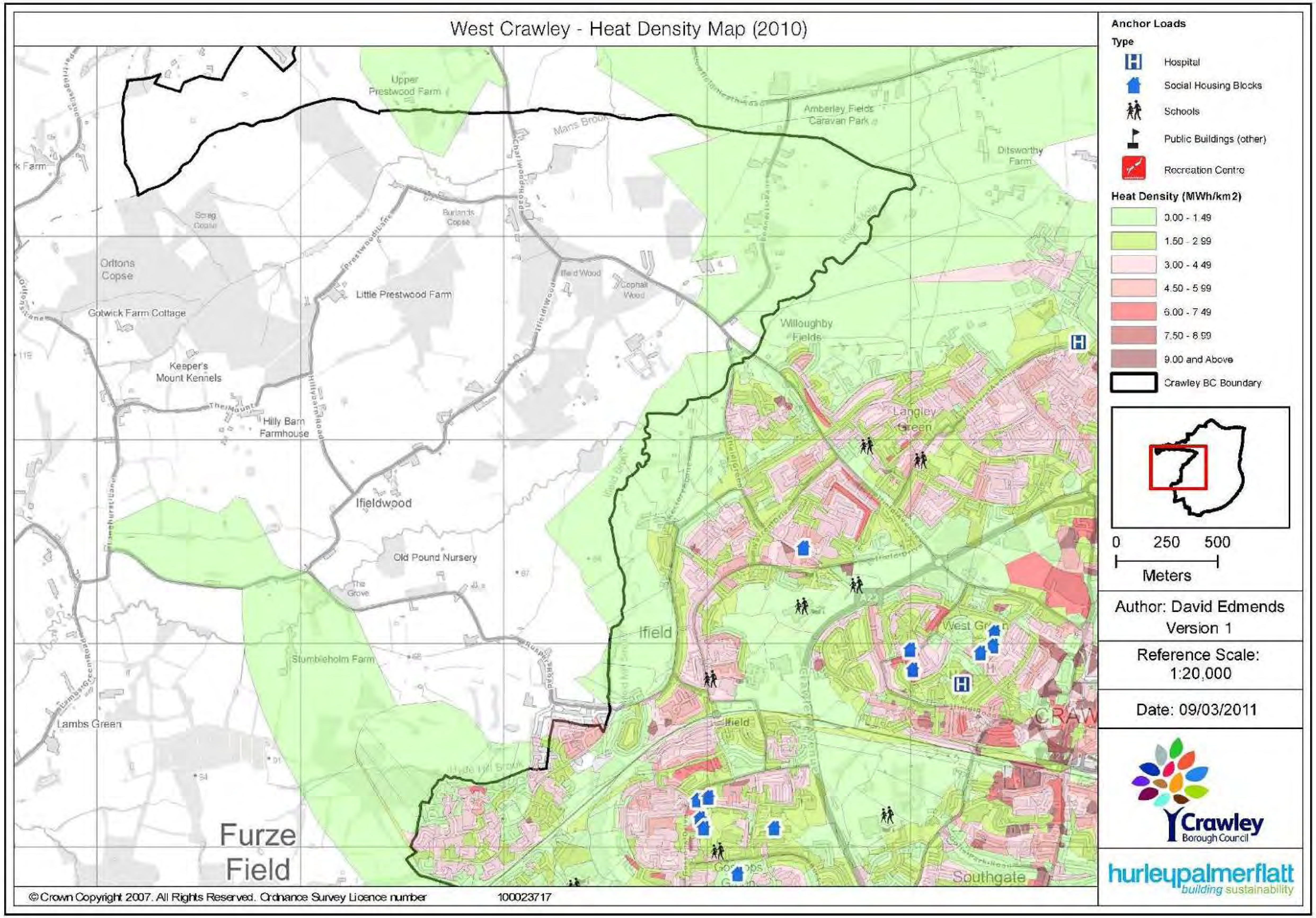
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Schools
Public Buildings (other)
Recreation Centre
Heat Density (MWh/km2)
0.00 - 1.49
1.50 - 2.99
3.00 - 4.49
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6.00 - 7.49
7.50 - 8.99
9.00 and Above
Crawley BC Boundary
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Meters
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Crawley
Borough Council
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building sustainability
Upper Prestwood Farm
Amberley Fields Caravan Park
Ditsworthy Farm
Ortons Copse
Little Prestwood Farm
Gatwick Farm Cottage
Willoughby Fields
Keeper's Mount Kennels
Hilly Barn Farmhouse
Langley Green
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Old Pound Nursery
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West Green
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Lambs Green
Furze Field
Southgate
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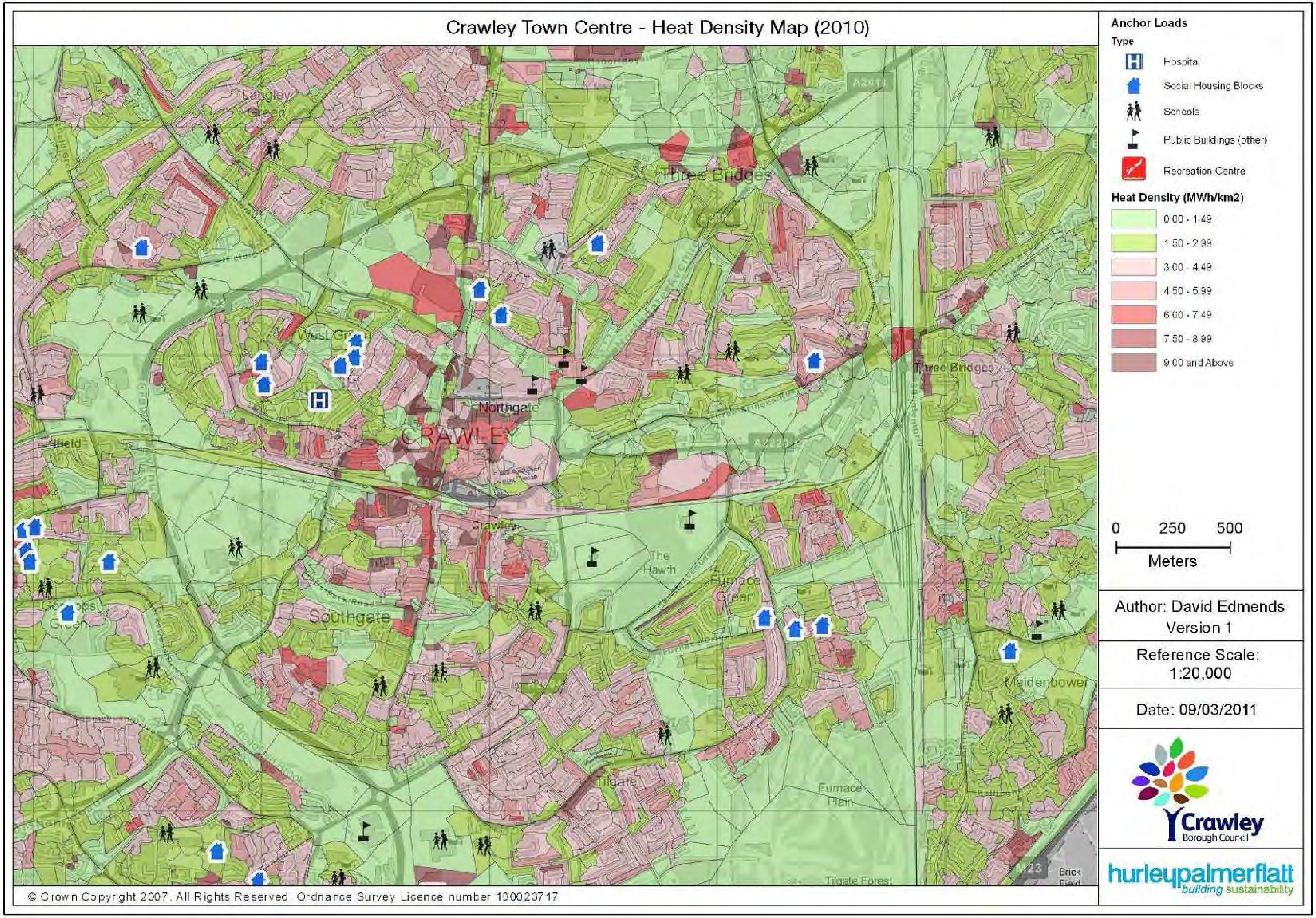

Crawley Town Centre - Heat Density Map (2010)
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Type
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Schools
Public Buildings (other)
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Heat Density (MWh/km2)
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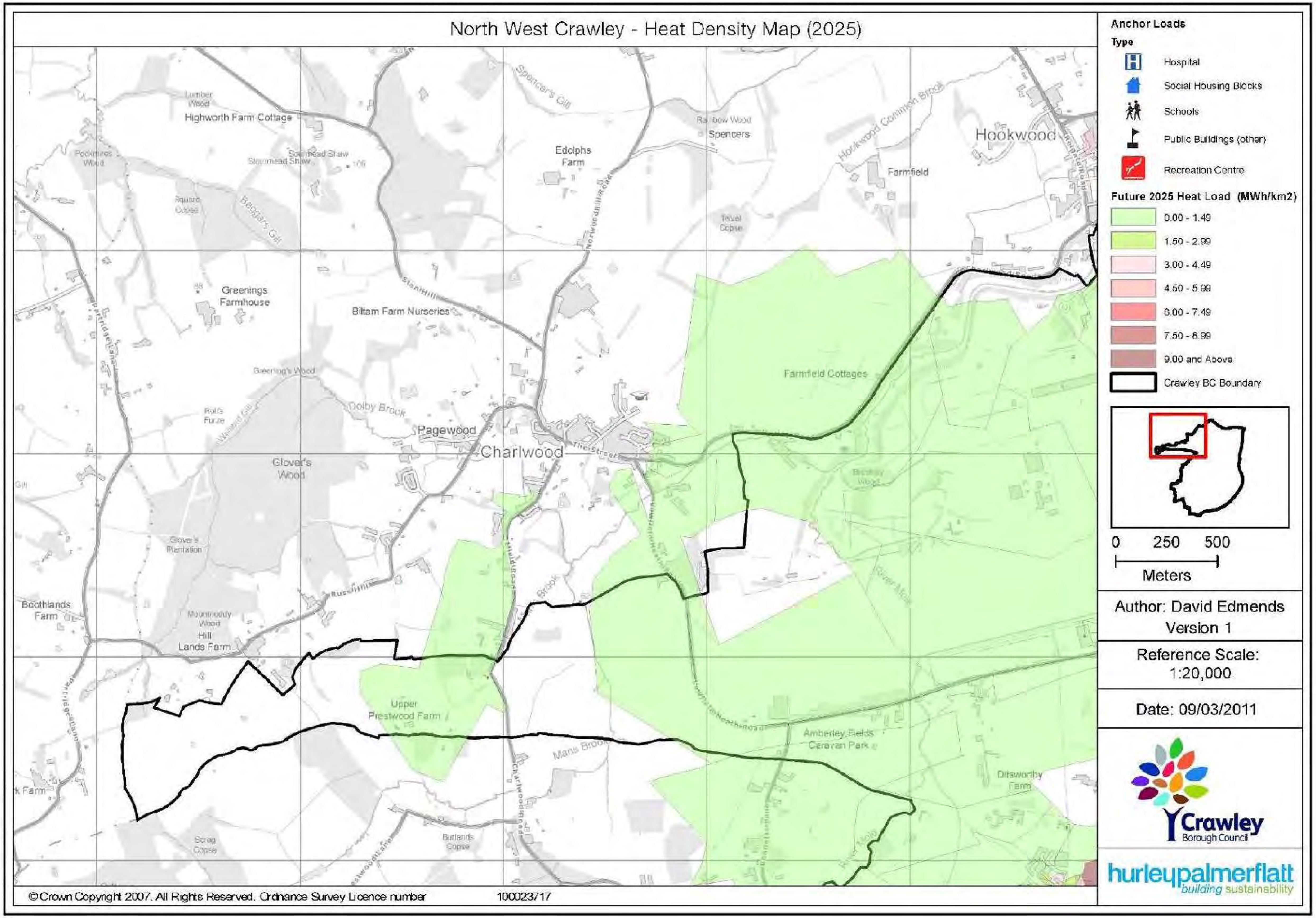
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Schools
Public Buildings (other)
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Future 2025 Heat Load (MWh/km2)
0.00 - 1.49
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7.50 - 8.99
9.00 and Above
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Highworth Farm Cottage
Edolphs
Farm
Spencers
Hookwood
Farmfield
Greenings
Farmhouse
Biltam Farm Nurseries
Farmfield Cottages
Pagewood
Charlwood
Glover's
Wood
Boothlands
Farm
Hill
Lands Farm
Upper
Prestwood Farm
Amberley Fields
Caravan Park
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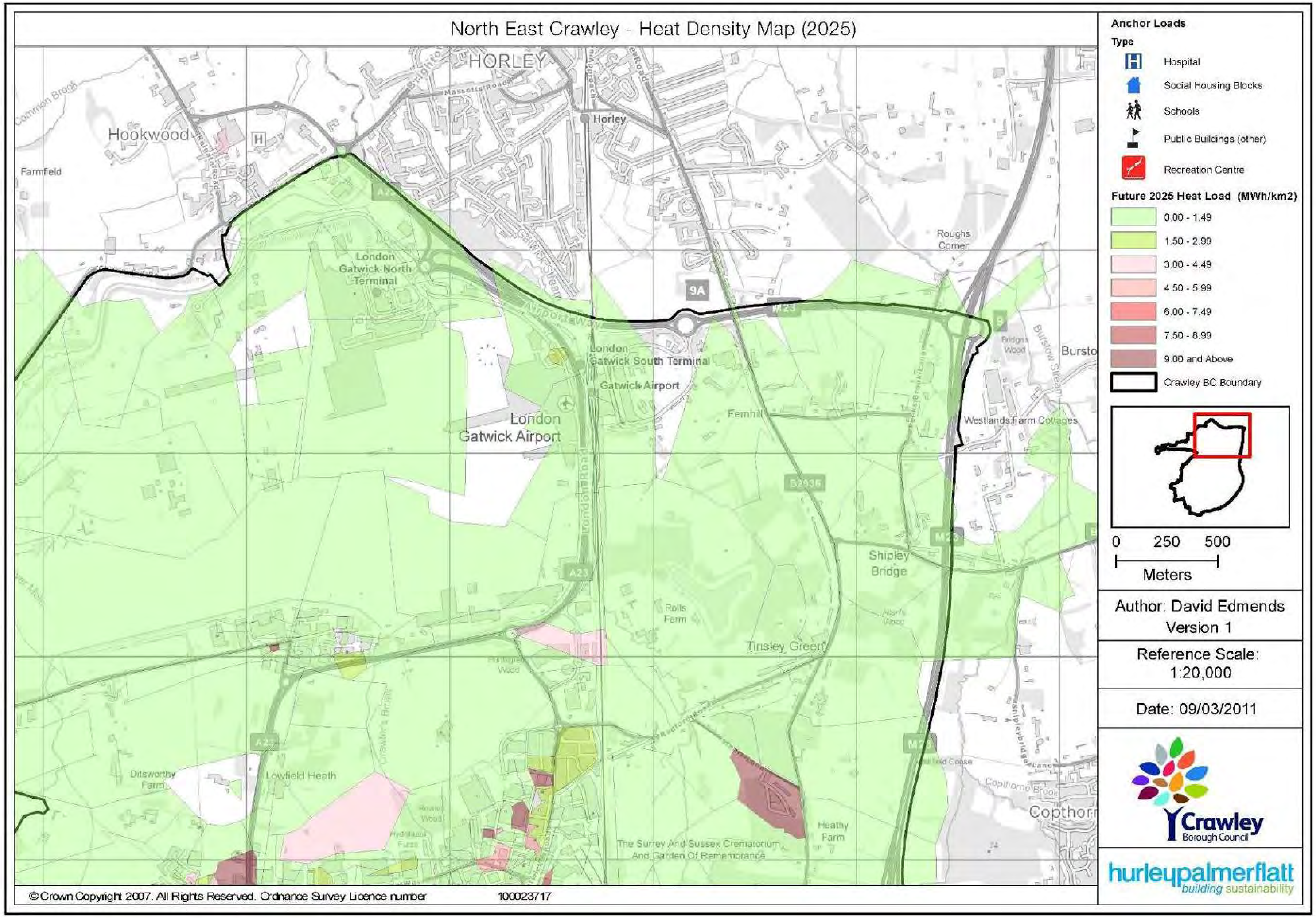
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Future 2025 Heat Load (MWh/km2)
0.00 - 1.49
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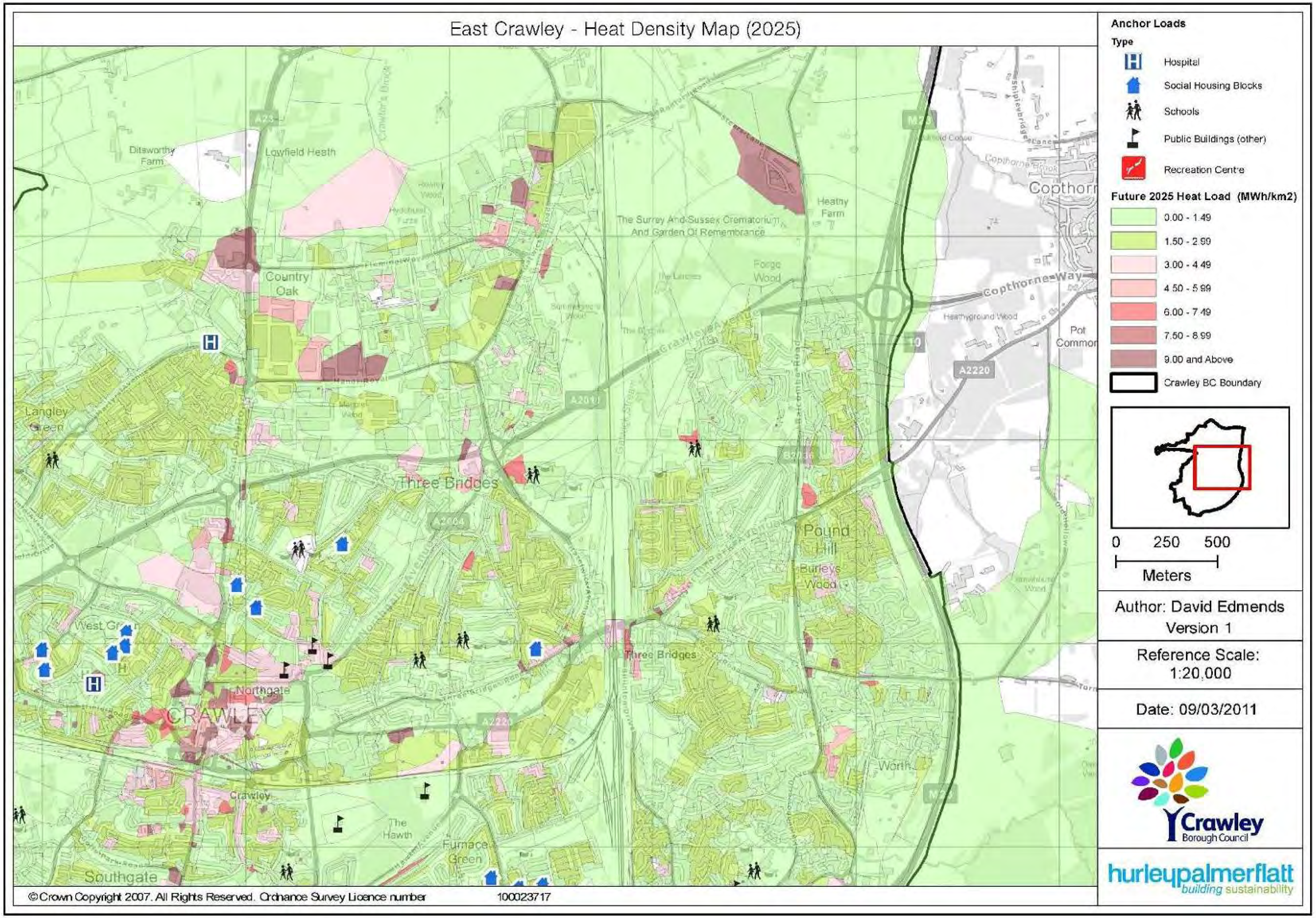
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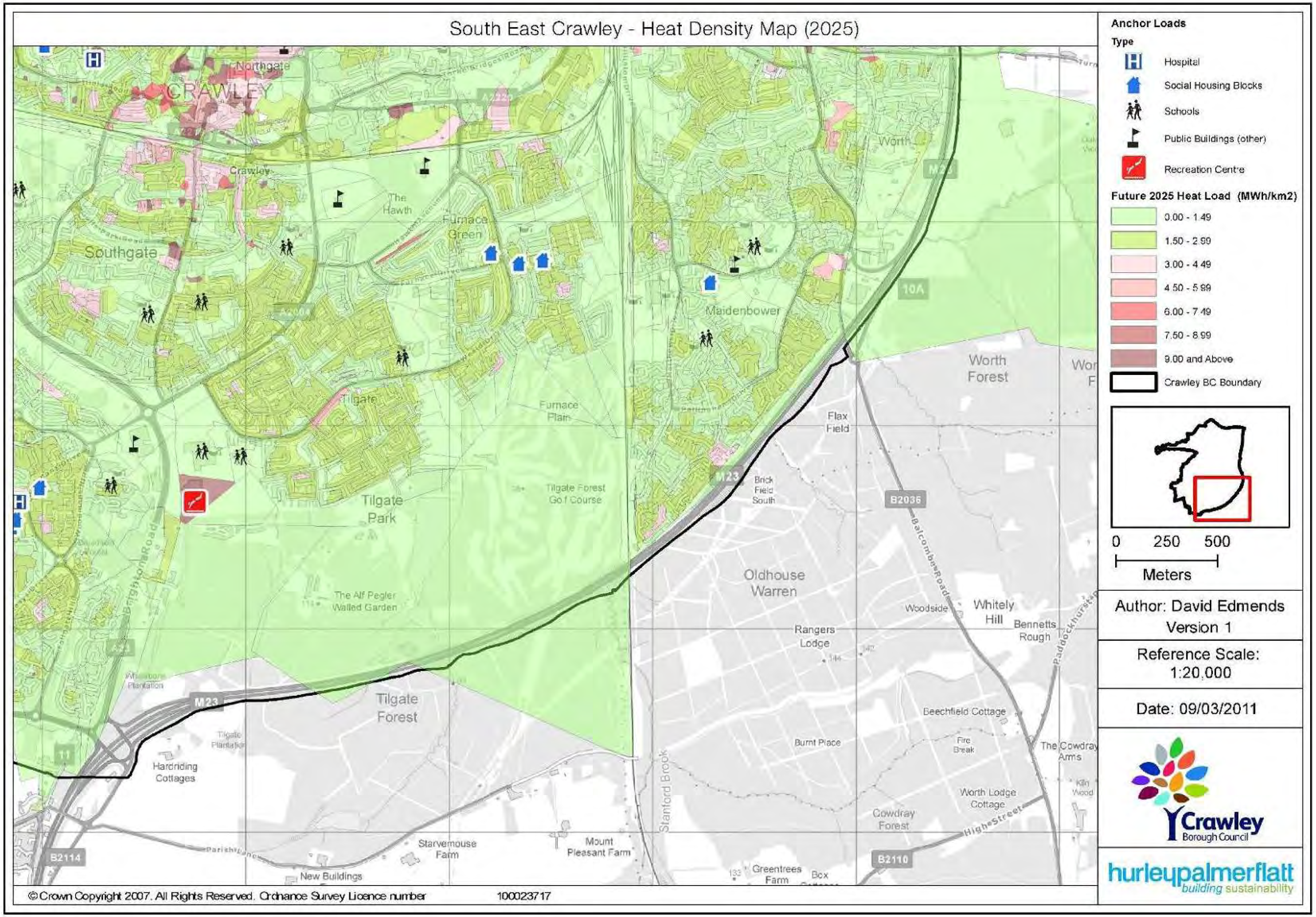
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Schools
Public Buildings (other)
Recreation Centre
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Worth
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Flax Field
Brick Field South
Tilgate
Furnace Plain
Tilgate Forest Golf Course
Tilgate Park
The Alf Pegler Walled Garden
Oldhouse Warren
Woodside
Whitely Hill
Bennetts Rough
Rangers Lodge
Tilgate Forest
Beechfield Cottage
Burnt Place
Fire Break
The Cowdray Arms
Hardriding Cottages
Worth Lodge Cottage
Cowdray Forest
High Street
Starvemouse Farm
Mount Pleasant Farm
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A23
B2114
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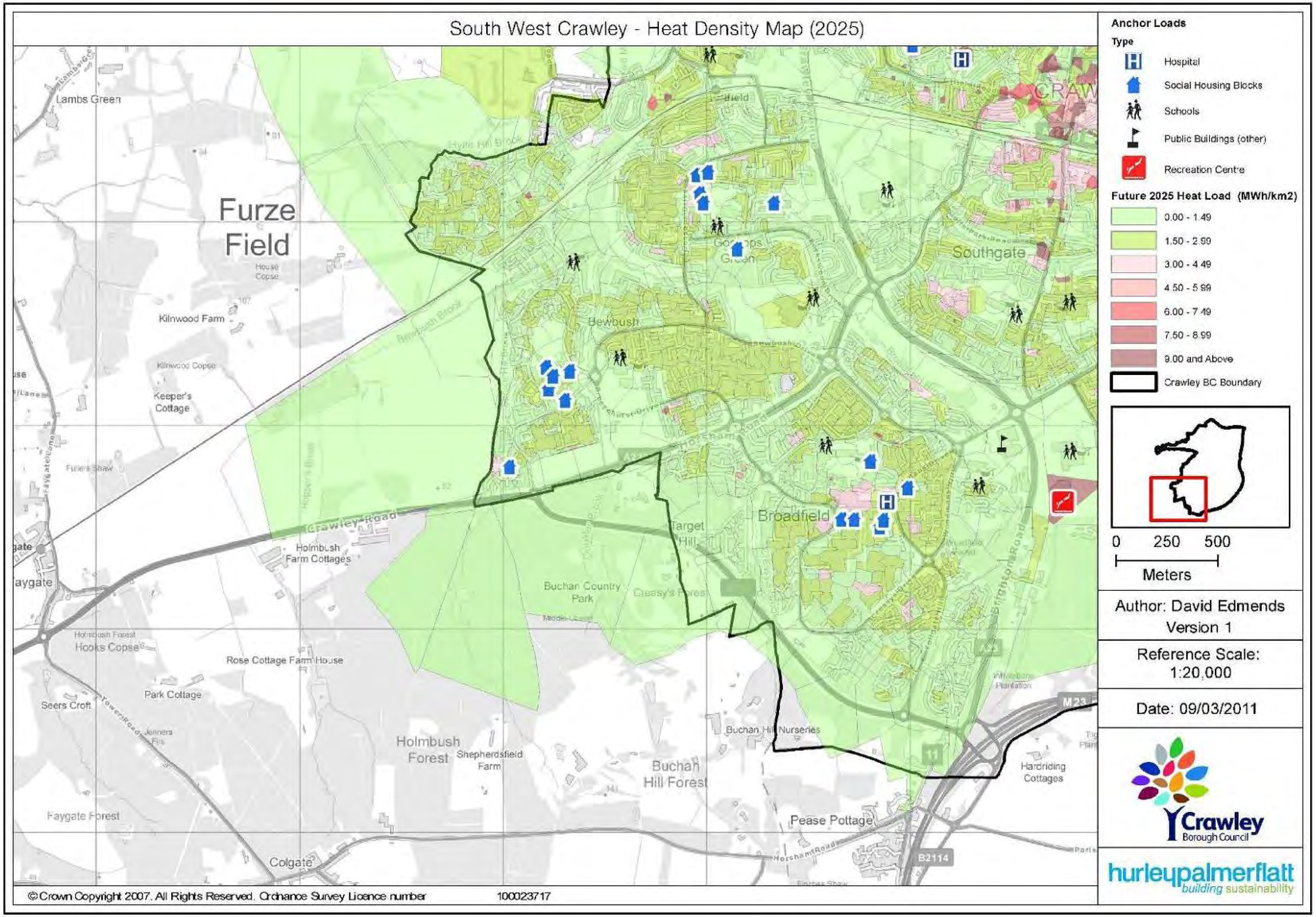
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Borough Council
hurleypalmerflatt
building sustainability
Furze
Field
Lambs Green
Kilnwood Farm
Keeper's
Cottage
Bewbush
Southgate
Broadfield
Target
Hill
Holmbush
Farm Cottages
Buchan Country
Park
Hooks Copse
Rose Cottage Farm House
Park Cottage
Seers Croft
Holmbush
Forest
Shepherdsfield
Farm
Buchan
Hill Forest
Buchan Hill Nurseries
Pease Pottage
Hardriding
Cottages
Faygate Forest
Colgate
M23
B2114
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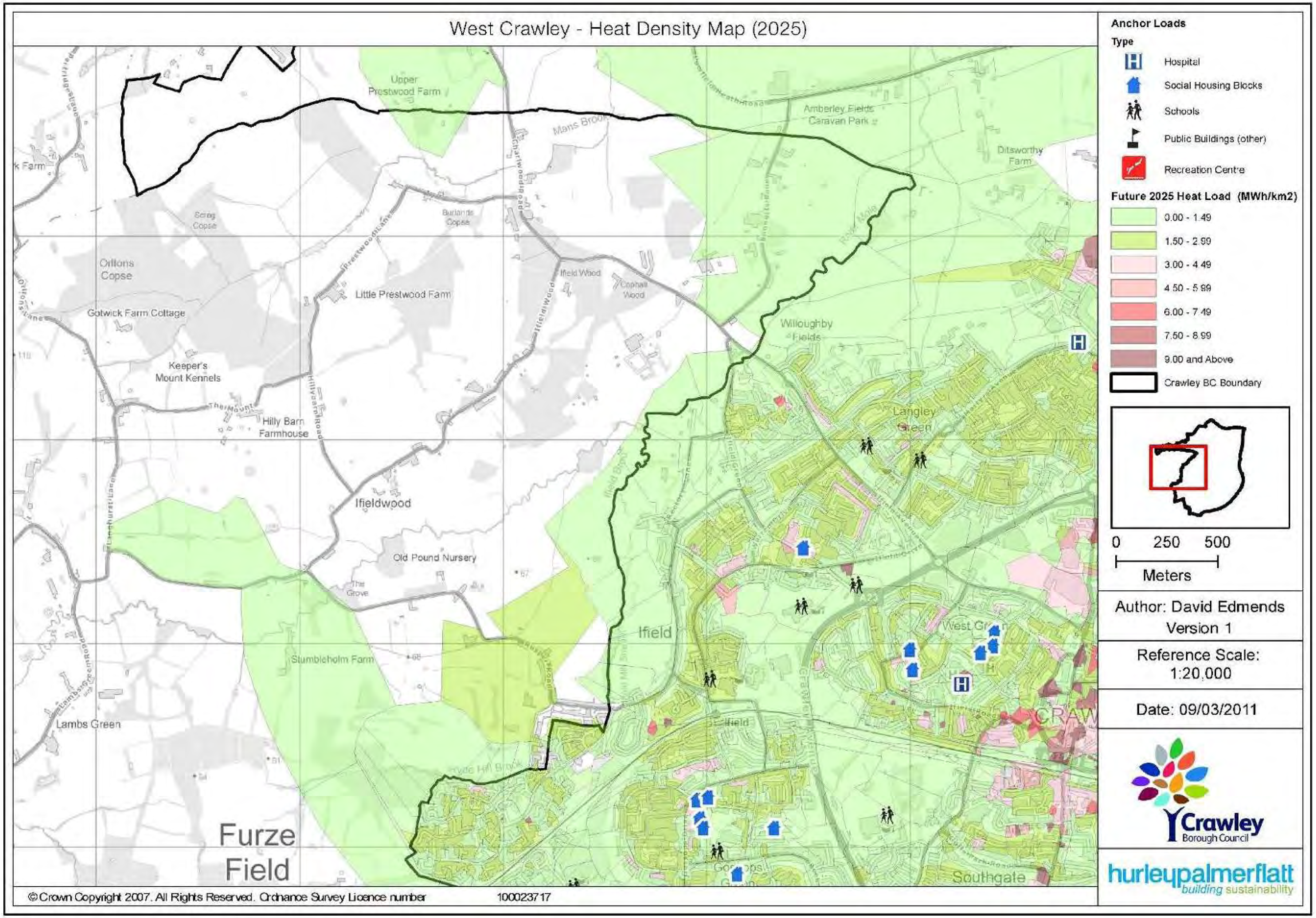
West Crawley - Heat Density Map (2025)
Anchor Loads
Type
Hospital
Social Housing Blocks
Schools
Public Buildings (other)
Recreation Centre
Future 2025 Heat Load (MWh/km2)
0.00 - 1.49
1.50 - 2.99
3.00 - 4.49
4.50 - 5.99
6.00 - 7.49
7.50 - 8.99
9.00 and Above
Crawley BC Boundary
0 250 500
Meters
Author: David Edmends
Version 1
Reference Scale:
1:20,000
Date: 09/03/2011
Crawley Borough Council
hurleypalmerflatt building sustainability
Upper Prestwood Farm
Amberley Fields Caravan Park
Ditsworthy Farm
Orltons Copse
Gotwick Farm Cottage
Little Prestwood Farm
Keeper's Mount Kennels
Hilly Barn Farmhouse
Willoughby Fields
Langley Green
Ifieldwood
Old Pound Nursery
Ifield
West Green
Stumbleholm Farm
Lambs Green
Furze Field
Southgate
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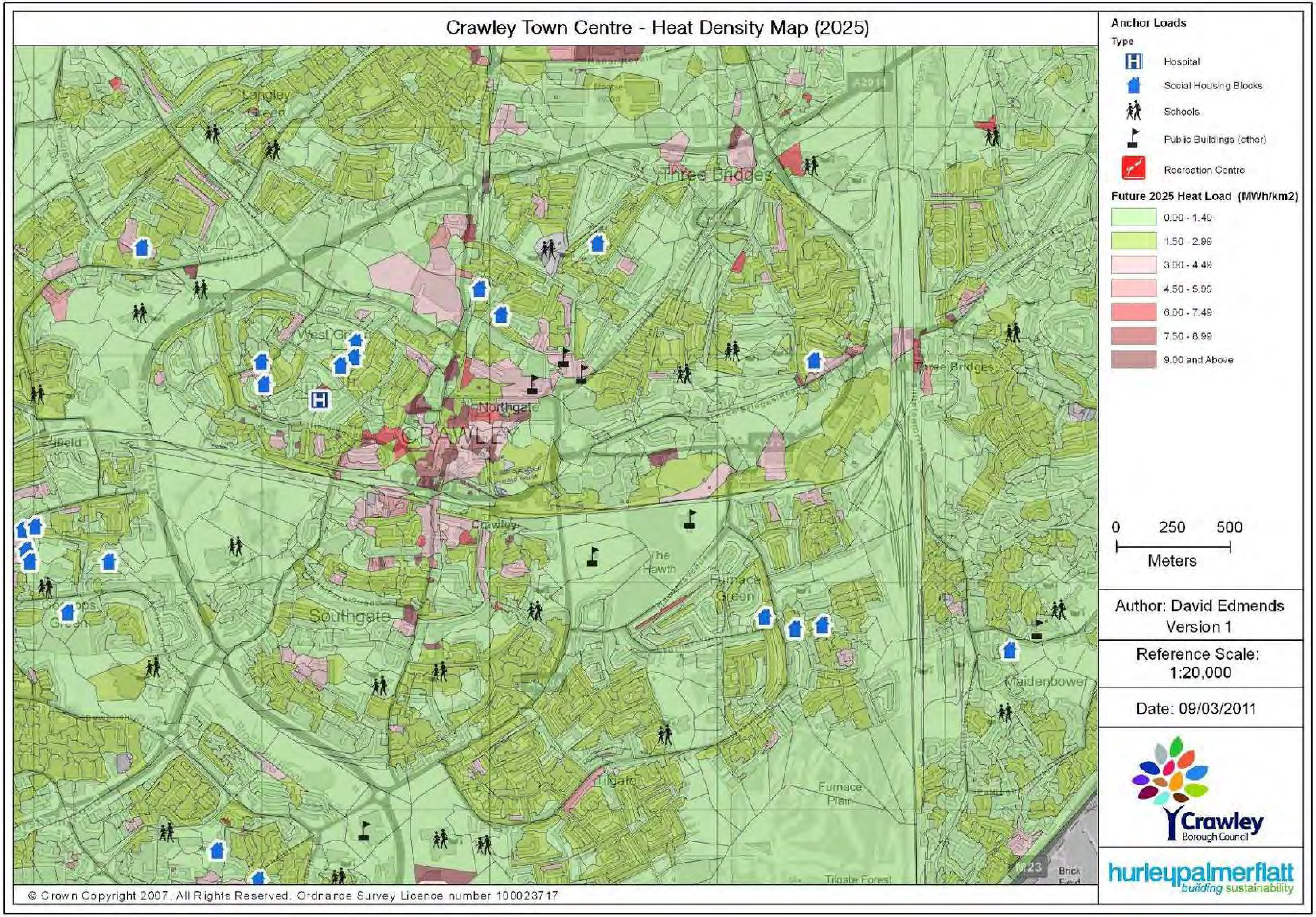
Crawley Town Centre - Heat Density Map (2025)
Anchor Loads
Type
Hospital
Social Housing Blocks
Schools
Public Buildings (other)
Recreation Centre
Future 2025 Heat Load (MWh/km2)
0.00 - 1.49
1.50 - 2.99
3.00 - 4.49
4.50 - 5.99
6.00 - 7.49
7.50 - 8.99
9.00 and Above
0 250 500
Meters
Author: David Edmends
Version 1
Reference Scale:
1:20,000
Date: 09/03/2011
Crawley
Borough Council
hurleypalmerflatt
building sustainability
Langley Green
Three Bridges
West Green
Northgate
CRAWLEY
Southgate
The Hawth
Furnace Green
Maidenbower
Tilgate
Furnace Plain
Tilgate Forest
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