Woking Borough Council
Local Development Framework

Climate Change and Decentralised, Renewable and Low Carbon Energy Evidence Base

ecsc
Energy Centre for Sustainable Communities

WOKING
BOROUGH COUNCIL

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Contents

Table of Figures

Table of Figures (contd.)

Tables

Executive Summary

This report is divided into ten sections, each of which is summarised below:

1. Study Objectives and Scope

This study has been commissioned to help inform Woking Borough Council's emerging Core Strategy and provides the foundations on which a policy framework can be built that addresses twin objectives:

1) Enabling a planned response to the changes in climate that are anticipated during the first half of this century;
2) Informing a spatial approach to local, decentralised energy planning.

The study pays particular attention to the following broader sustainable development aims:

- Contributing to energy security
- Stabilising growth in CO_2 emissions.
- Minimising the growth in water consumption

The study has considered the potential for setting a policy framework predicated on new development meeting a significant proportion of its energy demand from local LZC energy sources.

Throughout the study, energy and water demand have been considered in terms of consumption in the built environment (i.e. energy demand for heating, cooling, hot water and electrical appliances and potable domestic water consumption for use within buildings). Process energy and water demand for industrial uses have not been included, although recommendations are made regarding measures to partially mitigate the very high energy demand associated with some types of commercial buildings such as data centres. Opportunities for reducing road transport emissions through measures to promote the use of hybrid fuel and plug-in electric vehicles are also identified.

2. Baseline analysis

The energy baseline for this study is set out in terms of the energy demand profile for Woking expressed at both regional and local levels, based on meter data provided by DECC. This has been used to benchmark heat and electrical energy consumption by residential and non-residential buildings in a regional context, and to identify the spatial distribution of energy demand within the borough's neighbourhoods defined at MLSOA (Medium Layer Super Output Area) level.

At a regional level, the baseline shows average domestic heat and electrical consumption in the borough is higher than the median across the South East, although average energy consumption by domestic and commercial customers is significantly lower. The energy analysis at neighbourhood level shows a clear relationship between energy consumption and centres of population and commercial activity. As a result, Woking town centre has the highest density of heat demand in the borough. This is explored in greater detail through heat and energy demand mapping for the town centre the outcome of which is set out in Section 7.

3. Policy Context

This study is set within a wide-ranging context of European and national policy drivers relating to climate change and energy security. The emergence of policy measures relating to the environmental performance of new buildings (including the Code for Sustainable Homes and targets for Zero Carbon Homes and other buildings) are of particular influence in setting standards for new development in local development strategies.

The study has been produced against the background of a changing national political agenda and far-reaching proposals for planning reform. The coalition government's proposals for localism and decentralisation have yet to be fully adopted and their implications for spatial planning and development management are still to be fully understood. Nonetheless, this study seeks to inform the council's policy framework on the basis of circumstances that are specific to Woking, and by association, is highly relevant to the new tier of Neighbourhood Plans proposed by government. Its focus on local patterns of energy demand within the borough and the potential for community scale generation of low and zero carbon energy provides a borough-wide perspective of major strategic objectives, whilst also enabling local communities to start to engage in these issues through the new neighbourhood planning process.

4. Existing Renewable and Local Carbon Energy in Woking

The study examines the scale, type and distribution of existing renewable and low carbon energy generation in Woking and concludes this is far more widespread and well established than most other areas of comparable size. The role of the council is identified as the primary driving force behind this, its influence being evident in three key areas:

1. As a civic leader, Woking Borough Council has led by investing in decentralised energy to serve its own built stock and championing the use of low carbon and renewable energy to other property owners and operators of buildings in the borough, encouraging them to switch their consumption from grid energy to decentralised low and zero carbon sources.

2. The council has used its discretionary powers and services to provide information, advice and targeted financial support to local business and residential communities to encourage investment in decentralised LZC energy.

3. The council has used its statutory and regulatory powers to maximise opportunities to drive up standards for new development in the borough through a wide range of policy and implementation tools.

Environmental protection and addressing climate change have been priorities for the council for the last ten years and Woking has well-established programmes for carbon mitigation including championing the use of decentralised energy production. As a result, nearly half the installed PV capacity of the south east is located in the borough, and heat and private wire electricity distribution networks have been installed in Woking and in Milton Keynes.

In addition to its generating and distribution capacity, the council has invested in the operational infrastructure through the establishment of Energy Services Companies (ESCos) to manage these assets. The Thameswey Group was set up in 1999 to further the council's climate change and environment programmes, and is now responsible for operating assets worth in excess of £25 million. In recent years the Group has expanded and diversified its activities to encompass energy planning and engineering, property and house building, and community outreach on behalf of the council. This has resulted in the acquisition of skills and experience that provide the council with a delivery vehicle that has significantly enhanced the borough's capacity to secure investment in new infrastructure. The existence of a wellresourced delivery vehicle is a key attribute for the council in seeking to progress its objectives through the Core Strategy.

5. Opportunities for Developing Renewable and Low Carbon Energy in the Borough

The study has sought to identify the opportunities and constraints tin relation to renewable energy generation in the borough. Across the South East as a whole, medium-large onshore wind, energy from waste and biomass heat and power are anticipated to provide the primary sources of renewable energy. The potential for renewable energy generation from these sources in Woking has been considered in Section 5 of this study. We conclude that a number of physical and environmental constraints limit the opportunities large scale renewable energy generation in the borough, especially from wind with very few unconstrained sites. Whilst the introduction of the Feed in Tariff has reduced the minimum wind speed threshold at which investment in wind power may be secured, within Woking there is little evidence yet of this over-coming other barriers to wind development arising primarily from environmental constraints and competing land uses.

The South East Plan sought to achieve over 25% of the Surrey and Thames Valley sub-region's renewable energy through biomass heat. However, this is dependent on a number of factors, with increased resource availability and establishing new supply chains being essential if a significant growth in demand is to be met. Whilst other studies have concluded there is good availability of biomass fuel stocks both within the region and from further afield, we have concluded that production within the borough will be constrained by two primary factors:

- Biomass production will have to compete for land with food production and recreational uses in the south of the borough and the Wey valley
- Environmental constraints relating to protected heath land where commercial extraction of biomass will need to fit within regulated habitat management regimes

However, there is evidence of wood fuel supply chains within the county becoming more established and we conclude that the importation of biomass from a number of sources, including timber removed from waste streams, could make a significant contribution to renewable heat generation in the borough. Factors that would contribute to the development of biomass energy in Woking include the presence of heat distribution mains in the borough, an established ESCo that could diversify its generating infrastructure to include biomass heat (and potentially CHP), and utilising rail delivery for storage and local distribution via the existing aggregates yard in Woking.

There is no current production of energy from waste in Woking and the potential for this to contribute to the borough's energy mix is largely dependent on the future strategy for waste collection and disposal at a county-wide scale. The Surrey Waste Plan identifies only one site (Martyrs Lane) where thermal treatment is an option, although a number of other sites associated with industrial uses may be suitable for energy recovery through non-thermal processes such as anaerobic digestion, and we conclude this is the most practical route for introducing renewable energy from waste into the borough's energy mix. The proposed introduction of incentives for the use of biogas for renewable heat production may stimulate investment in anaerobic digestion in the borough, but at this time we are not able to predict with confidence the level of take up that will occur in Woking.

The borough has extensive small scale (micro-generation) of solar energy. The council is a recognised leader in the installation of PV on its own buildings and has set up a programme to encourage residents to retrofit solar energy technologies. There is approximately 0.74

MWpeak installed capacity of PV currently in Woking. We have calculated there is the potential for a further 3.7 MWpeak to be installed on public and community buildings and the council's housing stock. Solar hot water panels have been installed extensively throughout the borough by private residents and by developers in response to planning policy requirements. We anticipate micro generation of solar electricity and heat will continue to play an important role in small scale renewable energy production in the borough.

The use of gas-fired combined heat and power (CHP) is well-established in Woking, and the council has received acclaim for its use within decentralised energy networks. The presence of heat distribution infrastructure in parts of the town centre and experience gained in its operation through a well established ESCo places the borough in a strong position to seek further investment in new CHP generating and distribution infrastructure. The potential for extending the existing network and creating new energy generating assets to increase use of low carbon energy is considered in more detail in Section 7 of the study.

Our assessment of the potential for generating renewable energy from other sources including low head hydro, landfill gas and sewerage methane concludes there is little opportunity for their exploitation as insufficient resources exist within the borough.

6. Development and Growth in Woking

The council is seeking to make provision for 4,964 new dwellings be built in the borough in the period 2010 – 2027. The focus of development is proposed to be within Woking town centre, where the council anticipates just over half of all new residential units will be located. Development in West Byfleet, along with infill development in Local Centres and the rest of the urban area will provide 1,170 new homes. Major sites at Brookwood Farm and Moor Lane (Westfield) will contribute a further 740 units, with the remainder (550 dwellings) to be provided through release of Green Belt land in the later stages of the plan period.

There is unmet need for retail, leisure and other non-domestic uses within the borough, and this set to grow, with a potential growth in floor space for retail uses by 75% from an existing gross floor space of 109,540m2 to approximately 185,000m2 by 2026, with particularly significant growth in non-food retail. The majority of growth in retail floor space is anticipated to be located within Woking town centre. Research suggests there is potential for a new superstore in the town centre, as well as a budget hotel and new office space. It recommends a strategy for growth in floor space promoting high density developments within a compact town centre with a mix of uses. It proposes major remodelling of the town centre to enable large scale non-residential growth, to be facilitated through an Area Action Plan.

The Council's forecast floorspace requirements for office, industrial and warehousing uses are based on different economic growth scenarios and show a requirement for additional office and warehousing space and reduced requirement for industrial space between 2009 and 2026. The requirement for office space is between 17,276m^2 and 66,974m^2, with an additional warehousing requirement of between 33,500m^2 and 130,861m^2. The majority of the required floorspace will be achieved through the redevelopment and intensification of existing sites, with a significant proportion of the office requirement sited within Woking town centre in accordance with its status as a Hub.

This study seeks to explore the opportunities and constraints for setting a policy framework that is predicated on new development meeting a significant proportion of its energy demand from local LZC energy sources, which is discussed in more detail in section 7.

7. Future Energy Demand and Supply in Woking

The concentration of energy demand within Woking town centre and its potential for change through planned growth in new residential, employment, retail and other uses, demands a more detailed understanding of existing energy consumption and how this is expected to change through growth and redevelopment. Modelling of energy use by the existing and proposed development in the town centre has been carried out to identify the distribution of energy demand (particularly heat), and predicted changes in demand as a result of redevelopment.

Energy demand has been modelled on the basis of three timescales:

1) Current demand assuming full occupancy of existing buildings
2) Demand in 2017, based on five years delivery of new housing post adoption of the Core Strategy, assuming completion of major extant consents and delivery of the town centre's share of new housing provision to meet the housing trajectory. All developments to be built on the basis of current and planned future national minimum energy efficiency standards.
3) End of plan period (2027) reflecting significant growth in town centre commercial and retail floor space as proposed in the Council's non-residential growth forecasts. All developments to be built on the basis of current and planned future national minimum energy efficiency standards.

The heat mapping models for 2017 and 2027 are on the basis of planned revisions to the Building Regulations set out in the Zero Carbon Homes and proposed Zero Carbon Non-domestic buildings timelines. The methodology employed for the energy modelling and mapping is set out in appendices I and II,

A series of heat and electrical demand maps for the town centre have been produced (Appendix III). The outcome of this exercise can be summarised as follows:

- Existing heat demand in Woking town centre is greatest in four 'quadrants' - the northern part of the town centre (the 'Civic quarter'), the eastern edge of the town centre (the 'eastern office quarter') , the southern edge of the town centre (Community Health campus), and the western edge of town centre
- Electricity demand in the town centre differs in distribution to heat demand, with the highest demand in the main retail centres
- Whilst redevelopment in Woking town centre will result in the replacement of older, less energy efficient buildings with buildings that are of significantly greater energy efficiency, the increase in building density will result in a net increase in overall energy demand. However, the demand profile is also likely to change, with a lower heat demand (per m^2) , higher total electrical demand (due to more intensive land uses) and greater diversity of demand as a result of more mixed uses

The modelling indicates that despite the planned introduction of higher mandatory standards for energy efficiency, the combined effects of higher density redevelopment within areas of retained buildings will result in the continuation of existing heat density loads, with some areas where this is likely to increase.

The study identifies areas within the town centre where high heat density and diversity of load would favour the use of district heating networks. Whilst some additional heat capacity can be provided by the existing town centre energy station, this is not sufficient to meet all the growth in heat loads throughout the town centre. Furthermore, the presence of physical barriers (such as the railway line) and high costs associated with the installation of heat and cooling mains, will limit the reach of the heat supplies from the energy station. Therefore, it is recommended that a strategy de developed for supplying district heating elsewhere within the town centre in areas designated 'District Heat Zones' where planned growth would favour the use of district heating networks. Within these zones, it is recommended that planning policies be adopted to require new development to contribute to the creation of new community heat generating and distribution infrastructure, and its use to supply low/zero carbon heat. District Heat Zones are recommended in the following locations:

- Extensions to the existing heat and cooling network connected to the town centre energy station at Victoria Way.
- West of Victoria Way encompassing potential redevelopments in Goldsworth Road, Church Street West and Poole Road
- East of Victoria Way to include the town centre 'Gateway' redevelopment proposals and redevelopment opportunities in the vicinity of the fire station and former post office
- South of the railway there is the potential to establish a heat network serving existing 'anchor load buildings' (including the police station, community hospital and magistrates courts) and major redevelopment sites

A number of small decentralised energy networks have been established outside the town centre, including CHP installations in Woking Leisure Centre and the Pool in the Park, and smaller heat networks serving primarily council-operated sheltered housing schemes throughout the borough. However, there is limited potential for extension of these schemes as they have limited excess capacity.

The use of renewable energy micro-generation is now an established requirement for new development throughout Woking. This is set out to continue in order to capitalise on market incentives (such as Feed in Tariff and Renewable Heat Incentive), and in order for new developments to comply with increasingly demanding mandatory standards required by Building Regulations and the Code for Sustainable Homes. In locations where there is no existing heat network and District Heat Zones are not proposed, it is recommended the council maintains the momentum it has achieved through negotiating energy efficient building design and provision of low and zero carbon energy through on-site generation.

With the introduction of mandatory lower limits on carbon emissions from energy through revision of Part L of the Building Regulations in October 2010, and further revisions planned for 2013 and 2016, it is anticipated that incremental improvements in the energy efficiency of all new development will be accompanied by greater adoption of micro-generation in order to achieve the mandatory standards, especially from 2013 onwards. The convergence of standards in Building regulations and the Code for Sustainable Homes Planning continue to drive building-scale carbon mitigation measures, whilst planning will play a greater role in permitting and encouraging the additional low and zero carbon energy supply measures that will be necessary to achieve the 'carbon compliance' components and 'allowable solutions' that are proposed to deliver zero carbon homes from 2016 (and ultimately all other buildings). Work is ongoing on the detailed definition of carbon compliance measures and the mechanisms that are to be used allowable solutions (including a proposed community energy fund), with the consequence that their cost and viability impact cannot be quantified at this stage.

As a result, we recommend the council's policy framework for setting carbon and energy reduction targets for housing be set at levels consistent with the standards defined within the Code for Sustainable Homes and kept under close review during the next 12 months, during which time it is expected that greater certainty will emerge regarding the practical and financial implications of delivering zero and near zero carbon developments.

In some locations, good opportunities exist to provide decentralised energy as part of their redevelopment for new business uses. For example, small-medium wind turbines may be appropriate where they can be positioned away from sensitive receptor sites, and large roof areas of warehouse or industrial buildings and surface car parks can support extensive arrays of solar panels. Where there is adequate base heat demand, these locations may also be more appropriate for biomass boiler and CHP plant, especially if connections can be made to buildings with high process heat demand or neighbouring housing stock. Therefore, the council's policy for development in these locations can seek to secure significant levels of sustainable energy generation, either as a requirement as part of a development proposal or, by adopting policies that encourage use of existing of industrial estates as suitable sites for 'stand-alone' renewable and low carbon energy installations.

The development of data centres has the potential to create a significant increase in demand for power to meet their operational needs, and in particular their cooling loads. It is recommended that the council considers how it wishes to address this type of development within the broader context of its strategic ambitions to stabilise and lower carbon emissions from energy consumption within the borough. Opportunities should be sought to re-use waste heat from data centre buildings and ensure a proportion of energy demand is met through renewable energy. The adoption of a common set of metrics by which the energy efficiency of data centres can be assessed is also recommended.

The council has the opportunity to promote the use of sustainable transport energy, especially in relation to plug-in electric vehicles. The provision of convenient, dedicated charging points would help stimulate take-up of electric vehicles within the borough. The council has trialled the use of planning conditions requiring the installation of electric vehicle charging points in parking areas serving new apartments. These can be provided at low cost within dedicated private off-street parking courts or could be secured by seeking a financial contribution towards the provision of purpose-made kerbside charging points on the highway or in public car parks. It is recommended the council considers more widespread use of planning powers to encourage the provision of electric vehicle charging infrastructure. Developments where this could be sought could include new housing (particularly apartments and dwellings without private driveways), offices and employment uses and large retail schemes.

8. Delivery of LZC Energy within New Development in Woking

This section of the report considers the cost and delivery implications of providing decentralised energy infrastructure. For district heating there is a clear relationship between capital cost and type and density of units. The cost of building district heat networks within Woking town centre and connecting to apartments will be generally lower than providing new district heat infrastructure to serve lower density residential developments outside the town centre. In addition, the greater diversity of heat demand associated with mixed use developments in Woking town centre and other central urban areas adds to the operational viability of heat network the town centre.

Where infrastructure and connection costs are relatively low, this can provide the least-cost strategy for low or zero carbon energy supply in new dwellings. However, the capital cost of connecting to distributed heat has to be weighed against the level of heat demand (and income generated for the energy provider) if investment is to be secured in new energy infrastructure. Where new buildings are designed with very high insulation levels, the viability of heat networks will be reduced unless there is demand generated through serving less efficient buildings and/or large anchor loads. The capital and operational costs of low/zero carbon heat networks also vary with technology type, and do not necessarily reflect their carbon efficiency.

The introduction of market intervention measures such as Feed in Tariff and the Renewable Heat Incentive are likely to have a significant impact on the cost and return on investment of micro-generation technologies as well as district energy systems and new business models are emerging that minimise the capital investment by developers. However, it is too soon to quantify the actual cost impacts for developers, although it is anticipated that these mechanisms will result in significant reduction in the capital costs for developers meeting planning policy objectives for low and zero carbon buildings.

Woking's investment in sustainable energy infrastructure and the establishment of an ESCo delivery partner that is largely owned by the council provides a significant advantage in helping to secure investment by developers. The existence of sustainable energy infrastructure in the borough along with acquired experience in its operation places the council in a strong position to support the delivery of its policy objectives for low carbon energy supply. In addition to providing demonstration schemes, it can offer to partner developers in the provision of new infrastructure or extensions to existing networks, and is able to provide secure arrangements for the operation and management of these assets, including engineering and customer services.

This section of the report includes recommendations for developing supporting guidance underpinning the council's core policies. This can be used to set design standards, to provide the means of defining financial contributions to be made towards investment in new infrastructure and as a source of technical guidance to ensure compatibility between building systems and energy supply networks. It is proposed that this information be set out in the form of Supplementary Planning Guidance (SPG).

Additionally, the use of decision support tools is recommended to assist in the evaluation of technical proposals and encourage dialogue between the applicant and the planning authority. Woking has pioneered the use of such tools to assist implementation of climate change policy and their continued use is recommended to assist the implementation of emerging policies. They can provide greater transparency making complex technical issues more readily understood and help provide consistency in the evaluation of evidence and supporting information. Their use is also recommended for collecting data for the purpose of monitoring policy implementation and it is recommended that appropriate systems are designed to enable monitoring and reporting of policy outcomes.

9. The Potential for Reducing Water Consumption in new Development

The national average for water use in England is approximately 150 litres per person per day (l/p/d). However, in Woking annual water consumption is significantly higher, reaching 170 litres per person per day for metered customers and 195 litres per person per day for unmetered customers and the Environment Agency classifies Woking as being within an area of serious water stress.

The council's Climate Change Strategy prioritises the reduction in water consumption, and sets a target of 130 l/p/d by 2018, twelve years in advance of the same target set by government for average domestic water consumption in England. Two factors external to the council's control will contribute to the reduction in domestic water in Woking. The introduction of tightened Building Regulations standards will reduce consumption in new dwellings to no more than 125 l/p/d. In addition, local water supply company (Veolia) is seeking an increase in the use of domestic water meters from the current level of 40% of dwellings to 90% metered supply by 2030. However, it is highly unlikely these measures will achieve the council's target within the next eight years. Hence, the council is seeking to influence water consumption through its 'Action Woking' programme. In addition, it has the opportunity to drive down water consumption further in new dwellings through adoption of the targets in the Code for Sustainable Homes. Code levels 3 and 4 set a mandatory target of 105 l/p/d. The cost implications of achieving the water standards in Code Level 3 are calculated to be in the order of £200 per dwelling. The higher standards required to achieve further significant reductions in water consumption result in substantially higher build costs, rising to over £4,000 per dwelling for Code Levels 5 and 6. Therefore, it is recommended that the council considers adopting the mid-range targets of 105 l/pd/ as this will reflect the council's ambitions to drive down water consumption, whilst limiting the additional impact on build costs and development viability. Furthermore, the inclusion of these standards will encourage the adoption of a number of measures (such as rainwater harvesting) that will contribute to sustainable drainage.

10. Recommendations for Informing Emerging Policy

On the basis of the evidence set out in this study, it is recommended that the following objectives be addressed in the council's preferred options for its Core Strategy:

Climate Change Mitigation and Sustainable Energy

I. District Heat Zones be identified in Woking town centre as shown on Figure 30 where development shall be expected to connect to heat networks and/or contribute funding towards the development of the networks and be designed to ensure the building services within the development are designed to be compatible with the network.

II. Detailed arrangements for specifying the Heat Zones, financial contributions to be made and building services standards for compatibility be set out in an SPD.

III. Consideration be given to identifying potential sites for new energy stations to serve the Heat Zones, and measures adopted to ensure land is reserved for the installation of distribution pipes and other infrastructure

IV. Developments that propose generating additional heat energy (such as stand- alone boilers or heat pumps) be resisted in the Heat Zones in order to encourage the viability of the low carbon community energy schemes.

V. All new housing developments be built to meet the equivalent of Code Level 3 in respect of energy and emissions until 2013, when this standard is to be revised to code Level 4, unless special circumstances warrant the adoption of higher standards.

VI. Emerging guidance in relation to the technical and economic impacts of achieving Zero Carbon homes be taken into account in reviewing the standards for housing development, such that the council can require all new housing to be built to the Zero Carbon homes standard at the earliest opportunity from 2016.

VII. The council should give early consideration to how it wishes to direct the use of 'allowable solutions' in meeting its objectives for reducing carbon emissions in the borough and supporting the development of sustainable energy.

VIII. Development proposals for data centres and other uses with exceptionally high energy demand be given particularly careful consideration in order to assess the potential for re-using waste heat and meeting a proportion of the development's energy demand through locally generated renewable energy.

IX. In exceptional cases where the proposed standards for carbon emissions reductions are demonstrated not to be possible for reasons of technical feasibility or economic viability, planning consent only be granted subject to payment of a contribution to fund the provisions of community renewable energy equivalent to offset the carbon excess emissions of the development.

X. Until the adoption of core strategy policies, the existing practice of seeking a significant proportion (at least 10%) of energy demands in all new developments though on site generation by renewable means be continued.

XI. The council is recommended to require new development to contribute to the provision of electric vehicle charging infrastructure in the borough, with further detail to be set out in an SPD.

Climate adaptation

XII. It is recommended the council considers setting its policy requirements for domestic water consumption at a figure of 105 l/p/d (equivalent to Code Levels 3 and 4).

XIII. The council should actively promote the use of SuDs and where-ever possible encourage an integrated approach to water management that addresses the objectives of water run-off and reduced water consumption.

XIV. The Council may also wish to consider the introduction of a policy requiring developers to provide 'information packs' to new occupants of that development providing advice on the need for and benefits of restricting water use.

Policy Implementation, Monitoring and Review

XV. That the council continues to work closely with its local partners (including its ESCo) to ensure delivery mechanisms are in place provide and operate new infrastructure.

XVI. The council considers how it proposes to implement its policies, with particular consideration given to the use of guidance, advice and decision support tools (such as checklists and online collaborative tools).

XVII. Monitoring systems be designed and used to ensure the effectiveness of the council's planning policies in meeting their objectives, and the policy framework reviewed as necessary.

1. Objectives and Scope of this Study

This study has been prepared to provide an evidence base to help inform Woking Borough Council's emerging Core Strategy. It provides the foundations on which a policy framework can be built that addresses twin objectives: firstly, responding to the changes in climate that are anticipated during the first half of this century; and secondly, encompassing the emerging needs to provide a spatial approach to local, decentralised energy planning.

The study has focused particular attention on three key areas of importance to be addressed in the council's emerging strategic policies. Energy security is of prime importance, along with stabilising growth in CO_2 emissions. These objectives are closely linked and are national priorities borne out of international agreements and legislation, where local planning has a vital role to play. Minimising the growth in water consumption is a further priority of particular importance in much of south east England where demand through population growth and increased per capita consumption threatens to exceed the availability of water resources, especially in a warming climate where rainfall is predicted to become more intermittent.

The study describes the complex context against which these objectives must be considered. It examines the international, national and regional planning and energy policy landscapes, and establishes a detailed baseline in terms of Woking's of energy and water consumption. This baseline has been expressed at different resolutions, with a detailed analysis of energy demand within Woking town centre where consumption is significantly greater than anywhere else in the borough, and future growth is planned.

Opportunities to develop decentralised low and zero carbon (LZC) energy resources have been explored in order to gain an understanding of the potential for setting a policy framework that is predicated on new development meeting a significant proportion of its energy demand from local LZC energy sources. This will also inform policy options for encouraging 'stand-alone' renewable and decentralised energy within the borough.

Where the emerging Core Strategy anticipates significant changes in the borough through redevelopment of existing aging commercial stock to provide new retail, employment and other commercial buildings, along with the growth in new housing to meet local needs, the study focuses attention on the opportunities that will arise to 'mitigate' carbon emissions (stabilising the level of Woking's CO_2 emissions and placing it on a reduction trajectory) through spatial planning. Similarly, the study sets out the current levels of domestic water consumption in the borough, expressed within the context of national targets for per capita consumption, and proposes measures available to planning to stabilise and ultimately reduce water consumption.

This study has not been conducted in isolation of other evidence that is to inform the council's Core Strategy, and other policy objectives including the delivery of affordable housing and new infrastructure will each have its impact on the cost of development. Where measures recommended through this study are likely to impact on build costs, these have been identified in order to inform a wider economic viability assessment of emerging policies.

The scope of the study also includes exploring the mechanisms for delivery of decentralised energy and other climate change measures through planning and development.

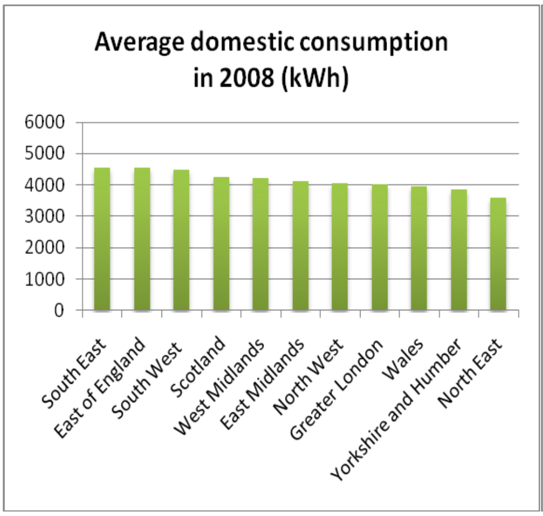
2. The Energy Context for this Study

This section sets out the context for this study in respect of existing demand for energy within the borough of Woking. Drawing the most recently available energy consumption statistics, electricity and gas consumption is compared at a national and regional level in relation to domestic and commercial customer demand. This reveals higher than national average levels of domestic demand for electricity within the region, but in Woking domestic and commercial electricity consumption is lower than average across the South East. Domestic gas demand in Woking is slightly higher than the regional average.

A more detailed analysis of energy demand within the borough is provided showing the distribution of heat and power consumption at MLSOA level.

2.1 Existing Energy Demand in Woking: Electricity Demand

Average metered domestic energy consumption in the South East is the highest in the UK at 4,543 kWh/year (Figure 1). The region's housing density and structure (with a high prevalence of properties using electricity as their main source of heating), and socio-economic factors influencing the purchase and use of electrical appliances could be responsible for this high level of domestic electricity consumption[1.]



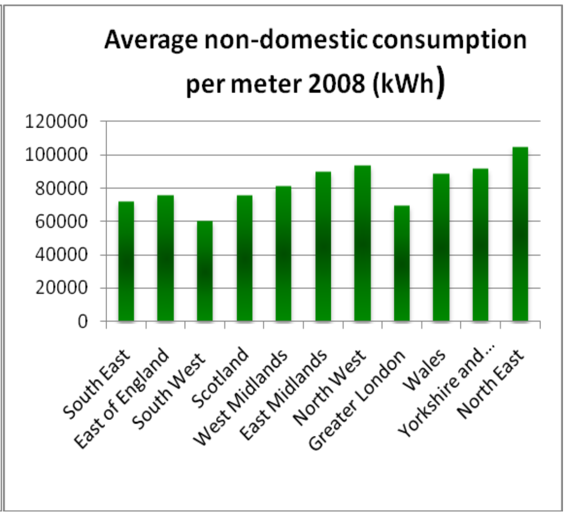


Figure 1 Average metered electricity consumption by domestic and non-domestic customers 2008 (source: Energy Trends March 2010 DECC)

Figure 1 reveals the significant scale of difference between domestic and non-domestic consumption per meter. In the South East, the average domestic meter consumption is only 6% of the total average electricity consumption per meter.

In Woking, whilst average consumption is still significantly higher than the national average, it is a little lower than many other local authority areas in the region (Fgure 2). This is possibly due to the lower dependence on electricity for domestic heating due to the availability of mains gas throughout the borough.

In contrast to domestic consumption, non-domestic electricity consumption per meter in the South East is the third lowest across all the regions. Non-domestic consumption per meter is a function of both the number of non-domestic consumers in an area and the amount of electricity they use. Therefore, areas with relatively few, large scale electricity consumers will tend to have the highest non-domestic consumption per meter.

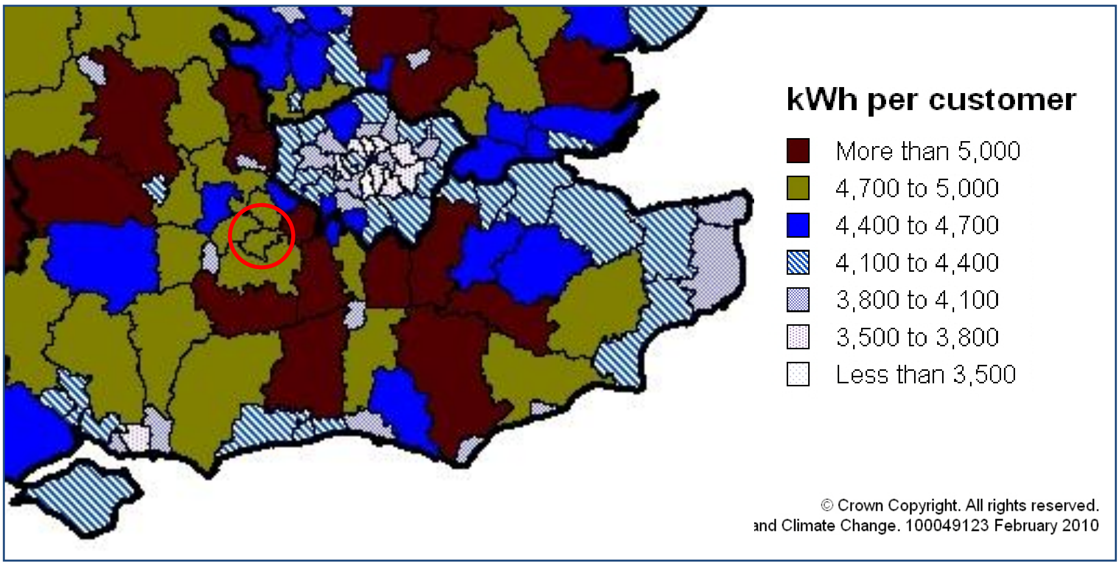


Figure 2 Average electricity consumption by domestic customers in London and the South East 2008 (source: Energy Trends March 2010 DECC)

2.2 Gas consumption

Domestic gas demand generally reflects geographical location as a result of climatic conditions, with northern regions and Scotland consuming more gas per meter than southern regions. However the South East is an exception to this trend, with gas consumption in many local authority areas falling within the top two bands. The average domestic consumption across the region is just over 17,000 kWh per annum and is marginally higher than the average for all the regions and devolved powers which is 16,900 kWh. Within Woking average domestic consumption is somewhat higher than the averages for the region at between 18,000 and 19,000 kWh per customer (Figure 3).

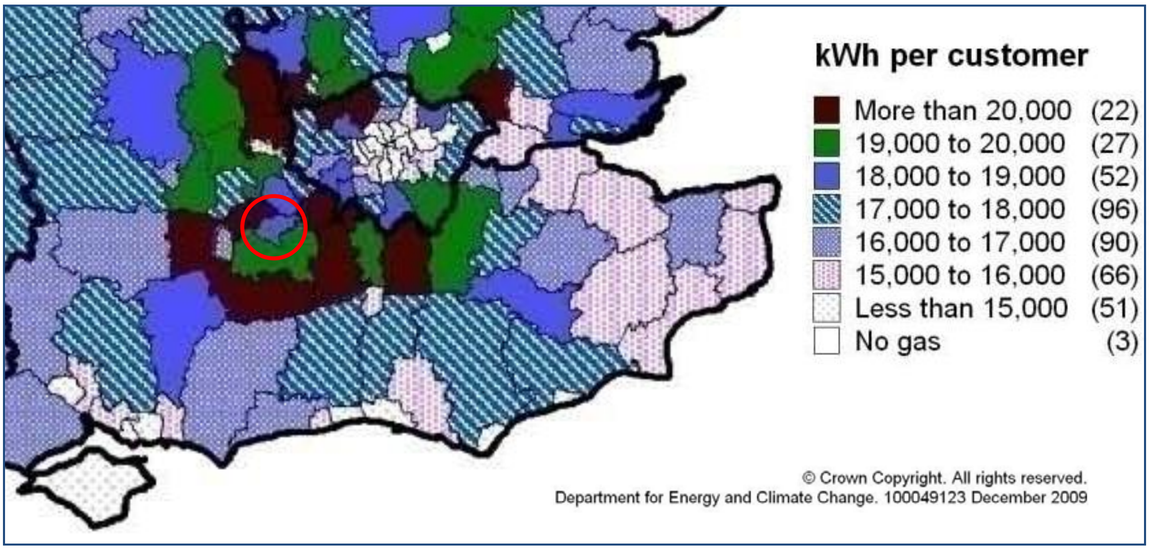


Figure 3 Average gas consumption by domestic customers in London and the South East 2008 (source: Energy Trends March 2010 DECC)

Gas consumption in non-domestic buildings is influenced by the mix of industry found within a region, with some industries being more gas-intensive than others. Hence, Wales has the highest gas average consumption per non-domestic meter, whilst London and the South East have the lowest, reflecting their relatively low levels of gas/heat intensive industry and their economies more focused on the service sector. When this is scrutinised at local authority level, a small number of high-gas consuming industrial consumers can influence the average consumption figures per meter.

Figure 4 shows the gas consumption across the regions, comparing average domestic metered consumption with non-domestic gas customers. It should be noted that the scales in the two charts are different, with mean domestic consumption being measured in kWh per annum, and non-domestic consumption measured in MWh per annum.

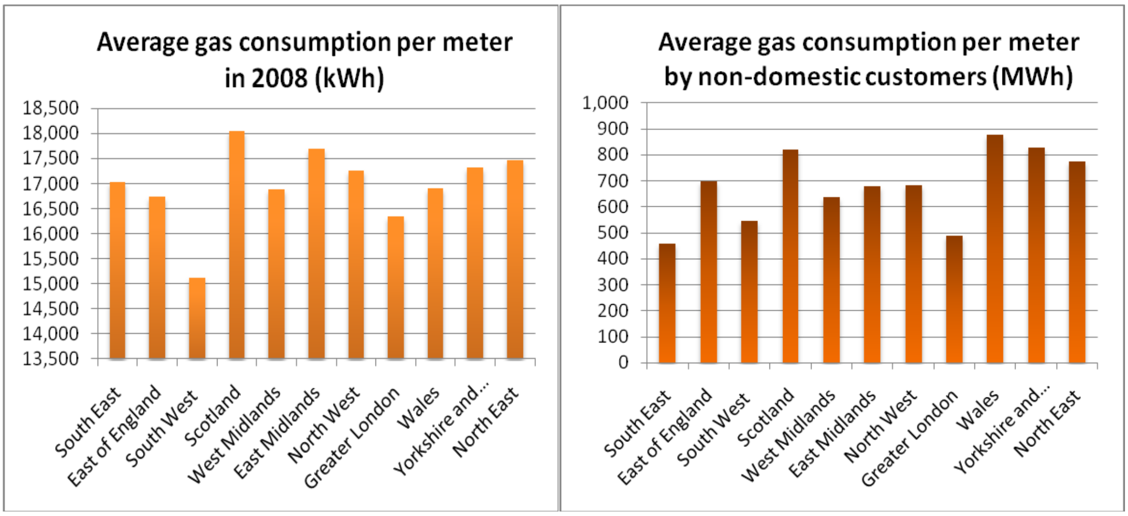


Figure 4 Average metered gas consumption by domestic and non-domestic customers 2008 (source: Energy Trends March 2010 DECC)

2.3 Non-Domestic Energy Demand in Woking

Average commercial and industrial energy demand in Woking is below the average for the region and reflects the relatively small number of high energy consuming businesses in the borough (such as heavy industry and manufacturing) (Figure 5).

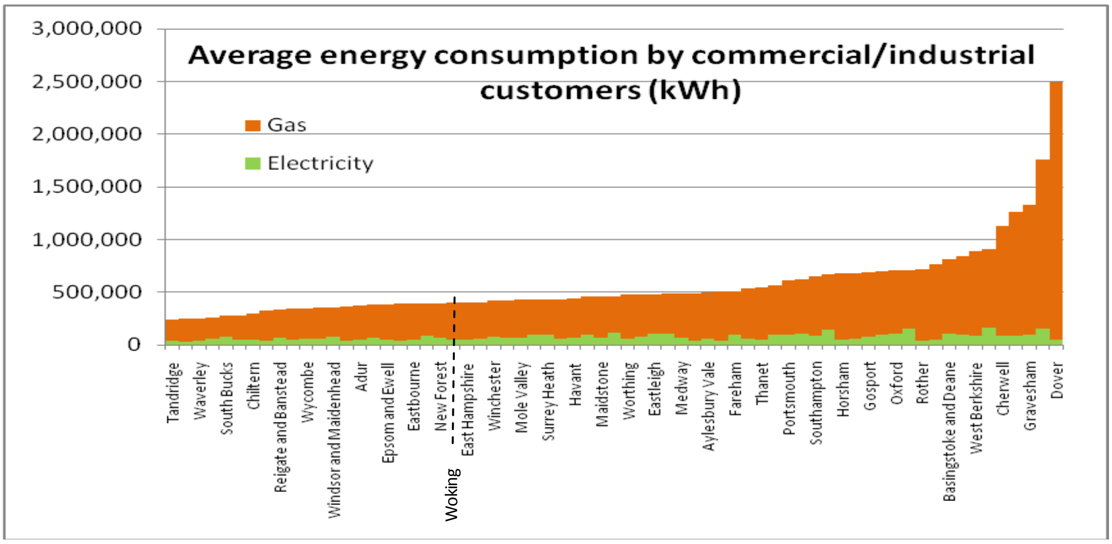
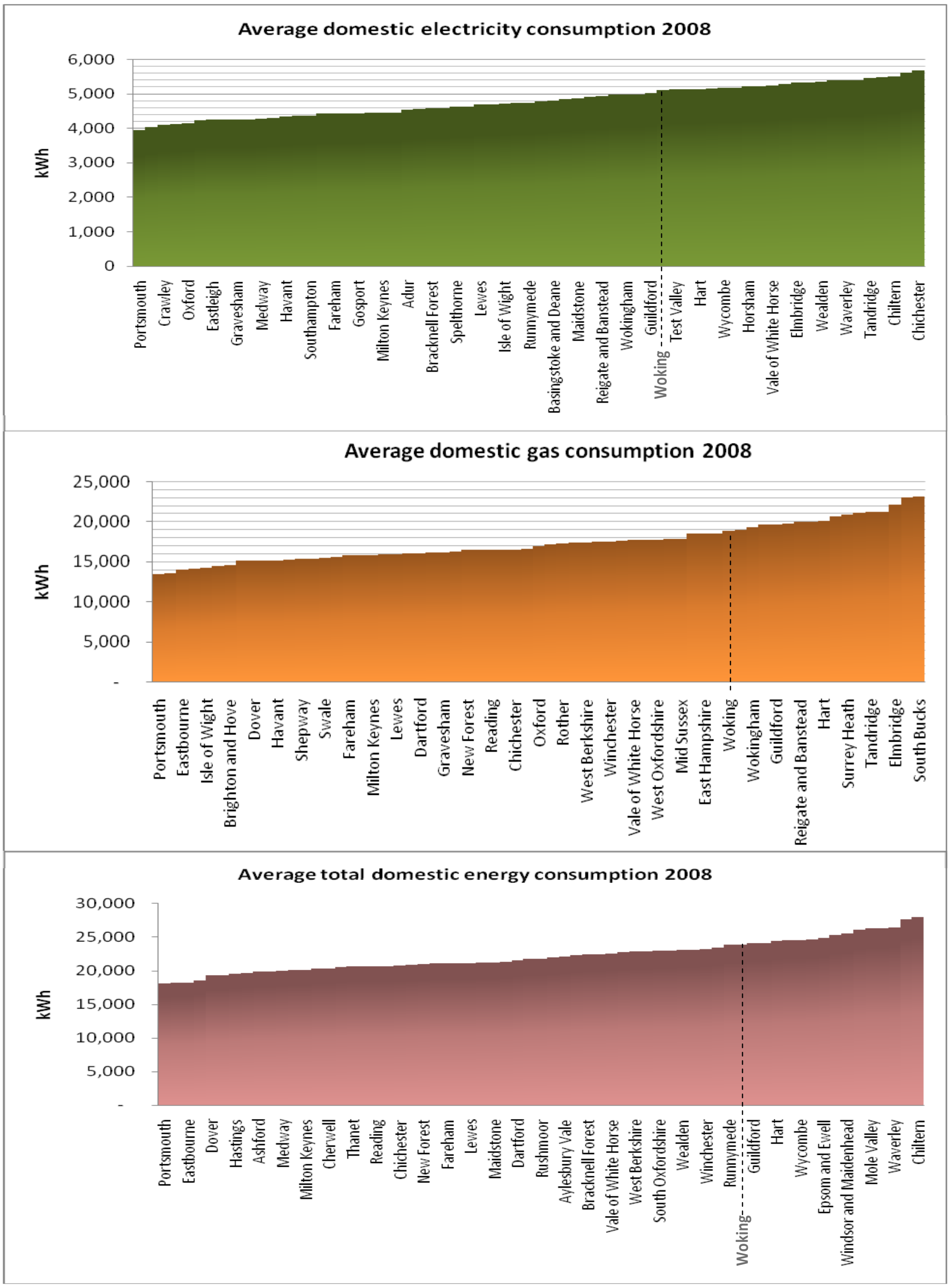


Figure 5 Average commercial and industrial electricity and gas consumption by local authority areas within the South East of England (source: Sub-National Gas and Electricity Sales, DECC 2010)

It should be noted the data available pre-dates the establishment of a data centre in the borough, which as a large consumer of electricity would increase average energy demand.

2.4 Domestic Energy demand in Woking

The most recent domestic energy consumption figures for the south east region indicate household gas and electricity consumption in Woking is higher than the average across the region with an estimated annual consumption of 18,910 kWh of gas and 5,100 kWh of electricity per household (Figure 6 a and b). The total average domestic energy consumption in the borough is 24,000 kWh per year, which places it in the highest quartile (Figure 6 c).



Figures 6 a-c. Average domestic electricity and gas consumption by local authority areas within the South East of England (source: Sub-National Gas and Electricity Sales, DECC 2010)

2.5 Spatial Distribution of Existing Energy Demand

Figures 8 to 11 show the distribution of existing energy gas and electricity consumption within the borough at MLSOA level. This data is based on the most up to date by energy statistics information available from DECC and relates to estimated levels of metered consumption in 2008.

The resolution of information available at MLSOA level is adequate to provide a general picture of the spatial distribution of energy demand across the borough. Whilst this provides a particularly good picture of domestic energy consumption, energy demand within non-domestic buildings is not illustrated well at this level. For example, electricity demand from the largest consumers is not included in this data (see Non-Domestic Electricity Demand below). Non-domestic gas consumption within the MLSOA covering the town centre is over three times greater than any other MLSOA.

For these reasons, it is appropriate to examine energy demand with Woking town centre more closely than elsewhere within the borough, and at a higher resolution than possible using DECC's MLSOA data. Furthermore, the town centre is the focus for the council's strategy for growth, and it is here that some of the most significant impacts of that growth will be experienced in terms of energy demand, and the greatest opportunities lie for influence through the council's planning policies. Therefore, more detailed heat and power mapping of the town centre has been carried out to inform this study, and its outputs are discussed in Section 7.

The energy consumption is presented geographically based on Middle Layer Super Output Areas (MLSOA). These are statistical units based on areas that have a minimum population of 5,000 with an overall mean of 7,200. MLSOAs are built up from Lower Layer Super Output Areas and constrained by local authority boundaries. In Woking, there are 61 LSOAs that are grouped to form 12 MLSOAs (see Figure 7).

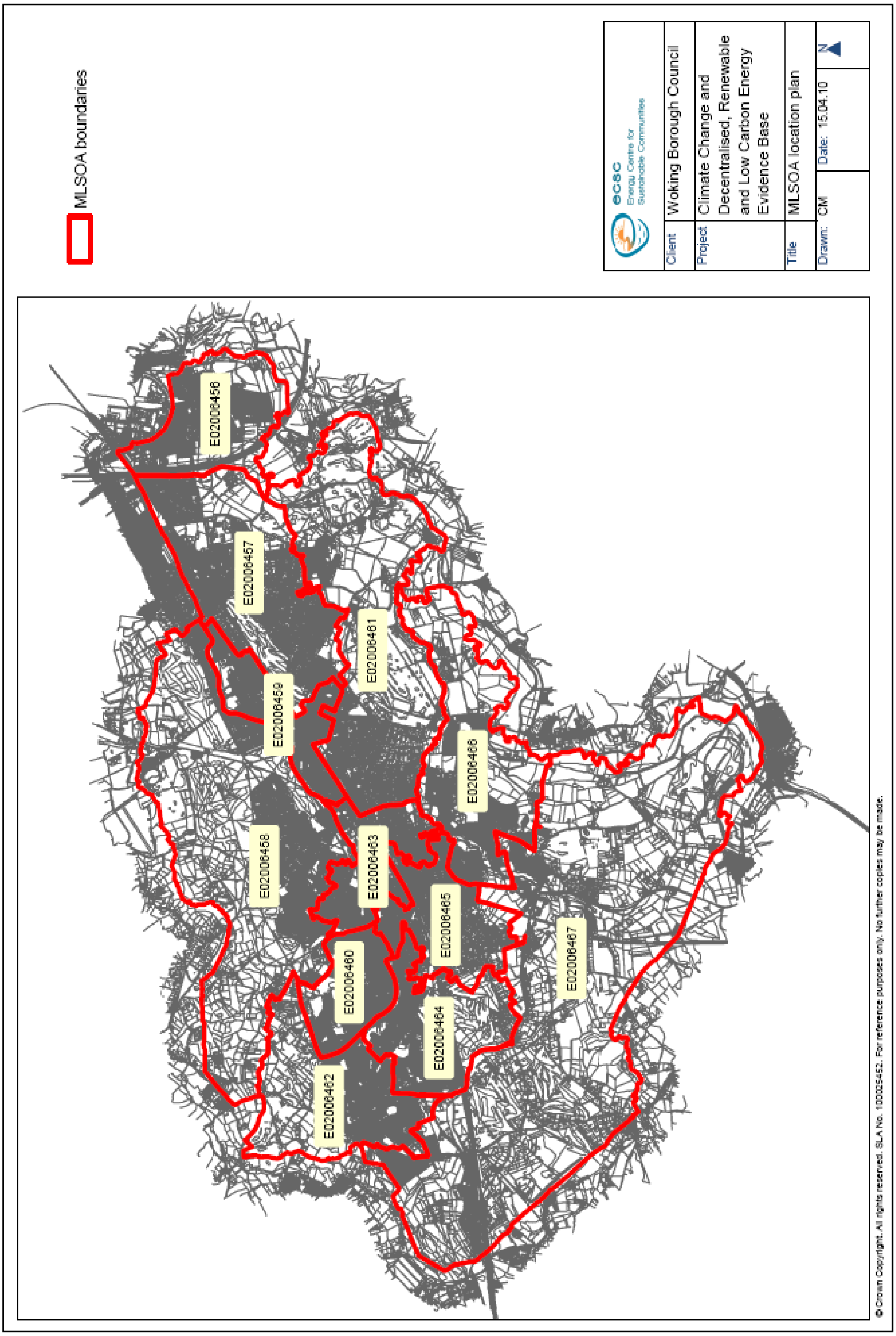


Figure 7 Medium Layer Super Output areas (MLSOAs) in Woking

2.6 Domestic Electricity Demand

The total annual household electricity demand in the borough is estimated to be just under 194 million kWh or 194 thousand MWh). Approximately one third of this consumption is via 12,800 Economy 7 night time meters, and the remainder being via just under 27,000 normal domestic meters.

Figure 8 shows the distribution of average household electricity consumption within the borough based on the sum of both normal and Economy 7 meters.

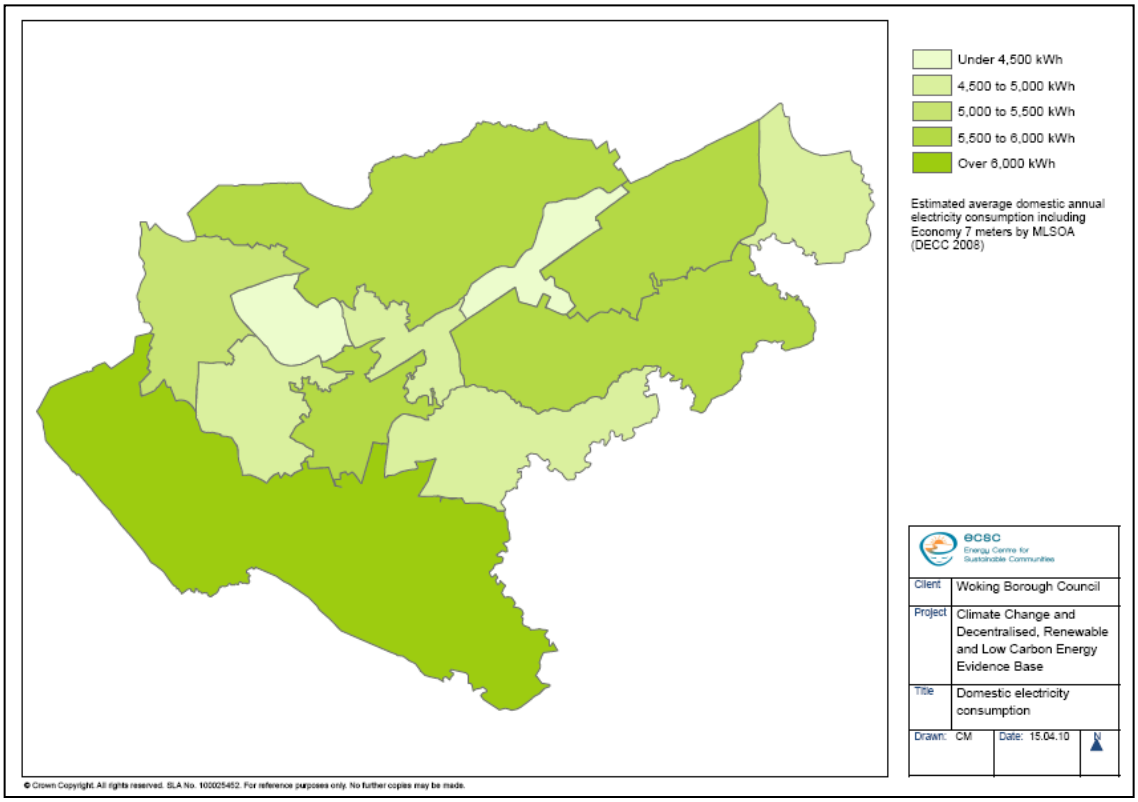


Figure 8 Estimated average domestic electricity consumption

The main conclusions on domestic electricity consumption are:

- Households with the lowest average annual electricity consumption are located in the MLSOAs covering Goldsworth Park, Maybury and Sheerwater. In Goldsworth Park, despite the highest level of Economy 7 meters in the borough (with over 50% of all domestic meters), but the lowest Economy 7 electricity consumption. A number of reasons may account for this, including the uniform age of housing on Goldsworth Park which will have been built to higher standards of insulation than inter-war, Edwardian and nineteenth century stock. In addition, the form of development, with many properties being in short terraces or semi-detached, will also contribute to their energy efficiency. Thirdly, it is possible that many houses on Goldworth Park may been initially built with electric storage heaters and have subsequently installed gas central heating. Whilst housing stock in Maybury and Sheerwater is generally older than Goldworth Park (and therefore likely to be less energy efficient), the relatively small size of housing stock in these areas and lower household income levels may account for the generally lower electricity consumption.

- The second highest number of Economy 7 metered households is in the town centre and parts of Mount Hermon. Here, 45% of meters are Economy 7. A likely explanation for this is night time tariff meters tend to be used where properties are electrically heated. In Woking, mains gas is available to throughout the borough, and electrical heating in domestic buildings will tend to be restricted to flats where individual gas boiler systems are generally not installed. The high proportion of Economy 7 meters in these areas corresponds with the large proportion of residential flats located there. Where a large proportion of properties are electrically heated, high overall consumption would normally be expected. However, this is not the case in the town centre and Mount Hermon areas, probably due to the smaller property size and lower levels of occupancy in these areas.

- The highest average household consumption is in Brookwood, Worplesdon, Mayford and Sutton Green. In these areas, average annual consumption is just under 6,400 kWh and over twice that of the lowest average consumption in Goldsworth Park. The mix of older housing stock and larger houses in these areas generally corresponds with higher average energy consumption.

2.7 Non-Domestic Electricity Demand

The total annual electricity demand by commercial and industrial customers in the borough is just under 300,000 MWh. However, it should be noted that over 70% of all non-domestic electricity demand in Woking is consumed by less than 5% of non-domestic customers in the borough. These large electricity consumers are required by law to have a half hourly meter fitted. Unfortunately, data for half hourly meters is not available at MLSOA level.

2.8 Domestic Gas Consumption

Figure 9 shows the estimated average annual gas demand by households in Woking.

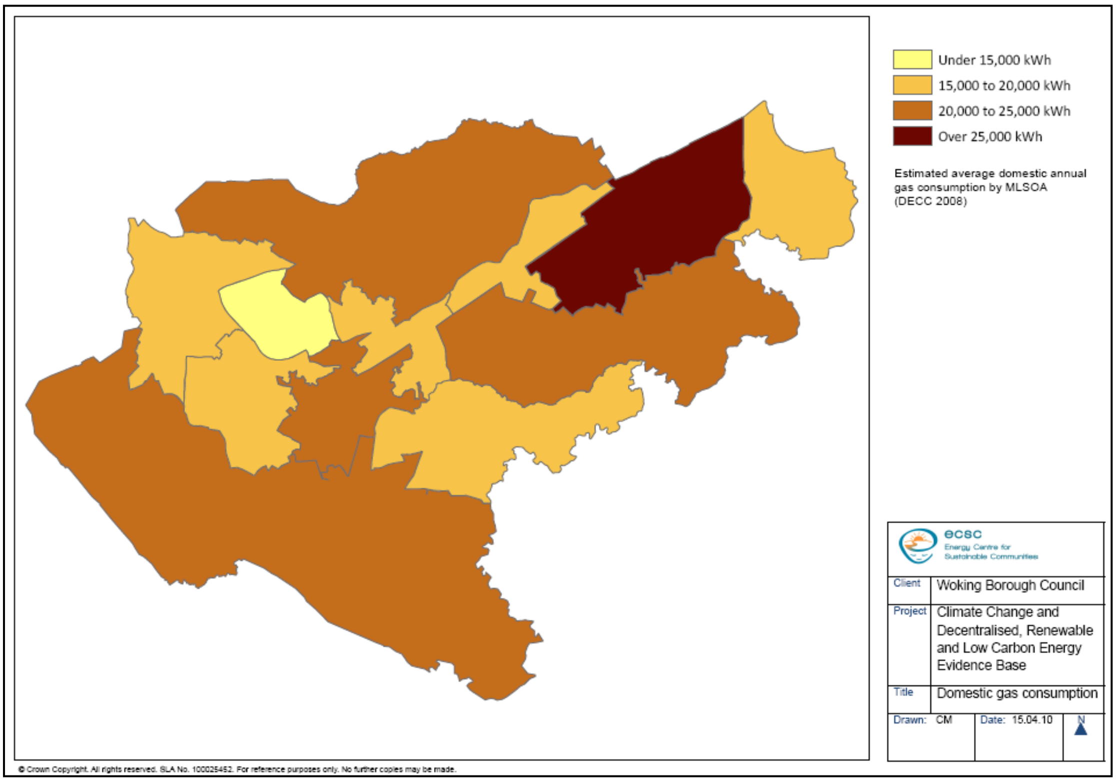


Figure 9 Estimated average domestic gas consumption

The lowest average levels of household gas consumption are in the Goldsworth Park MLSOA. Elsewhere, there is a general correlation between average gas consumption and the size of properties, with smaller average house sizes (such as the town centre, Sheerwater, Maybury, Westfield, Kingfield and Old Woking) having lower average gas consumption than Horsell, Worplesdon and Mayford, and the highest average consumption in West Byfleet.

2.9 Non Domestic Gas Consumption

The distribution of gas consumption levels in non-domestic buildings contrasts with average household consumption. Figure 10 shows the town centre area has significantly higher consumption than any other area and consumes over 37% of the borough's non-domestic gas consumption. The second highest non-domestic consumption is in the Horsell East and Woodham MLSOA, which includes the Goldsworth trading estate. Whilst total consumption by non-domestic buildings here is only a little higher than in other areas, the relatively small number of non-domestic buildings in this part of the borough accounts for the high average consumption.

It should be noted that as the number of non-domestic meters varies significantly between MLSOAs, the total metered consumption by non-domestic buildings for each area has been plotted (as opposed to the average metered consumption by domestic buildings).

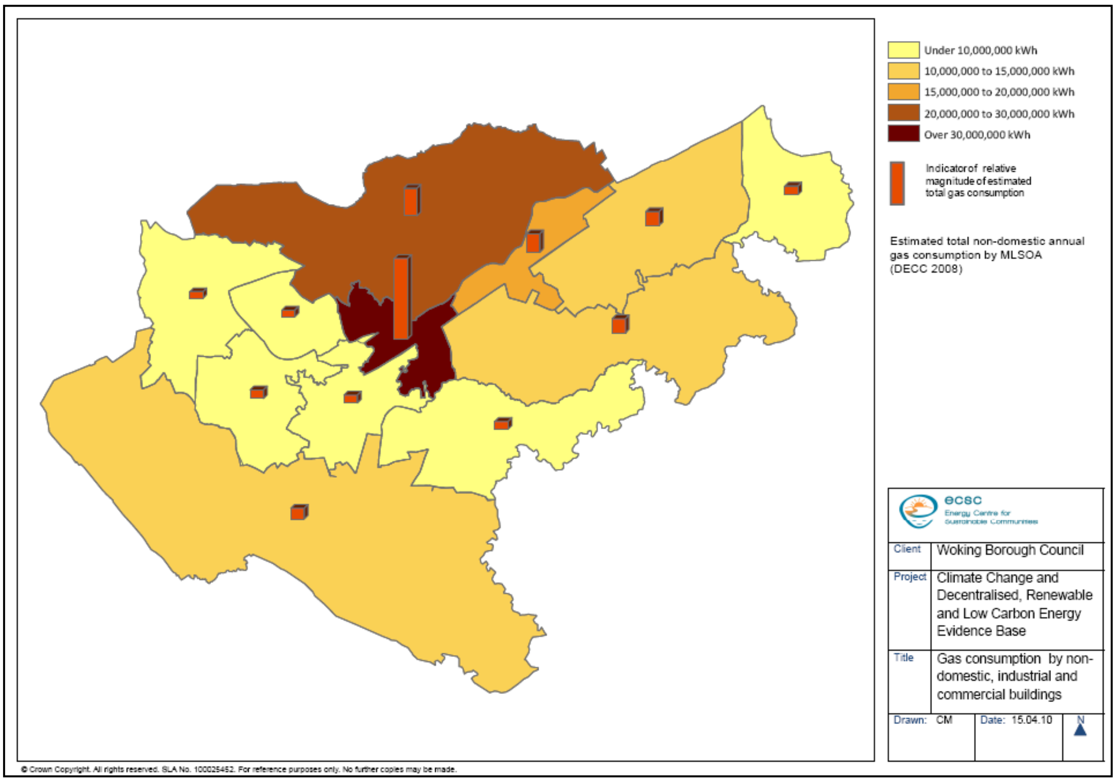


Figure 10 Estimated average non-domestic gas consumption

2.10 Total Gas Consumption

The total combined gas consumption of domestic and non-domestic customers in Woking is shown below in Figure 11. As gas is used primarily for heating and hot water, with only a small proportion used for household and commercial cooking purposes, the total gas consumption provides an indication of heat demand met by natural gas across the borough.

The high level of demand in the town centre from non-domestic customers determines the location of the highest levels of total gas demand. At over 125 million kWh per annum, this is more than twice that of the Goldsworth Park area which has the lowest total annual gas demand. The high levels of total gas demand in the Horsell and Woodham MLSOA and West Byfleet MLSOA can be attributed to the relatively high average non-domestic and residential consumption in these areas respectively.

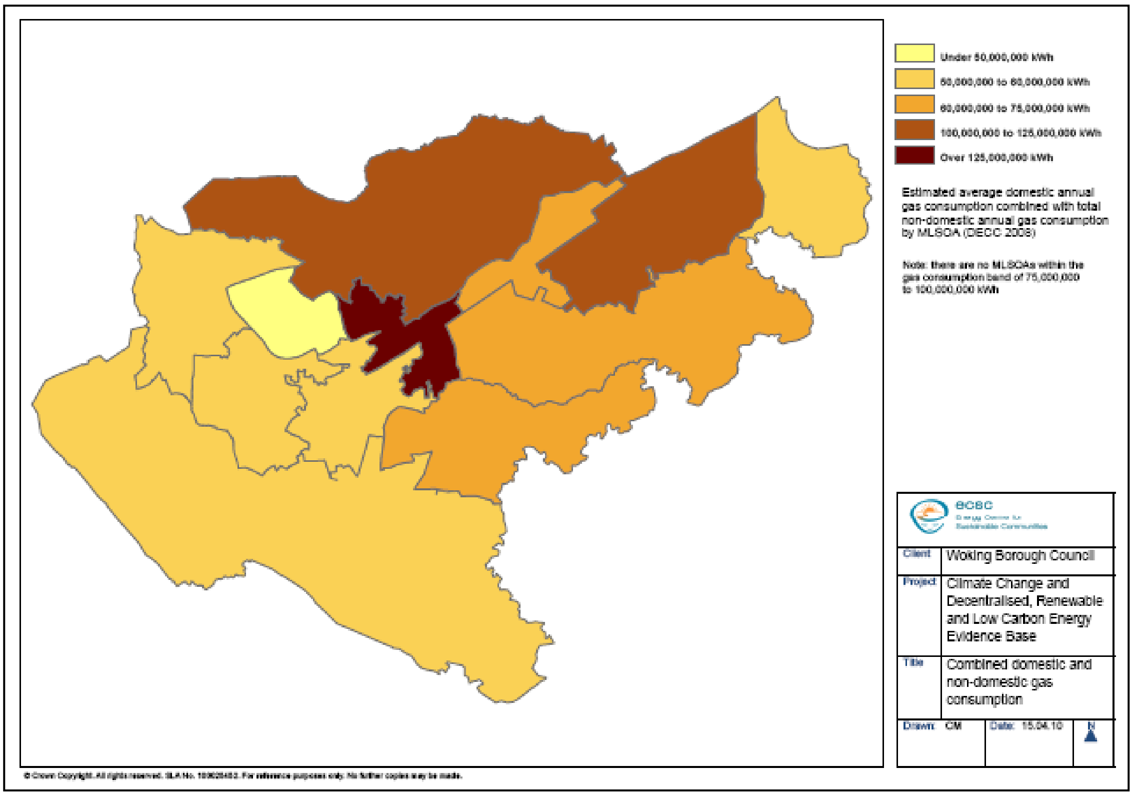


Figure 11 Estimated average total gas consumption

3. The Policy Context for this Study

There is an extensive policy framework context to this study, comprising planning, energy and climate change policy, each operating at international, national and regional levels. The following provides a summary of this context.

3.1 European Policy

There are a number of European Union Directives that have influence over UK national energy policy. These have wide ranging requirements including energy efficiency in new and existing buildings, promotion of international trade in energy supply, development of new renewable and low carbon energy sources, diversification of 'conventional' energy supply, market regulatory mechanisms and targets for reduction in carbon emissions and other harmful atmospheric pollutants.

3.2 Directive on the Promotion of Electricity Produced from Renewable Energy Sources (Directive 2009/28/EC)

This sets a target for the share of electricity to be produced from renewable energy sources in the EU. It defines national indicative targets for each Member State, encourages the use of national support schemes and the elimination of administrative barriers to grid integration of renewable energy. The UK has committed to securing 15% of its energy from renewable sources by 2020 and government has set out how it expects this to be achieved in the UK Renewable Energy Strategy (RES)[2].

3.3 Directive on the Energy Performance of Buildings (Directive 2002/91/EC)

The objective of this Directive is to promote enhanced energy performance of buildings within the European Community. Brought into force on 16 December 2002, each member state was required to enact its provisions into national law by 4 January 2006 (although a time extension of up to three years is available where a Member State has identified a lack of qualified and/or accredited experts to carry out the required energy assessments and energy performance certification.

In the UK, implementation of the requirements of this Directive has been through amendment to existing Acts and regulations (including amendment to the Building Regulations 2006 and amendment to the Building Act (1984). These have introduced new regulatory mechanisms including Energy Performance Certificates (EPCs) and Display Energy Certificates (DECs).

EPCs are to be made available to the owner or to the prospective buyer or tenant when a building is constructed, sold or rented out. The certificate is to contain reference values such as current legal standards and benchmarks to allow comparison of the energy performance of buildings. It is to be accompanied by recommendations for the cost effective improvement of energy performance. In England and Wales, the requirement for an EPC forms part of the Home Information Packs. Additionally, a DEC has to be displayed prominently in all buildings over 1,000 m^2 where public services are provided to a large number of persons and are therefore frequently visited by the public. This is valid for 1 year and has to be accompanied by an advisory report (containing recommendations for the improvement of the energy performance of the building) which is valid for 7 years. The Government is currently reviewing its requirements in respect of DECS with a view to broadening the requirements for the display of DECs to make this mandatory for commercial buildings[3]

It should be noted that domestic EPCs show only the predicted energy consumption from benchmark data, they do not show the actual use from occupancy. Conversely DECs show the actual use, from meter readings, of the building being certificated.

3.4 National Policy and Statutory Instruments Relating to Energy and Emissions

National government is seeking to bring about major re-structuring of the UK's energy supply through a wide range of measures including increased capital investment by public and private sectors, new incentives for low carbon energy infrastructure, increased market stimulation and reform of regulatory and market structures. In addition, adaptation predicted changes in climate present significant challenges to the existing built and natural environments, and there is a pressing need to provide greater climate resilience.

The planning system has a key role to play in bringing about these changes. By positively encouraging more sustainable forms of development that are highly efficient in energy use, maximising the generation of low and zero carbon (LZC) energy, and minimising vulnerability to changes in climate, planning can make a significant contribution to national and regional objectives for mitigating climate change and responding positively to it.

3.5 PPS 1 Climate Change Supplement (published December 2007)

One of the key principles of the PPS Supplement is that local planning authorities should ensure that development plans contribute to global sustainability by addressing the causes and potential impacts of climate change through policies which reduce energy use, reduce emissions and promote the development of renewable energy. The PPS requires local planning authorities to set out a clear and evidence-based local policy framework through which development proposals are to be assessed in terms of measures to reduce greenhouse gas emissions, and resilience to changes in climate.

PPS1 Supplement makes it clear that where local circumstances warrant higher standards of energy efficiency, LZC energy and climate change resilience, these must be clearly expressed and evidenced.[4]

3.6 PPS22 Renewable Energy (published August 2004)

This PPS sets out the Government's policies for renewable energy and introduces a strong encouragement to plan positively for renewable energy, for both stand-alone energy developments and also when incorporated into new developments. It states that Local Development Documents may seek to secure a percentage of the energy used in new developments from renewable energy generated on site. PPS 22 also seeks to foster greater community involvement in renewable energy projects.

3.7 Consultation Draft Replacement PPS

The previous government published a consultation draft PPS that was intended to replace PPS22 and the Climate Change Supplement to PPS1[5]. The draft PPS sought to secure 'radical cuts in greenhouse gas emissions', and expects planning to 'actively support and help drive the delivery of low carbon energy'.The draft PPS expects planning local and regional policies to help bring about the transition to a low carbon economy and places a greater emphasis on the importance of a community-scale focus in preparing evidence for plan-making. Specific measures that were positively encouraged in the draft PPS include identifying opportunities for renewable heat networks, allocating strategic sites in the core strategy that are central to delivering decentralised energy and setting criteria for site selection for new development that include the extent to which decentralised energy can contribute to a development's energy demand and a development may contribute to a heat network. Other measures supported by the draft PPS include the provision of charging infrastructure for electric-powered vehicles.

The coalition government has signalled its intention to reform the planning system with the revocation of regional spatial strategies and the introduction of a new simplified national planning framework. In time this is likely to lead to the replacement of PPS with a new policy framework.

3.8 The Planning and Energy Act (2008)

This enables planning authorities to set requirements for energy use and energy efficiency in their Development Plans, including a proportion of energy used by development to be of a LZC source, and/or setting energy efficiency standards in new development that exceed those set out in Building Regulations.

3.9 The Climate Change Act

Development of renewable and low carbon energy provides one of the mainstays of the provisions set out in the Climate Change Act. The Act puts into statute the UK's targets to reduce CO_2 emissions through domestic and international action by at least 80% by 2050 and at least 26% by 2020, against a 1990 baseline. The Act is supported by the UK Low Carbon Transition Plan[6] which sets out the UK Government's strategy for climate and energy and proposes measures to reduce carbon emissions across all sectors.

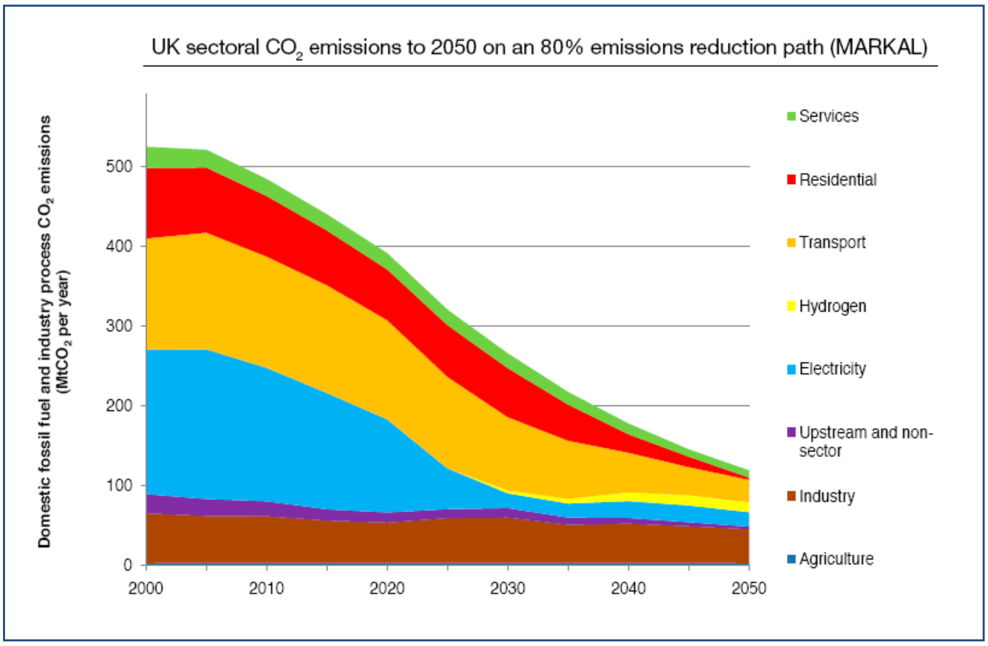


Figure 12 Carbon descent trajectories for sectors (source: DECC 2009)

3.10 Energy Security and Mix

Security of the UK's energy supply and its distribution, and reducing the carbon emissions arising from energy generation and use, are two of the main national policy drivers behind UK government policy. In addition, tackling fuel poverty has shaped UK energy policy. Increasing diversity of energy supply, along with reduced dependence on UK-sourced and imported fossil carbon fuels, form part of the national strategic response to these objectives.

The Renewable Energy Strategy (RES) seeks to decrease demand for fossil fuels by 10 % and reduce gas imports by 20-30% by 2020[7]. It also sets out ambitious targets for increasing the supply of renewable electricity (at least 30% by 2020), and over 10% of heat to be produced from renewable sources. Achieving these targets will require a major shift in the ways in which energy is supplied and consumed in the UK and the RES proposes a range of measures to help achieve this, including reducing the barriers to delivery, and providing greater financial incentives for development of renewable energy.

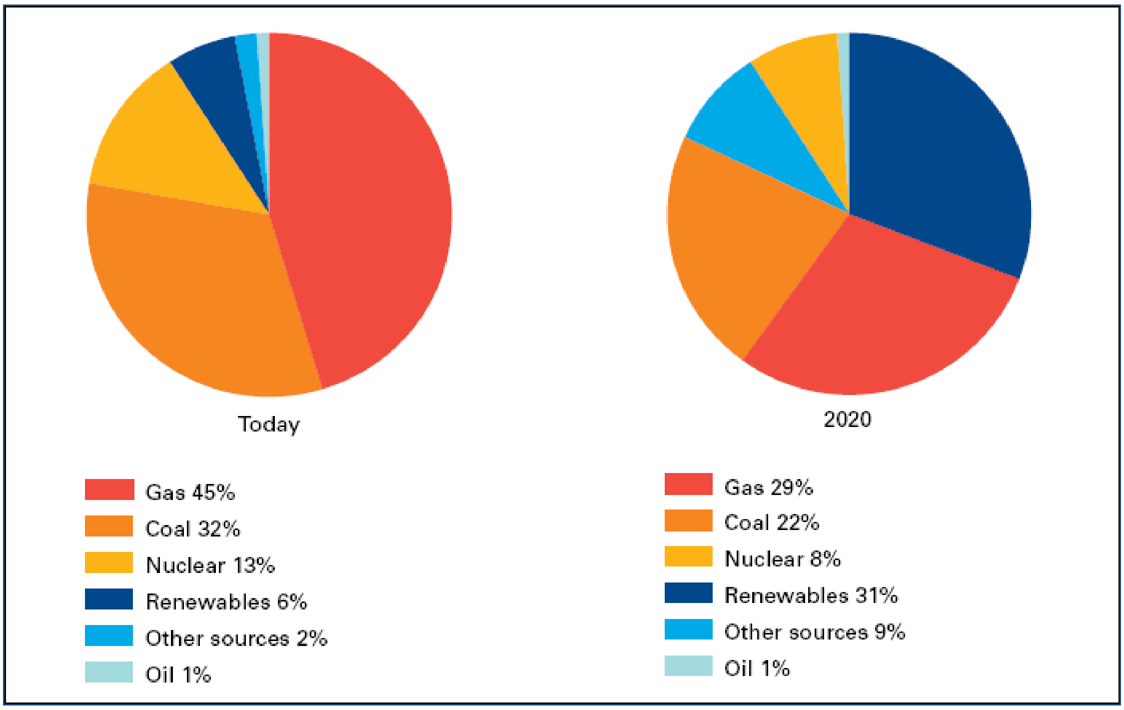


Figure 13 UK targets for switching from fossil-fuelled electricity to 30% renewable energy power generation (source: DECC 2009)

3.11 Financial Incentives

The government is seeking to stimulate greater investment in energy efficiency and renewable energy generation through a wide range of measures. The Energy Act (2008) provided the basis on which the Secretary of State could introduce fiscal measures that reward the generation of LZC energy[8]. This includes the introduction of a feed-in tariff (FIT) for small scale renewable electricity in April 2010 and the planned introduction of renewable heat incentive (RHI) the following year. These measures have been designed to provide a guaranteed income to owners and installers of small scale LCZ heat and power generating technologies at a level and for a duration that is sufficient to incentivise significant investment in these measures.

3.12 Zero Carbon Homes (ZCH) and Non-Domestic Buildings

The government has set the objective for all new houses to be zero carbon by 2016 and non-domestic buildings by 2019 (with government buildings achieving this standard a year earlier in 2018). A number of measures is proposed in order to meet these standards, combining significantly improved energy efficiency along with widespread deployment of renewable and low carbon energy supply systems.

Stepped tightening of standards of energy efficiency are proposed through amendments to Part L of the Building Regulations, with the initial revisions due in October 2010, followed by further revision in 2013. However, ZCH applies to the emissions from all energy uses including those aspects not currently subject to Building Regulations such as energy used for cooking and domestic electrical appliances ('unregulated emissions'). The planned changes in Building Regulations in 2010 and 2013 will not make an impact on unregulated emissions, which can account for between one third and half of all domestic energy use and emissions. Therefore, a further steep descent in emissions will need to be achieved between 2013 and 2016.

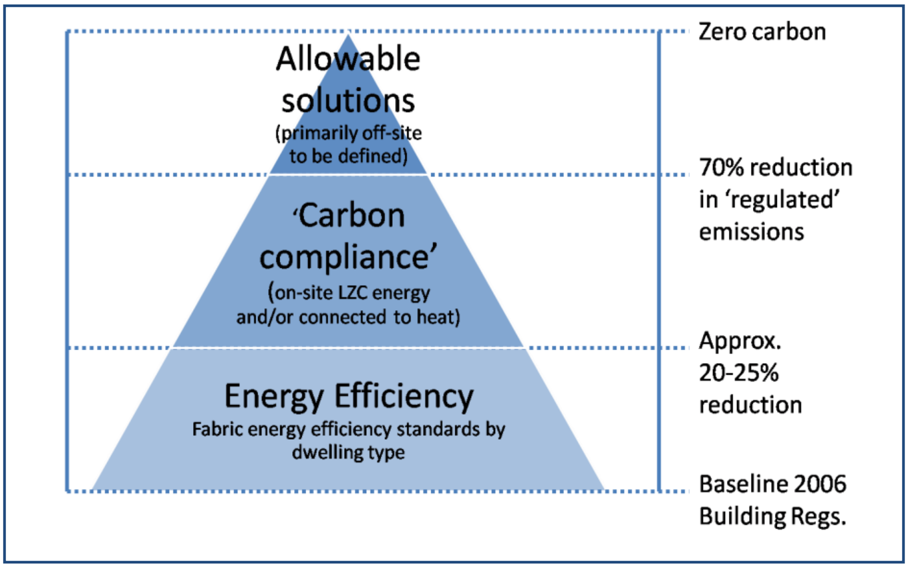


Figure 14 The hierarchy of steps for achieving zero carbon homes (source: CLG)

The government has carried out a consultation on the policy options for zero carbon non-domestic buildings. This has included applying the same approach to non-domestic buildings and houses in a number of areas, but also recognises where fundamental differences exist between the building types.

In domestic and non-domestic buildings, there is an expectation that district heating will become widespread, with nearly half of all new non-domestic buildings expected to have access to district heating.[9] Delivery of this scale of new decentralised energy infrastructure will require strong enabling mechanisms to be set out at every level of planning policy.

Despite high standards for energy efficiency and widespread use of LZC energy, it is acknowledged that achieving net zero carbon emissions through on-site measures alone will be prohibitively costly and for many residential and non-domestic buildings not technically possible. Therefore, both set of proposals include measures termed 'allowable solutions' to address the 'residual' emissions through funding a range of off-sire measures. Proposed allowable solutions for homes include increased levels of carbon compliance, exports of low carbon or renewable heat from the development to other developments, and investments in low and zero carbon community heat infrastructure. Allowable solutions will be expected to mitigate the carbon emissions from a home for 30 years after it is built[10]. It is likely that a maximum price will be set by government for each tonnes of residual emissions to be met by the development industry through allowable solutions.

The challenges of meeting zero carbon will require energy solutions that extend beyond the building envelope, or indeed the red line of a planning application site. This will require the planning system to play a key role in achieving zero carbon development by enabling and encouraging the provision of extensive community energy supply infrastructure. Planners will need to consider the heating and power needs across wider areas and maximise the opportunities for development to contribute to and benefit from community-scale energy infrastructure.

3.13 Decentralisation and Localism Bill and Planning Reform

The coalition Government has stated its intention to significantly reform the planning system through the Decentralisation and Localism Bill that is scheduled to be presented to Parliament before the end of 2010.

The detailed measures have yet to be set out, but the government has signalled that it wishes to move decision making in respect of strategic planning from regional bodies to local authorities and empower local communities to have greater influence over planning and development. Other reforms to the planning system will include replacing planning policy statements with a simplified national planning framework. This is likely to set out the key policy objectives that planning authorities should seek to address in their strategic plans.

In Woking, the council has the opportunity to capitalise on its strong track record in delivering sustainable energy in engaging with the local community. The nature of this engagement will help determine the shape and form of the council's policies, and new opportunities may arise for community participation and benefit in sustainable energy.

3.14 National Policy Context Relating to Water

The following extracts summarise the Government's national planning policies of relevance to planning and water consumption:

3.15 Planning Policy Statement 1 - Delivering Sustainable Development (PPS1)

Paragraph 20 of PPS1 requires that Development plan policies should take into account a number of environmental considerations, including mitigation of the effects of, and adaptation to, climate change.

Paragraph 20 of PPS1 identifies that development plan policies should 'seek to minimise the need to consume new resources over the lifetime of the development by making more efficient use or reuse of existing resources, rather than making new demands on the environment'. It states that, inter alia, this should include 'the sustainable use of water resources; and the use of sustainable drainage systems in the management of run-off'.

Paragraph 27 requires that development plans seek to, inter alia, 'address, on the basis of sound science, the causes and impacts of climate change, the management of pollution and natural hazards, the safeguarding of natural resources, and the minimisation of impacts from the management and use of resources'.

3.16 Planning Policy Statement: Planning and Climate Change Supplement to Planning Policy Statement 1 (Planning and Climate Change Supplement)

Paragraph 23 identifies a number of criteria to be taken into account when considering whether land is suitable for development. This includes existing and potential water supply infrastructure.

Paragraph 31 states that where an LPA is proposing any local requirements for sustainable buildings they must be able to clearly demonstrate the local circumstances that warrant and allow this. An example given in this respect is a requirement for water efficiency without which the envisaged development would be unacceptable in that given location

Paragraph 42 requires, inter alia, for new development to 'give priority to the use of sustainable drainage systems, paying attention to the potential contribution to be gained to water harvesting from impermeable surfaces and encourage layouts that accommodate waste water recycling' (bullet 5).

3.17 Planning Policy Statement 25 - Development and Flood Risk (PPS25)

Annex F (Managing Surface Water) of PPS25 identifies in paragraph F14 that LPAs should:

- Adopt policies for incorporating SuDS (Sustainable Drainage Systems) requirements in Local Development Documents.
- Encourage developers to utilise SuDS wherever practicable in the design of development, if necessary through the use of appropriate planning conditions or by planning agreements.
- Promote the use of SuDS to achieve wider benefits such as sustainable development.

Paragraph F7 of annex F clarifies that the term SuDS may cover the whole range of sustainable approaches to surface water drainage management including, 'source control measures including rainwater recycling and drainage'.

3.18 Building Regulations relating to water

Approved Document G2 of the Building Regulations came into force on 6 April 2010 and states that 'reasonable provision must be made by the installation of fittings and fixed appliances that use water efficiently for the prevention of undue consumption of water'.

Part 17k of the Building Regulations relates specifically to water efficiency of new dwellings and states that 'the potential consumption of wholesome water by persons occupying a dwelling to which this regulation applies must not exceed 125 litres per person per day, calculated in accordance with the methodology set out in the document "The Efficiency Calculator for New Dwellings"'.

3.19 The South East Plan (SEP)

The South East Plan (published May 2009, revoked by the Secretary of State July 2010) provided a regional framework of polices relating to climate change and sustainable use of resources. It encouraged local planning policy to adopt measures in their DPDs to enable the mitigation of, and adaptation to, climate change. The most relevant of these to this study are:

- Improving energy and carbon efficiency performance of new and existing buildings
- Encouraging development and use of renewable energy
- Guiding development to locations offering greater protection from impacts
- Ensuring new and existing building stock is more resilient to climate change impacts
- Incorporating sustainable drainage measures and high standards of water efficiency

The council has been effective in employing the Regional Plan's policy NRM11 (Development Design for Energy Efficiency and Renewable Energy), as an interim requirement (pending adoption of local DPD policies) for all new developments to secure at least 10% of their energy from decentralised and renewable or low-carbon sources unless. The policy as originally adopted applied only to major developments, but the council has taken the view that, on the basis of evidence gathered through the implementation of the predecessor policy SE2 in the Surrey Structure Plan, this requirement is technically and economically viable at a much smaller scale of development has successfully sought its application in smaller schemes right down to single new houses.

The SEP proposed targets at both regional and sub-regional level for the generation of renewable energy and defined a number of criteria for the location of new renewable energy technologies. The target for 2026 generation would meet the electricity demand for a million homes.

	Sub-regional targets land-based renewable energy (Installed capacity - MW)				*Total MW (including offshore wind)*
Timescale	*Thames Valley and Surrey*	*East and West Sussex*	*Hampshire and IoW*	*Kent*	
2010	*140*	*57*	*115*	*111*	*620*
2016	*209*	*68*	*122*	*154*	*895*
2020	*No sub-regional targets*				*1,130*
2026					*1,750*

Table1 Region and sub regional targets for renewable energy (source: SEP, 2009)

The SEP sought to provide an indication of how the targets for renewable energy can be achieved at a sub-regional level based on a broad assessment of resource availability. In the Thames Valley and Surrey sub-region, it assumed a growth in all the main sources of renewable heat and electricity, with wind, landfill gas and biomass meeting the majority of renewable energy generation.

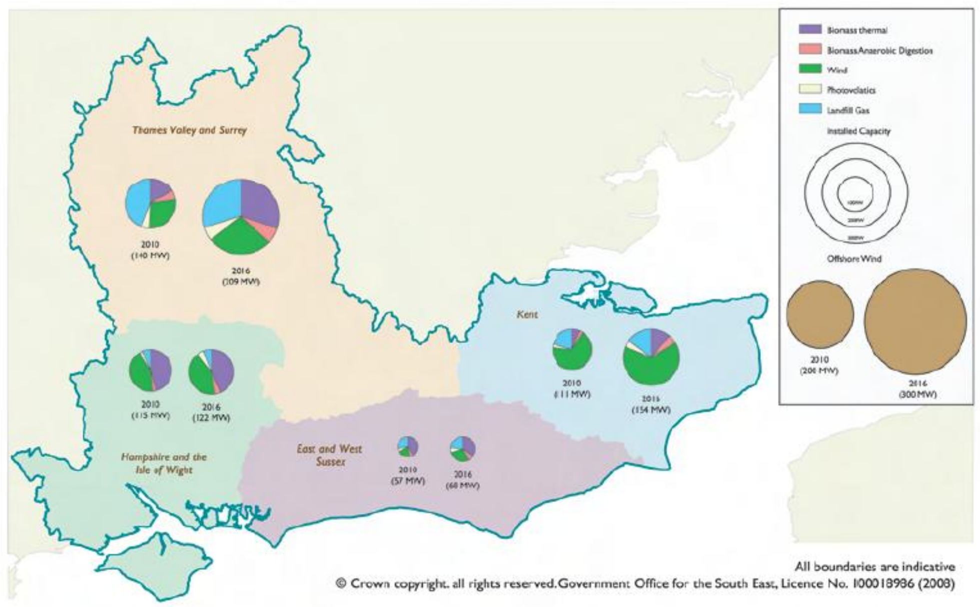


Figure 16 Indicative sub-regional generation of renewable energy (source: SEP, 2009)

3.20 BREEAM standards for non-domestic buildings

BREEAM (Building Research Establishment Environmental Assessment Method) is a methodology for assessing the environmental impact of new buildings. It is nationally recognised for setting best practice for sustainable design and is used by many LPAs as a tool for the application of planning policies.

BREEAM assess the sustainability of a building at both the design and post construction stages. In doing so it assesses and scores individual elements. This includes how well a new building performs in relation to water efficiency and credits are awarded where specific measures are put in place (e.g. water metering).

In undertaking a BREEAM assessment the building has the potential to score either a PASS, GOOD, VERY GOOD, EXCELLENT or OUTSTANDING rating based on an assessment of all the sustainability criteria (not just water efficiency). Unlike the Code for Sustainable Homes (see below) when considering water consumption BREEAM does not base the scoring on an overall amount of litres of water used per person. Instead it relates to a number of individual elements relating to water use, such as water efficient appliances and use of water meters.

3.21 The Code for Sustainable Homes

The Code for Sustainable Homes (CSH) is the Government's national standard for the sustainable design and construction of new homes. The code measures the sustainability of a new dwelling against 9 sustainability criteria including energy/carbon emissions and water efficiency. Each criterion is given a score which contributes to an overall rating based on six levels (1 lowest, 6 highest). The mandatory standards required for energy and carbon emissions have been aligned with recent and planned amendments to Building Regulations. The following table sets out how the assessment scores water consumption. Compliance with these maxima is a mandatory requirement for each Code level.

Code Level	Maximum Potable Water Consumption in litres per person per day
Level 1 (*)	120
Level 2 (**)	120
Level 3 (***)	105
Level 4 (****)	105
Level 5 (*****)	80
Level 6 (******)	80

Table2 Mandatory maximum water consumption for each level of the Code

Although all new homes are assessed against the code, there is no mandatory requirement for new dwellings to meet any specific code level. Instead it gives an indication to the buyer of whether the dwelling had been built to standards in excess of those required by Building Regulations. The exception to this is that Code for Sustainable Homes is compulsory where public sector funding is involved (such as the Homes and Communities Agency)

3.23 Local Strategic Context for Energy and Water

In March 2003, Woking Borough Council became one of the first local authorities to adopt a corporate climate change strategy that sought to place the council on a carbon reduction trajectory aligned with the national target of 60% reduction in emissions by 2050. The council's strategy seeks to address the objectives of emissions mitigation, adaptation and promoting sustainable development in delivering all of its services, including planning. In its updated strategy[11] the council prioritised a number of actions for its planning and regulation services.

Action	Timescale
Encourage the widespread adoption of higher standards promotin[g] development that is more sustainable	1 – 3 years
Incorporate planning policies which will ensure that new developmen[t] in the Borough contributes to a reduction in CO2 equivalent emission[s] of greenhouse gases through the Local Development Framework.	1 – 3 years
Consider options for expansion of the decentralised energy system i[n] Woking including CHP within the town centre and elsewhere within th[e] Borough.	1 – 3 years
Continue to share information and carry out 'Peer Support' work wit[h] other local planning authorities as initiated through Beacon statu[s] programmes.	1 – 5 years
Continue to liaise with neighbouring authorities to establish whethe[r] joint working/unified action would be possible in complying wit[h] Institute of Lighting Engineers (ILE) guidelines and in the reduction o[f] light pollution.	1 – 3 years

Table3 Priority climate change actions for planning and regulation (source: Woking Bough Council Climate Change Strategy, 2008)

Woking's Community Strategy identifies six broad themes for the long term vision for the Borough[12]. These include two actions that are particularly relevant to the preparation of a planning framework:

- Promoting actions to reduce greenhouse gas emissions, respond to the challenges of climate change and encourage sustainable development, and;
- Exploring through policy and action, ways in which all local people have a reasonable expectation of a decent, appropriate and affordable place to live.

4. Existing Renewable and Low Carbon Energy in Woking

The borough of Woking has one of the most extensive decentralised renewable and low carbon energy infrastructures in the UK and has been widely recognised for its work in this area. Over the last two decades the Council has been at the forefront of a radical programme of investment in LZC energy for which it has received national and international acclaim including the Queens Award for Innovation and Beacon authority awards for Sustainable Energy (2005/06) and Tackling Climate Change (2008/09). The council has also been the subject of numerous case studies and best practice examples, including the Carbon Trust[13], Audit Commission[14] and environmental organisations.[15]

4.1. Woking Borough Council's sustainable Energy Programmes

The council has pursued this programme through three main avenues:

11. Civic leadership: Investing in its own property of public buildings and housing stock, and influencing property owners and operators of buildings in the borough to switch their consumption from grid energy to local decentralised LZC sources.

12. Local authority discretionary powers and services: Providing information, advice and targeted financial support to the local business and residential communities to encourage investment in decentralised LZC energy.

13. Use of statutory and regulatory powers: Maximising the opportunities to drive up standards for new development in the borough through a wide range of policy and implementation tools.

As a result of this programme, Woking is at the forefront of LZC energy generation in the region. Its championing of the use of PV has resulted in the borough accounting for nearly half of the total installed PV capacity in the region (Figure 17).

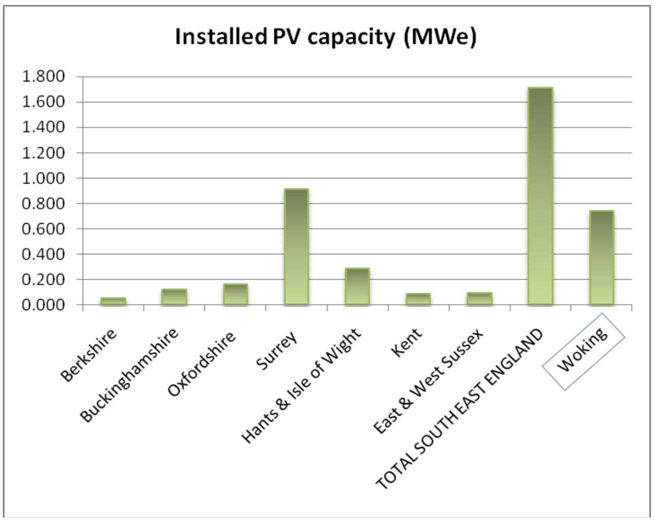


Figure 17 Installed PV in the South East by county (source: SEE STATS, 2009)

4.2 The Council's Role in Civic Leadership

Woking Borough Council has been in the vanguard of decentralised energy and since the mid 1990s has invested in a programme of energy efficiency improvements and LZC energy generation encompassing public buildings and its housing stock throughout the borough. This includes:

- The installation of gas-fired CHP in a number of sheltered housing schemes, community centres, short-stay family accommodation and Woking's leisure and swimming complexes.
- Large PV arrays installed on 15 community and housing sites, and PV-integrated glazing in a new canopy installed in the redesign of the public realm at Woking station/Albion Square.
- A government-funded demonstration project using hydrogen fuel cell technology to produce heat and power for the Pool in the Park complex.
- A 1.4MW_e gas-fired CHP energy station. This provides heating, hot water, cooling and electricity to a cluster of public and private buildings in Woking town centre, including the council's headquarters, the Lightbox museum and gallery and the H.G. Wells conference centre.

The council has also been able to use its influence to encourage other building operators to connect to its heat network. This includes a 150 bed Holiday Inn hotel, the Big Apple entertainment complex and the 'Y-Pod' YMCA. Some large buildings remote from the heat network purchase surplus electricity generated in the town centre energy station, including the large Peacock's shopping centre.

Figure 18 Woking town centre energy station provides heat, power and cooling to public buildings, commercial developments and homes in the north east sector of the town (source: ecsc Ltd.)

Woking Borough Council has also demonstrated innovation in setting up dedicated businesses to accelerate delivery of its environmental objectives.[16] The establishment of the Thameswey group of companies in 1999, which includes two ESCos (Thameswey Energy Limited and Thameswey Central Milton Keynes Limited), has enabled the council to progress its investment in decentralised energy infrastructure through a Special Purpose Vehicle. This has established a robust commercial business platform on which to base further expansion of energy infrastructure and diversify its customer base.

The council has set high standards for the development of its own new housing stock. Its housing company Woking Borough Homes was set up in 2005 to facilitate the delivery of affordable rented properties and is pioneering the construction of high level Code for Sustainable Homes dwellings in the borough. Its development of ten new affordable family homes at Brookwood Farm has been designed to meet CSH Level 5. Brookwood Farm, which is planned for completion in May 2010, has been designed to demonstrate the application of very high environmental standards within a form that development that is highly replicable. Features include roof-integrated solar tiles, very high standards of thermal insulation, heat recovery systems and rainwater harvesting tanks.

Figure 19 New Code Level 5 family homes under construction by Woking Borough Homes at Brookwood Farm, Knaphill (source: ecsc Ltd.)

The council has secured approval for £44 million of PFI credits to fund the development and management of 190 affordable family housing at Moor Lane. The scheme, which will provide up to a total of 400 new dwellings, is required to meet high standards of environmental sustainability including a minimum CSH Level 4 and securing at least 20% of its energy from sustainable LZC sources generated on site. The PFI project has been procured through a process of competitive dialogue which has enabled the council to secure exemplary design proposals from bidders that include the use of community heating with CHP, sustainable drainage (SuDS) and electric vehicle charging.

4.3 Discretionary powers and services

In addition to investing in measures to improve the sustainability of its own buildings, Woking Borough Council has also actively assisted its communities in improving the energy efficiency of private housing stock. It has provided direct grant aid to improve the insulation and energy efficiency of over 5,000 homes across the borough through a number of funding programmes including its *Winter Warmer* scheme targeting vulnerable and older people.

Householder investment in renewable energy has been promoted by the council through the *Woking Solar Frontier* project launched in 2007. This provided advice and access to information for householders wishing to install solar energy. The project has subsequently been developed into *Actio$_2$n Woking*, a broader programme aimed at encouraging households to adopt lower carbon lifestyles through a wide range of energy and water efficiency measures. The focus of *Actio$_2$n Woking* is an energy advice centre in Woking and the Oak Tree House retrofit show-home.

Oak Tree House is a small family home built in the 1950's in Knaphill and is representative of many owner-occupied and rented houses in the borough. Acquired by Woking Borough Homes, it is has undergone a complete refurbishment and equipped to very standards of water, waste and energy efficiency. Information has been provided throughout the house explaining the savings to be made through improved insulation, water and energy efficient fixtures and appliances, rainwater harvesting and solar hot water and PV. Oak Tree House is open to the public and provides the opportunity for residents who are planning to carry out home improvements or whole-house refurbishment to source ideas and benefit from advice and a supplier network.

Figure 20
Oak Tree House is the figure-head of Woking Borough Council's *Actio$_2$n Woking* programme

4.4 Statutory and Regulatory Powers

Woking's Climate Change Strategy has sought to drive up environmental performance within new development in advance of the adoption of Core Strategy policies. In 2004, the council introduced its *Climate Neutral* development guidance for developers. This seeks to encourage development that meets the twin objectives of neutral impact on the climate in terms of emissions and, through inclusion of adaptation measures, will be unaffected by changes in climate during its deign life. The guidance prioritises a number of aspects of design and construction in new buildings that can contribute to these objectives, including design and orientation, incorporation of passive design measures, LZC energy supply, water conservation and SuDS. The Climate Neutral development guidance has been adopted by the council's planning service as a voluntary good practice guide that applicants are encouraged to meet, and has been successful in securing many examples of good practice in the absence of DPD policies.

Between 2004 and publication of the South East Plan in 2009, the council rigorously implemented policies in the Surrey Structure Plan[17] that required all developments to be built to best standards of energy efficiency, to generate at least 10% of their energy demands from renewable source on site, and that use of CHP should be strongly encouraged, particularly on large sites. The council applied this requirement to all commercial developments and new housing schemes. Over this period of time, it has been largely successful in maintaining housing supply whilst also achieving consistently high levels of compliance with the Structure Plan policy.[18] Housing developments ranging from a 148 dwelling scheme with 40% affordable units at the former Lion Works, Old Woking, down to numerous individual new dwellings have been required to meet the Structure Plan policy target. The policy has also been successfully applied to Listed Building conversions[19] and a new travel-lodge in the grounds of a listed building and Conservation Area.[20]

Figure 21
Retirement Village's development of 42 extra care units is in an edge of Green Belt location at Mayford. The planning consent secured very high standards of energy efficiency, along with a small CHP unit and large PV arrays that have been sensitively screened.

The Structure Plan policy has also been applied to a number of other building types, including extra care housing, a day centre, self-storage facilities, a warehouse and a large prestige car assembly facility in the Green Belt. As a result, nearly 100 decentralised renewable energy installations have been provided as a planning requirement for new development. These have included heat pumps, solar hot water panels, PV, biomass boilers and gas-fired CHP. Where development proposals have come forward on sites near to existing community energy infrastructure, the council has successfully applied the principle set out in paragraph 27 of PPS1 Supplement and required the development to connect to the decentralised energy network[21]

Figure 22
Enterprise Place is a development of 129 apartments in Woking town centre and was granted planning consent in 2006 subject to a legal agreement requiring connection of hot water and heating supplies to the town

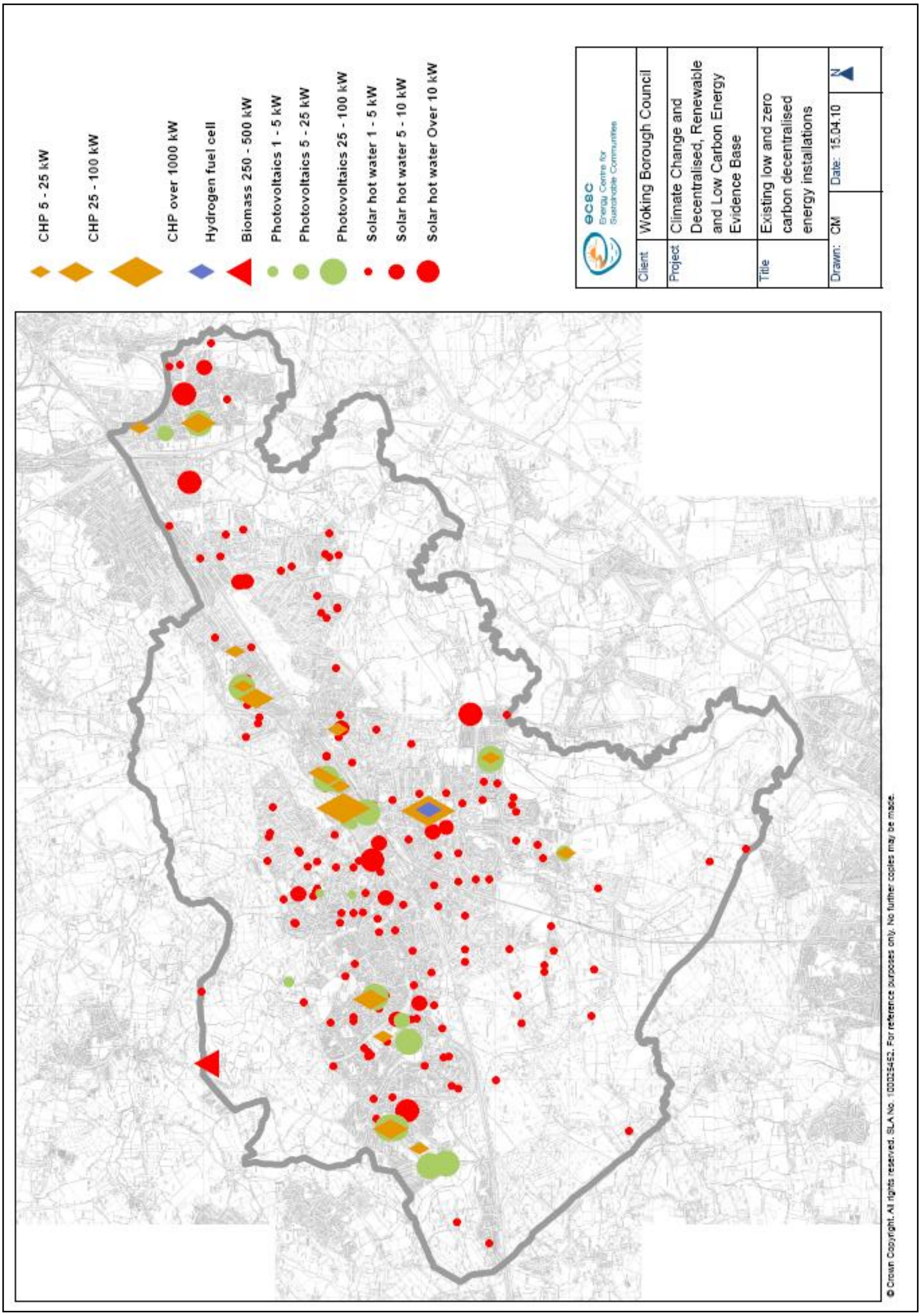


Figure 23 Existing low and zero carbon energy in Woking

The South East Plan (adopted in May 2009) replaced the Surrey Structure Planand introduced but with a minimum size threshold of more than 10 dwellings or 1000m^2 for commercial development. As a significant proportion of Woking's new housing is delivered through small schemes of less than 10 units, the council recognised that many developments would be exempt from the RSS policy. Therefore, the council has argued that compelling evidence accumulated over four years of implementing the Structure Plan policy has demonstrated the viability of applying the policy to all developments, including small and single house schemes. The council has further justified this on the basis that it is in line with the key planning objectives of the PPS1 Supplement.[22]

The council has invested significant time in developing providing training for its planning officers in energy planning and low carbon development and has communicated its energy planning objectives with developers through its website and annual planning agents' forum. Woking has also pioneered the development of *C-Plan*, a web-based tool that enables developers and planners to jointly evaluate the energy and carbon impacts of a development proposal.[23] C-Plan has provided Woking's planners with a consistent framework for the implementation of carbon and energy objectives, and has provided planning officers with insight on the most appropriate design approaches for low carbon buildings. This strategy of rigorous implementation of policy, combined with a strong emphasis on collaborative working with developers to achieve a common approach to energy and carbon assessment of planning proposals has been cited as a national exemplar of planning good practice.[24]

5. The Potential for Low and Zero Carbon Energy in Woking

This section of the study examines the potential for increasing the supply of low and zero carbon energy within the Borough. It considers the opportunities and constraints that will impact on the development of a range of different renewable and low carbon energy sources.

5.1 Renewable and low carbon energy potential in Woking

Despite is limited size and other physical constraints discussed below, there is a significantly greater level of existing renewable and low carbon energy in Woking than in many other boroughs of comparable, or indeed, larger size. The reasons behind this have already been explored in Section 4 and can be summarised as:

- A strong and early lead taken by the local authority through investing in decentralised energy since the 1990s.
- Well-established delivery partners, including one of the first Energy Services Companies (ESCO) in the UK.
- Consistent and assertive use of planning powers and tools to secure investment over in decentralised energy through new development for over five years.

A significant share of existing renewable energy capacity in the Surrey and Thames Valley sub region is based on a small number of large installations using co-fired biomass in power stations (e.g. Didcot A power station), and biomass. By comparison, Woking's renewable energy installations include many smaller scale installations, and include a large proportion of the region's total installed capacity of PV (Figure 17).

5.2 Renewable and low carbon energy in Woking - Opportunities and Constraints

A review of renewable energy targets for the south east region anticipates large scale wind (both off-shore and on-shore) will make the largest contributions to the region's renewable energy production by 2020[25]. In addition, energy from waste and landfill gas are anticipated to continue to make significant contributions to the renewable energy mix, along with an increase in solar electricity (Figure 24).

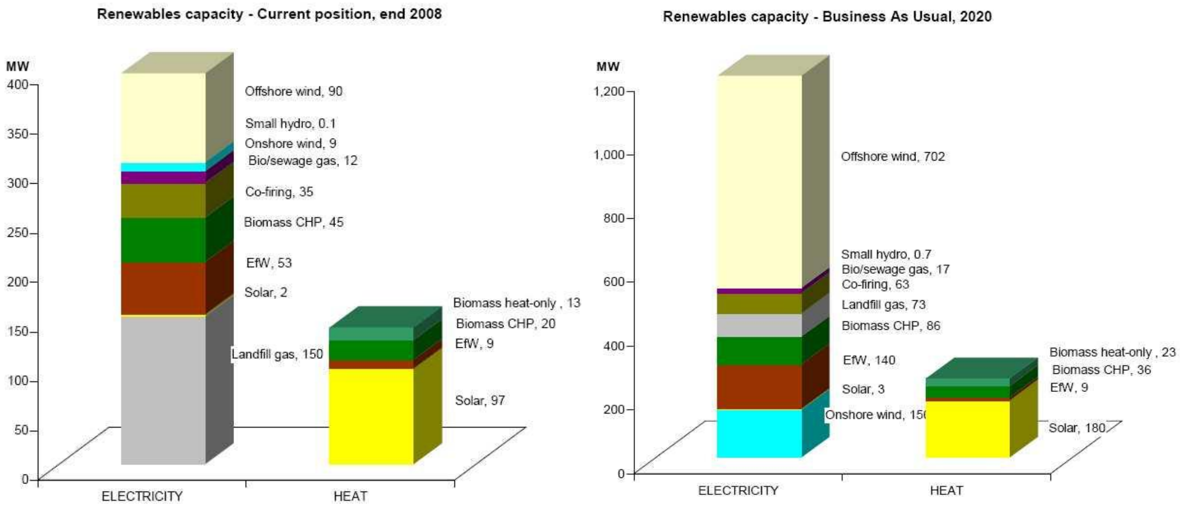


Figure 24 Current and forecast sources of renewable energy in the South East (TV Energy/SEPB 2009)

The opportunities and constraints for these and other forms of renewable and low carbon energy in Woking are set out in more detail below.

5.3 Medium - Large Scale Wind Energy Potential

There are a number of primary limiting factors that determine the feasibility of wind energy are the availability of wind resource to power the turbines, the availability of land (or tall buildings) on which to site turbines, and the absence of over-riding environmental or planning objections. In addition, some technical constraints may apply in rural areas such as proximity to an adequate connection point to the distribution grid, although this is unlikely to be a major constraint in Woking. Each major limiting factor considered in turn below.

This study has only considered the potential for medium-large wind turbines and does not seek to consider the potential for small and micro-scale wind turbines. Many smaller turbines are of limited efficiency in urban areas, and wide-scale deployment within the urban area of the borough is considered unlikely unless significant technological advances are made.

A wind energy feasibility study for the borough selected 5.7 metres per second (at 45m hub height) as the minimum wind speed below which wind energy is generally not commercially viable.[26] Based on the national wind speed database maintained by DECC, the study concluded that wind speed was at this height was not a limiting factor anywhere in the borough. However, a number of land and planning-related constraints do apply. The 2007 study identified a hierarchy of site and land constraints divided between 'absolute constraints' that are unlikely to be suitable for wind turbines (such as ancient monuments, designated landscapes and habitats), and 'possible' areas of constraint where less stringent protection applies but nonetheless some constraints do exist. For example, possible areas of constraint include safeguarded aerodrome notification areas. Whilst these areas do not necessarily rule out the potential for wind turbines, there is a requirement to consult the relevant operators and authorities.

The study revealed there are very few unconstrained places for wind turbines in the borough. In other words, there will be some practical obstacles to be overcome in siting medium-large turbines throughout the borough. However, when only the absolute areas of constraint are eliminated it is evident that there are nonetheless many areas where it may be possible to locate wind turbines subject to over-coming one or more possible constraints (Figure 25). Recent guidance on the assessment of potential capacity for renewable and low carbon energy[27] recommends a wind turbine density of 9 MW/km2 in unconstrained areas. However, it also recommends excluding all land within 150 m of major road and rail corridors and 600m buffers from all settlement areas. Following this methodology, the potential wind energy capacity for large turbines within the borough is largely limited to isolated areas in the green belt in the north of the borough, areas to the east and west of the London-Portsmouth railway line in the south of the borough and a narrow corridor north of the River Wey. Existing land uses in these areas comprise common land, golf course and farmland.

We are advised a commercial wind developer has expressed interest in installing a number of 2.5 – 3.0 MW turbines in the south of the borough in the Wey valley, and is embarking on early feasibility work. It should be noted that locating wind turbines in any locations within the borough would require detailed studies to assess potential adverse impacts such as noise nuisance, flood risk, shadow flicker and interference with telecommunications.

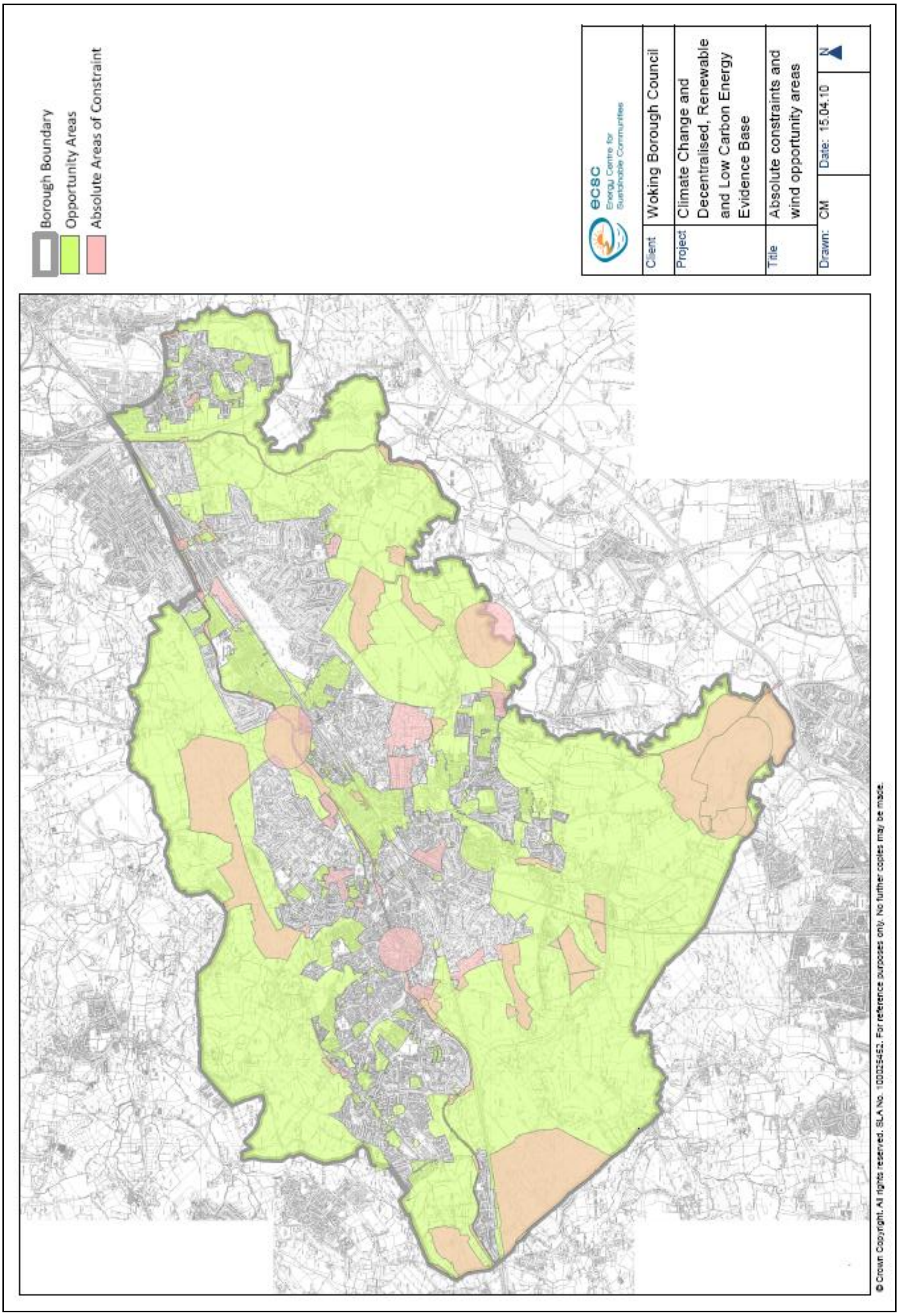


Figure 25 Wind opportunity areas and constraints (source: RPS report for Thameswey)

5.4 The Potential for Biomass Energy

A number of different fuel types are collectively described as 'biomass' including:

- wood fuel from clear felling, woodland management, forest thinning operations and arboricultural arisings
- sawmill arisings and waste wood (e.g. from the construction industry)
- agricultural products and wastes including straw, slurry and chicken litter
- energy crops including miscanthus grass and short rotation coppice
- household putrescible waste

The South East Plan seeks to generate over 25% of the Surrey and Thames Valley sub-region's renewable energy through biomass heat. However, this will be dependent on a number of factors, including resource availability and supply chains being able to support a significant growth in demand. The Biomass Fuel Source Review concludes that there is good availability of biomass fuel stocks both within the region and from further afield, with limited or very limited potential fuel stocks in the region currently being exploited for energy production. However, it is noted that as biomass use in the UK and abroad develops, increased competition for fuel may arise.[28]

Within Woking there is some potential for a limited quantity of biomass to be produced. However, agricultural production is largely restricted to areas in the south of the borough and the Wey valley, with grazing pasture the predominant agricultural activity and there is currently no commercial biomass production. Recreational uses such as golf courses and horse pasture grazing are also widespread. Large parts of the Green Belt to the north and west of the borough comprise secondary woodland and heath, and there may be some scope for extraction of wood fuel as part of existing heathland management practices. However, the protected status of much of this land as SSSI/SPA imposes restrictions on management practices, and this combined with the relatively small parcels of woodland, will limit its suitability for biomass production.

Surrey has over 22% woodland cover and elsewhere in the county, there are a number of commercial wood fuel producers and the sector has benefited from financial support through programmes such as the Surrey Hills LEADER grant scheme. The Surrey Hills Wood Fuel organisation has been established to promote the use of locally sourced wood fuel and claims to provide wood chip and pellet fuel at a lower price per kWh than comparable non-renewable heat energy.

Wood waste collected by commercial waste contractors, along with household waste and arboricultural arisings are currently sorted and processed outside the borough. However, as transport costs continue to rise, the incentive to retain potential fuel stock for use within the borough, and to bring fuel based on waste wood into the Borough is likely to grow.

Hence, whilst there is limited potential for the borough to generate adequate biomass to meet a significant growth in biomass heating, supply chains are becoming established within the county and it is reasonable to assume resource availability will continue to grow with demand.

We conclude there are a number of opportunities and constraints will influence the potential for development of biomass energy in the borough:

- Delivery - a major component of the cost of biomass fuel is the transportation costs from producer to consumer. Woking's road connections with trunk and arterial routes provide good connectivity with existing and future suppliers. Furthermore, the presence of an active aggregates rail terminal in the town centre could provide a bulk handling point for imported biomass from further afield. The rail freight operator DB Schenker is introducing dry hopper wagons for transporting bulk biomass fuel for rail delivery to power stations, and in time this may open up the opportunity to bring large volumes at low cost into the centre of the borough.

- Fuel Storage – fuel storage bunkers are required for biomass systems and space can be a limiting factor, particularly in high density areas. Whilst some fuel types with higher calorific values (such as pellets) require less storage space than most other forms of biomass, in medium- high density areas individual domestic biomass systems are unlikely to be viable due to limited fuel storage space. Therefore, larger community-scale biomass heat systems, with a centralised fuel store and boiler plant, are more likely to be feasible within or at the edge of the town centre.

- Air quality standards - biomass boiler systems require chimney flues to safely disperse gases and particulates. Where high levels of air-borne pollutants have resulted in a designation of Air Quality Management Areas (AQMAs) biomass boilers are required to meet particularly stringent emissions standards. However, there are no AQMAs designed in the Borough, and air quality is unlikely to be a limiting factor for the use of biomass.

- Heat distribution – the existence of heat distribution mains in some parts of the borough could be used to distribute energy generated via community-scale biomass heating. The introduction of new biomass-generated heat into these networks could help meet a growth in demand for low carbon heat supply to new and existing buildings, and with careful integration with existing heat plant, could provide additional network resilience at times of high demand or interrupted heat supply.

- Operation and management – the existence of an ESCo in the borough with experience in operating community energy systems and retailing heat to customers would help to ensure delivery of new community biomass heat energy.

5.5 The Potential for Landfill Gas and Energy from Waste

There are currently no active or recent landfill sites where methane gas is being produced on a regular basis or at a volume that would enable gas capture and re-sue for energy production.

The Surrey Waste Plan (adopted May 2008) sets out the county's strategic planning for waste up until 2018 and identifies a number of potential sites for different forms of waste treatment. One site in the borough at Martyrs Lane is subject to policy WD5 where, subject to meeting Green Belt and other criteria, permission may be granted for thermal treatment of waste including recovery of energy from waste. However, there are currently no firm plans for an energy-from-waste (EfW) facility to be developed at Martyrs Lane.

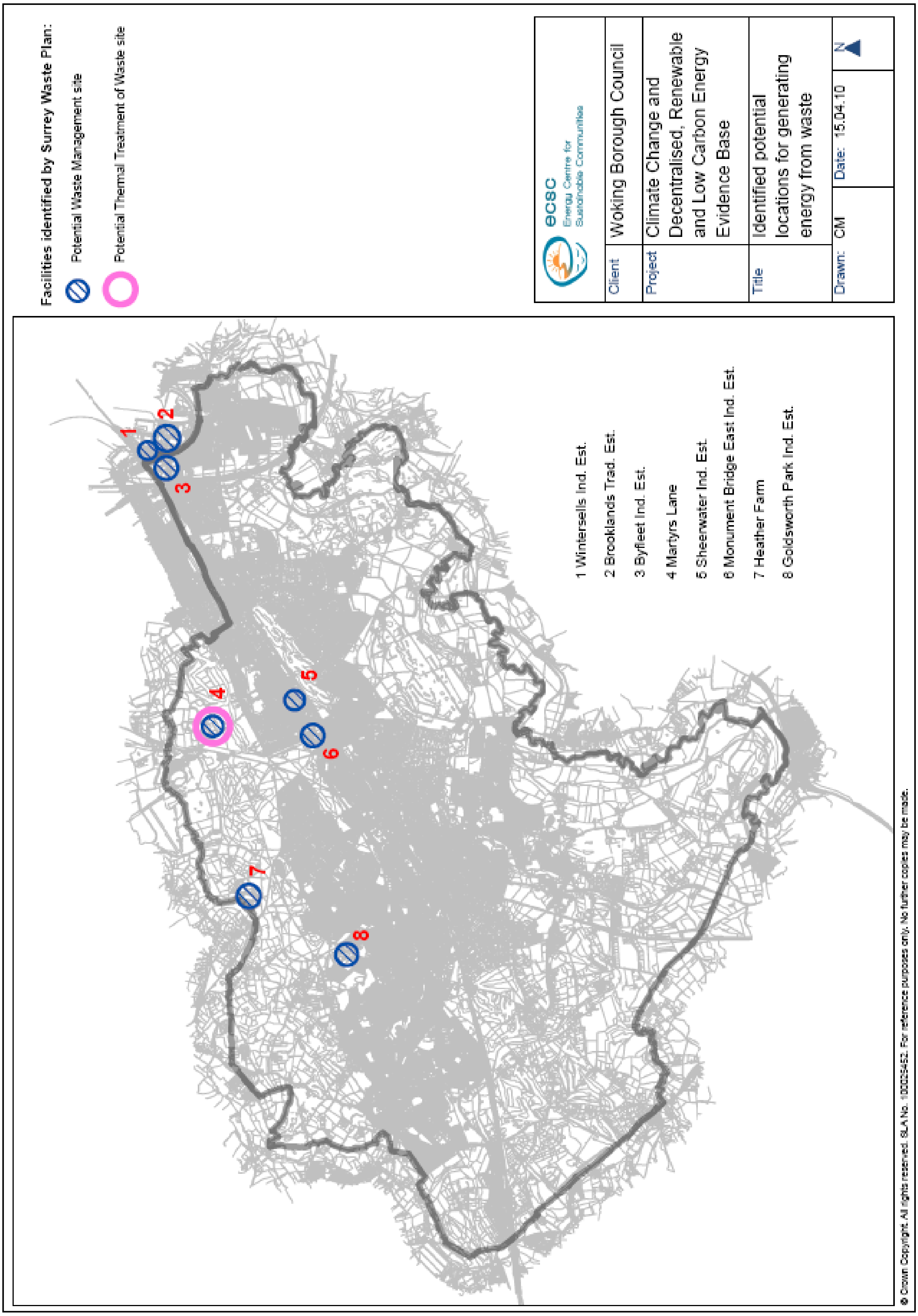


Figure 26 Potential sites for generating energy from waste

The Surrey Waste Plan also proposes the establishment of Waste Management Facilities within urban areas where possible close to the source of waste materials, which would provide a number of waste recovery processes including production of biogas as an energy resource (e.g. through anaerobic digestion). The Plan identifies a number of sites including six industrial estates in the borough as potential locations for waste management facilities.[29] These are shown on Figure 26. However, the Plan recognises that this list of potential sites is not exhaustive, and anticipates that other sites may be suitable sites brought forward. In addition, the Plan also identifies Martyrs Lane and Heather Farm in the borough as sites that are considered to be appropriate for Waste Management Facilities (although it should be noted that Heather Farm has subsequently been purchased by TAG McLaren as is thought unlikely to be made available for this purpose).

We conclude that the adopted Surrey Waste Plan provides a policy framework that is supportive of the development of waste facilities that can be used to generate biogas along with other reclaimed materials, and there are a number of locations in the borough where planning consent may be granted for this, if proposals are brought forward. These have been further considered in Section 7. However, to date no firm proposals have been made for such facilities, and whilst energy from waste at these or other locations may become available in the borough over the next 10-15 years, it is currently not possible to quantify the contribution that locally generated EfW (including anaerobic digestion) will make to Woking's decentralised energy mix.

5.6 Sewage Gas

Sewage gas ('biogas') is generated as a by-product from the anaerobic digestion of sewage sludge or other organic wastes and is mixture of methane, carbon dioxide, nitrogen, hydrogen and hydrogen sulphide gases. If compressed and purified, biomethane can be used to power a generator or combined heat and power plants. Government has proposed introducing permits and financial incentives (through the Renewable Heat Incentive) for biomethane capture and purification for injection into the national gas distribution grid.

The only sewage treatment works within the borough of Woking is located at Carters Lane in Old Woking and operated by Thames Water. However, the sludge from Woking is transferred to another Thames Water site outside the borough for treatment before being recycled to agricultural land and therefore the Carters Lane site does not generate any biogas. We understand Thames Water currently has no plans to construct new sewage treatment works in the borough and we conclude that locally produced biogas from sewage treatment plants is unlikely to make a contribution to the sustainable energy mix in Woking.

5.7 Combined Heat and Power (CHP)

Woking Borough Council has pioneered the use of CHP in combination with private wire electricity distribution networks. Existing installations in the borough range in size from 5.5 KW mini CHP serving small multi-occupier buildings up to the 1.27MW and 1.4MW district heating installations operating in Woking Park and the town centre respectively. The council has also been at the forefront of innovation in the use of CHP through its hosting and participation in a hydrogen fuel cell CHP demonstration project Woking Park, and.

The Councils' leadership in the use of CHP has contributed to a number of small CHP units being installed as a planning requirement to serve residential developments. These include a 5.5kW unit at Tudor Court, Maybury (22 apartments developed by McCarthy and Stone in 2008) and an 11 kW installation at Mayford Grange (46 one and two bed retirement apartments developed by

Retirement Villages in 2008/09). Development is also underway of 32 one, two and three bed apartments in Maybury by George Wimpey which will use biomass heating and CHP.

The experience gained through the deployment of CHP in the borough means it is well placed to encourage further use of this technology. However a number of opportunities and constraints will impact on the viability of CHP:

- A relatively constant level of demand is required in order to maximise the efficiency of CHP. This can arise from a single building (examples being a hospital, care home, hotel or swimming pool), or may be from a combination of different building types (e.g. town centre mixed uses comprising business, retail, public and residential buildings). Where new buildings are built to very high insulation levels with low heat demand, it may be necessary to ensure there is a mix of older, less well insulated buildings supplied by CHP, along with new development.

- A range of building types and uses can also contribute to the viability of heat distributed ('community') heat networks by creating a diverse heat load. By spreading the demand for heating over a longer period during the day and 'ironing out' the peaks in demand associated with a single type of consumer, CHP can be operated more cost effectively.

- The high cost of installing heat distribution pipes favours the use of CHP within high density developments where heat distribution infrastructure can be provided to a number of buildings with the minimal capital cost and disruption.

- CHP can be used to supply both new and existing buildings. However, it is vital that the arrangements for distributing hot water and heating within a building are designed to benefit from the particular characteristics and requirements of CHP-generated distributed heat. New buildings can be designed to ensure their services are compatible with a community heat supply, even if the heat supply is not available when the building is completed. This approach is likely to be far more cost in enabling future expansion to heat networks than costly retro-fitting of a building's services in order to facilitate connection to a community heat network.

- CHP is designed to reflect heat demand (as opposed electric demand). This is because if the heat produced as a by-product of the electricity generation exceeds demand, there is little opportunity to for it to be stored (other than in large thermal stores for a limited period). As a result, surplus heat must either be 'dumped', which is both costly and jeopardises carbon savings, or the CHP switched off.

- In planning the installation of new heat distribution infrastructure (or expansion of existing networks), consideration should be given to physical constraints such as railways, watercourses and existing large underground services. An understanding of current and future heat loads in areas of mixed use and/or high density settlement can inform the planning of new CHP and community heat distribution infrastructure. For example, it may be necessary to designate heat network infrastructure corridors and reserve sites for the construction of CHP installations in order to safeguard the land required to accommodate new energy infrastructure.

The borough has an extensive gas supply network in the borough (all existing CHP units in Woking use natural gas), and this is unlikely to be a limiting factor that will restrict further use of CHP.

5.8 Solar Heat and PV

There is good potential for exploiting solar energy to develop electricity through photovoltaic (PV) generation and heat ('solar thermal') in Woking (Figure 27).

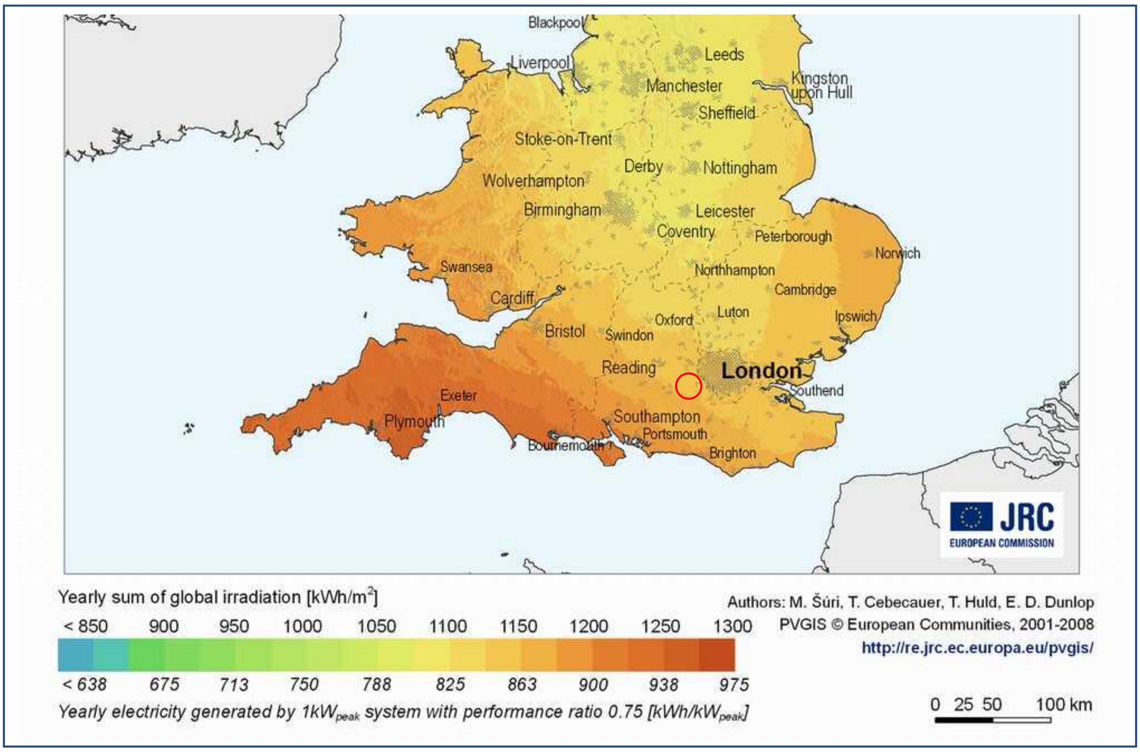


Figure 27 Solar energy available in the southern UK.

Woking has extensive installations of solar hot water, with over 170 private domestic installations identified in a recent household energy survey[30]. In addition, the implementation of planning policies over the last five years has resulted in numerous commercial and residential developments installing solar thermal equipment resulting in over 200 solar hot water installations in the borough (Figure 23). The establishment of the 'Action Woking' outreach programme in 2009 is stimulating further interest among householders in solar hot water and providing the borough's residents with impartial advice and assistance with accessing accredited installers.

The main constraints to installing solar hot water are:

- Availability of space to mount the equipment (usually but not necessarily roof space) with a good solar orientation and angle, free of shading from trees or buildings.
- A reasonable demand for hot water (normally in the form of water for washing, but subject to appropriate installation, space heating)
- Adequate storage capacity to maximise the capture of solar energy when available.

In Woking, there has been an extensive programme of PV installation on public buildings and local authority housing stock within the last ten years. In many cases this has been in conjunction with small scale CHP installations. A number of new commercial buildings have also installed PV arrays in order to meet some or all of the minimum level of renewable energy required by the planning authority. These have included a small sheltered housing scheme (10kWpeak), Retirement Village's development of 52 extra care apartments (18kWpeak), a small warehouse in Horsell and a self-storage facility in Byfleet (8kWpeak). In addition, the Action Woking programme has assisted householders to retrofit small PV installations. Figure23 shows the location of PV installations in the Borough.

The lead taken by the council in its investment in PV combined with installations in new development and householders' retro-fitted equipment, has resulted in Woking having the highest single concentration of private and publicly installed PV totalling nearly 0.8MWpeak installed capacity, equivalent to nearly half the total installed capacity of the entire south east of England (Figure 17).

Figure 28 Private installation of PV retrofit (Kirby Road, Horsell)

The ability to provide energy storage is not a limiting factor in the use of PV generated electricity as surplus energy unused by a building can be exported to the grid. However, the greatest constraint in use of PV has hitherto been the high capital cost of installing panels, and the low price paid for PV-generated electricity exported to the grid. The introduction by the government of a 'Feed-in Tariff' in April 2010 provides a significant financial incentive for further installations of PV, and the provision of a guaranteed price for each kW of renewable energy generated is anticipated to stimulate further investment in this technology in the borough.

The capital cost of PV is likely to continue to act as a barrier to its use if the revenue received through the energy generated is not returned to the individual or organisation making the initial capital expenditure. Hence, speculative developers or house builders may continue to be resistant to the use of PV unless they can either secure a consequential uplift in the value of a building, secure the capital investment through a third party (such as an ESCo). It is too soon to assess the effectiveness of the Feed-in Tariff in stimulating greater investment in PV, but the government is anticipating a market response resulting in new financing mechanisms to emerge that will help to overcome this barrier.

There are no physical constraints preventing the widespread deployment of PV across the borough, other than the availability of a roof or other supporting structure that provides a good solar orientation and angle. In Woking, PV has been installed on buildings in the form of roof-mounted panel systems, glass laminate glazing systems (with the cells embedded between two layers of glass), and integrated roof tile systems where the PV structure also forms the weather protection to a building. In addition, PV panels have been mounted on free-standing frames.

A feasibility study for retro-fitting PV in Woking concludes there is the potential to install up to 3.7 MWpeak of PV on existing public and community buildings and the local authority's housing stock[31]. This figure is based on available roof area with good solar orientation.

5.9 Waste heat recovery

Some industrial activities produce large amounts of waste heat that are dumped through the use of cooling towers or heat dumping into rivers, lagoons or the sea. Power stations are an example where this often occurs with large cooling towers used to release heat to the atmosphere.

Planning authorities should consider whether excess or waste heat from large heat producing uses within their area can be recovered and distributed to new or existing buildings. Within Woking, there are currently no power stations or industrial installations producing large volumes of waste heat that are available for re-use. However, there may be the potential to capture the heat discharged from some other types of buildings with very high cooling loads (such as data centres), and re-using it in buildings nearby.

5.10 Low head hydro electricity

Woking has a number of small rivers flowing through the Borough and along its boundaries. One development proposal has explored the potential to install a small hydro generator in a former mill building that has planning consent for conversion and construction of new dwellings (former Unwins Brothers site, Old Woking)[32]. However, elsewhere the flow within the local streams and rivers is relatively small, and combined with restrictions imposed by their land drainage function and navigation rights on the River Wey, there is very limited potential for installation of low head hydro generation of power. Therefore, it is not considered that there is significant scope for the use of low head hydro elsewhere in the borough.

6. Development and Growth in Woking

The Council's emerging Core Strategy will form part of Woking's Local Development Framework and will set out a strategy and vision for meeting known and anticipated development requirements up to 2026. This will include planning policies against which proposals for new development will be considered. Understanding the type, distribution scale and timing of development is key to defining a policy framework meets the council's objectives and is deliverable.

6.1 Residential Growth

The borough of Woking covers an area of approximately 6,400 ha and at 2008 had a population of around 92,200 (Office for National Statistics mid-year estimates). As at March 2010 there were 40,877 dwellings in the Borough with extant planning permission for a further 1,819 units.

The council is seeking to make provision for 4964 new dwellings be built in the borough in the period 2010 – 2027. As at March 2010 there was extant planning permission for 1,819 new units. Therefore by 2027 it is estimated that there will be in the region 45,400 dwellings. It is noted that currently the average occupancy rate for a dwelling in Woking Borough is 2.41. However, the Council's population forecasts indicate that by 2026 this figure is expected to be in the region of 2.12 persons per dwelling.

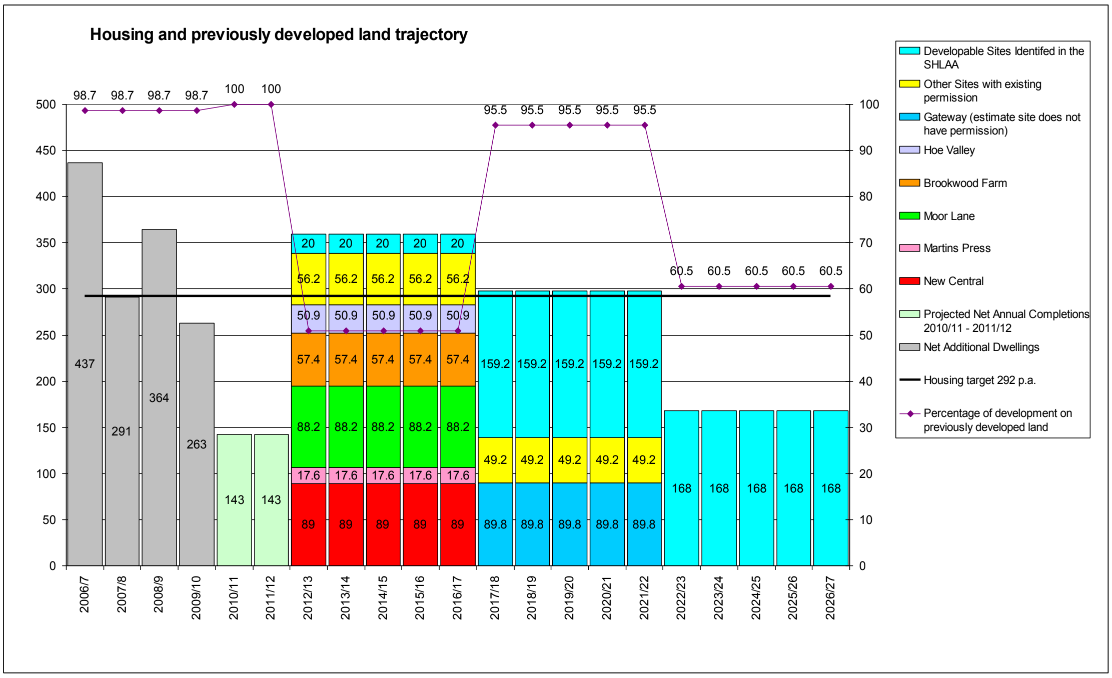


Figure 29 Housing trajectory including small sites and extant consents

The council anticipates that just over half of all new residential units will be located within Woking town centre. Development in West Byfleet, along with infill development in Local Centres and the rest of the urban area will provide 1,170 new homes. Major sites at Brookwood Farm and Moor Lane (Westfield) will contribute a further 740 units, with the remainder (550 dwellings) to be provided through release of Green Belt land in the later stages of the plan period.

6.2 Non-residential growth

A study of Woking town, district and local centres has concluded that there is unmet need for retail, leisure and other non-domestic uses within the borough, and this set to grow[33]. The study identified a potential growth in floorspace for A1 – A5 uses by 75% from an existing gross floorspace of 109,540m^2 to approximately 185,000m^2 by 2026. The greatest element of growth within these uses is for 'comparison' (non-food) retail, which the study believes could grow from 67,000m^2 to 103,000m^2 by 2021, with two thirds of additional floorspace being provided during the latter five years (i.e. post 2016), and further potential for significant growth up to 2026.

The majority of growth in retail floorspace is anticipated to be located within Woking town centre and reflects national planning guidance that uses which attract large numbers of people should be located within existing centres. In addition to a growth in non-food retail floorspace, the study also identified the potential for a new superstore in the town centre, as well as a budget hotel and new office space. The study identified a series of opportunity sites within the town centre for potential retail development. These have been chosen sequentially and include major sites where development agreements are in place and/or are allocated in the 1999 Local Plan. The scale and location of these opportunity sites presents significant opportunities for the extension of existing and/or development of new decentralised energy infrastructure. In summary, the recommended strategy for growth in floorspace promotes high density developments within a compact town centre with a mix of uses. The study recommends that major remodelling of the town centre to bring forward large scale non-residential growth (and by inference, other uses as well) should be facilitated through an Area Action Plan. This would also provide a framework through which new energy infrastructure can be planned.

The Council's forecast floorspace requirements for office, industrial and warehousing uses are based on different economic growth scenarios and show a requirement for additional office and warehousing space and reduced requirement for industrial space between 2009 and 2026[34]. The requirement for office space is between 17,276m^2 and 66,974m^2, with an additional warehousing requirement of between 33,500m^2 and 130,861m^2. The majority of the required floorspace will be achieved through the redevelopment and intensification of existing sites, with a significant proportion of the office requirement sited within Woking town centre in accordance with its status as a Hub.

Finally, growing demand for electronic data storage and management is likely to result in new proposals coming forward for 'data centres'. The energy demand associated with these types of buildings is considered further in the next section.

Section 7 considers how the predicted levels of growth and new development in Woking will impact on energy demand in the borough, and the opportunities this may present for developing new low and zero carbon energy supplies.

7. Future Energy Demand and Supply in Woking

An analysis of existing energy demand at local level has been provided in Section 2 of this study. However, the concentration of energy demand in Woking town centre (especially heat), and the potential for change through planned growth in new dwellings, employment floorspace, retail and other commercial uses focused in the town centre, demands a more detailed understanding of existing energy demand. This forms the basis on which to predict changes in energy through future growth and redevelopment and plan for the provision of new energy infrastructure.

This section concludes with a number of areas on which to focus a planning policy framework to mitigate carbon emissions in new development, and (through the integration of low carbon energy infrastructure), also reduce emissions from existing buildings.

7.1 Heat Mapping Woking Town Centre

A series of heat and power maps have been produced that analyse the spatial distribution of energy demand in the town centre (Appendix III). The heat and energy maps form the basis on which the impact of future development in the town centre can be assessed in terms changes in demand. This can be used to target policies in order to address the most significant implications, and to help inform decision-making regarding the opportunities to develop low and zero carbon decentralised energy.

The energy mapping has been carried out a resolution based on street blocks. These have been grouped into 33 zones within the council's defined town centre boundary (Appendix II). Zones have been identified on the basis of similar uses and urban character and/or logical street pattern. Appendix II identifies each zone by number and name, and provides a brief description of the existing type, age and density of buildings within each zone.

Energy consumption within each zone has been modelled on the basis of size and use of commercial/non-residential buildings and quantity, age and type of residential stock, based on recognised benchmarks (note: where zones contain sites that have planning consent and have been cleared for re-development, the modelled output has been based on its current status as vacant land, and will be adjusted to reflect the anticipated energy use arising from future development, with completion assumed to be within the first five years milestone). The methodology is set out in Appendix I.

The energy mapping has been modelled on the basis of three time scales:

- Current energy demand (2010) assuming full occupancy of existing buildings and allowing for vacant sites
- First milestone 2017: based on five years delivery of new housing post adoption of the Core Strategy, assuming completion of major extant consents and delivery of the town centre's share of new housing provision to meet the housing trajectory. All developments to be built on the basis of current and planned future national minimum energy efficiency standards.
- End of plan period (2027) as 2017, but also including significant growth in town centre commercial and retail floorspace as proposed in the Council's non-residential growth

forecasts. All developments to be built on the basis of current and planned future national minimum energy efficiency standards.

The heat mapping models for 2017 and 2027 are on the basis of planned revisions to the Building Regulations set out in the Zero Carbon Homes and proposed Zero Carbon Non-domestic buildings timelines. This provides a forward projected baseline for energy consumption within new development in the town centre on the basis of a 'do nothing' approach for planning policy (i.e. non-intervention). Alternative policy scenarios can then be compared to this baseline in order to gauge the impact of planning policy intervention.

7.2 Existing Energy Demand within Woking Town Centre

The heat and power mapping of Woking town centre reveals the following characteristics:

- Existing heat demand (Figure 37): There are four 'quadrants' within the town centre that have the highest heat demand. These are broadly located in the northern part of the town centre (zone 5 – the Civic quarter), the eastern edge of the town centre (zone 10 - eastern office quarter), the southern edge of the town centre (zone 32 – Community Health campus), and the western edge of town centre (zone 1 – Vale Farm Road). Other areas with relatively high heat demand exist close to the areas with highest demand include Church Street West (zone 17) and the Leisure and Entertainment Quarter (zone 11). It is worth noting that zones 5 and 11 are already served by the town centre district heating network.

- Heat density (Figure 38) largely follows the distribution of heat demand, with zone 26 (Heathside Crescent and Station Approach) also having a relatively high level of heat density.

- Electricity demand (Figure 40) shows a number of distinct differences to heat demand. The major retail centres (zones 3 and 15 comprising the Peacocks and Wolsey Place shopping centres respectively) have the highest power demand. Electricity density (Figure 41) is generally higher within the central core of the town centre that lies within Victoria Way and adjacent to the railway.

- Total energy demand (Figure 42) and demand density (Figure43) reflect a combination of the distribution of heat and power demand within the town centre, with a more evenly distributed pattern of energy demand being evident.

7.3 Heat load anchor buildings

Buildings with the greatest heat demand in the town centre have been identified individually (Figure 30). These are termed heat anchor loads and are provide some of the best opportunities for connecting to distributed heat networks as they have significant heat demand. These have been split into:

- Public buildings (in descending order, Woking Community Hospital; Police station; the Ambassadors theatres and cinemas; Civic Offices; Magistrates Courts; Woking Hospice and the Lightbox) and;

- Commercial buildings. Dukes Court has the highest heat demand, with the Holiday Inn and Big Apple entertainments complex among the greatest consumers of heat (note: H.G. Wells conference centre has been included within the Big Apple complex).

7.4 District heating networks and the significance of heat density

The draft national Heat and Energy Saving Strategy identified the development of district heating networks among its priorities for reducing energy-related carbon emissions[35]. The is based on the combination of improved efficiencies through large-scale heat generation, the potential to combine this with generating power through CHP and the opportunity to use lower carbon fuels.

However, the operation of all district heat networks (including those linked to CHP) is highly dependent on the presence of sufficient and consistent levels of load (demand for heat). In urban areas (such as Woking town centre), relatively significant heat loads are often found within existing buildings. Furthermore, the higher density and mixed use nature of town and city centres lends itself to greater consistency of demand and lower costs from installation of heat distribution networks than lower density and/or single use areas.

Research into the potential for district heating in the UK has found that areas with a heat density above 3000 kW/km^2 could provide returns on investment of 6% or above [36]. If this is applied as a broad indicator of the heat density threshold for development of community heat networks, existing heat leads throughout almost the entirety of Woking town centre are found to exceed 3000kW/km^2 with the Peacocks shopping centre, railway station and undeveloped land being the only exceptions (Figure 39).

7.5 Growth in energy demand in the town centre

The impact of redevelopment within Woking town centre has been modelled to provide an indication of how heat demand may change between 2010 and 2027. Assumed growth targets for new dwellings, office and retail space have been applied within two time bands: 2010-2017, and 2018-2027. The methodology used to model the changes in heat demand and heat density is set out in Appendix I.

There are a number of factors that are influential in determining how future energy demand may change over the next two decades:

- The density of new development – it has been assumed that in all cases redevelopment within the town centre will be at a higher density than the existing buildings that it will replace. All other factors being equal, an increase in density of buildings will result in an increase in overall energy demand, although the type of energy demand (e.g. heating, cooling or electrical energy) and patterns of demand (time and duration of peak loads) may change. For example, higher levels of thermal insulation and predicted changes in climate may result in a significant shortening of the heating season, with resulting reductions in heat loads. However, this may be at least partly offset by elevated summer temperatures and higher density development accentuating 'urban heat island' effects resulting in increased cooling demand including a growth in cooling loads for residential stock.

- The efficiency of energy demand in new buildings – assumptions about the energy efficiency of new buildings (especially thermal insulation standards) have been based on current proposals for the phased tightening of energy efficiency standards through the planned introduction of 'zero carbon' homes in 2016 and non-domestic buildings in 2019. Our predictions have been built on assumed compliance with these standards (with an adjustment to end dates to reflect lag times for build out of new developments). In addition, the replacement of older less efficient existing stock with significantly more energy efficiency buildings has been taken into account.

- The type and mix of new development – our assumptions are based on quanta of new employment, retail and residential development to be provided primarily in mixed use schemes. However, some of the effects of a significant increase in some uses may have a major impact on type of energy demand. For example, an increase in retail floorspace may also result in little or no increase in heat demand but is likely to significantly increase electrical loads.

Hence, it is considered likely that redevelopment in Woking town centre will result in some existing single use buildings of relatively low energy efficiency being replaced by higher density mixed use schemes that have significantly greater energy efficiency (per m^2 of floorspace), but a higher overall energy demand (with proportionately less of this being in the form of heat), and a greater diversity of peak loads. Where significant increases in building density are likely, this is set to out-weigh improvements in energy efficiency (especially in the period prior to universal implementation of zero carbon standards as a statutory minimum), and our modelling suggests that up to 2017 and beyond, the combination of retained existing stock and higher density new development will maintain heat density loads above 3000 kW/km^2 practically throughout Woking town centre (Figures 45 and 47).

7.6 Future energy supply in Woking town centre

The compact urban form of Woking town centre, combined with other physical constraints and resources limitations, will influence the opportunities for deployment of some low and zero carbon technologies:

- There are no sites that have been identified where medium – large scale wind turbines could be installed close to the town centre. Whilst future technical developments in small and micro-scale wind turbines may improve their effectiveness in lowland urban environments, we currently do foresee this making a major contribution to future decentralised energy supply in the town centre.

- The increase in density of development and scarcity of open land in the town centre does not favour the widespread of use of ground source heat pumps. Some new buildings may be able to combine piled foundations with deep bored heat collectors (and these can also be used to provide ground coupled cooling). We also foresee continued growth in the use of air-source heat pumps and they will make a significant contribution in many new buildings where they have relatively low heat loads. In mixed use developments, they have the potential to be particularly effective when combined with mechanical heat recovery systems, re-circulating the heat from exhaust warm air. However, we would caution that until such time as the UK electricity grid is generated from significantly lower carbon dioxide emitting fuels (the 'de-carbonisatiion' of the grid), electrically powered heat pumps will provide only modest reductions in carbon emissions, particularly; when compared to gas-fired heating systems, the fuel supply of which may also be de-carbonised through biomethane injection into the national gas grid.

- We anticipate solar technologies will continue to grow in their use in the town centre, particularly as the effect of financial incentives such as the Feed-in Tariff and proposed RHI become more widely recognised. However, the effects of over-shadowing by tall buildings and limited roof area-to-volume ratios may limit their use. However, we do anticipate further developments in PV-based technologies, including PV products that provide rain screens and glazing materials resulting in their broader application as building-integrated systems.

- Extended existing town centre heat network. The existence of a district heat network in the north east sector of the town centre provides a 'bridge-head' for this technology that can be extended to serve new buildings in that part of the town centre. It is proposed that the north-west quadrant of the town centre be designated a District Heat Zone where a presumption exists that new developments be required to connect to the town centre energy station (see Figure 30). This Zone would be served by extensions to the existing heat and cooling network connected to the town centre energy station:

    - Extending the heat mains to the east along Church Street East and down Chertsey Road would enable a number of existing and future proposed developments to connect to it, including the apex of Chertsey Road.
    - Extending the network to the west along Church Street East would provide the opportunity to connect a number of existing buildings and potential redevelopment sites in Chobham Road.
    - Adding a southern arm of approximately 180m to the network would reach potential redevelopment sites in Duke Street and Locke Way, as well as the opportunity of connecting the large existing load generated by Dukes Court.
    - The redevelopment of Brewery road car park has also been included in this Heat Zone and would require a spur connection from the heat mains serving The Lightbox to cross the Basingstoke Canal.

  The increased demand that would arise if all the above extensions to the existing heat network were to be implemented would exceed the capacity of the existing town centre energy station, and there is limited space for additional generating capacity to be installed within the station. However, the addition of satellite heat/CHP generating plant as part of major redevelopment proposals within this area could be connected to the network to provide enhanced resilience within the network.

Whilst some additional heat capacity can be provided by the existing town centre energy station, this is not sufficient to meet all the growth in heat loads throughout the town centre. Furthermore, the presence of physical barriers (such as the railway line) and high costs associated with the installation of heat and cooling mains, will limit the reach of the heat supplies from the energy station. Therefore, we recommend a strategy for supplying district heating elsewhere within the town centre be developed on the basis of identifying new district heat zones in the following locations. These are shown on Figure 30 and comprise:

- To the east and west of Victoria Way
- To the south of the railway station

7.7 New District Heat Zones

Our heat mapping of the town centre reveals a concentration of heat loads in four broad quadrants, two of which (the northern and eastern town centre edges) are partly served by the existing heat network with the potential for further expansion into these areas. The remaining areas (to the east and west of Victoria Way and south of the railway station) are predicted to continue to have significant heat loads as a consequence of forecast growth through redevelopment in these locations. These are shown on Figure 30 and described in more detail below:

- **West of Victoria Way** – planning consent has already been granted for a major new office development adjacent to Victoria Way which is subject to a legal agreement to connect to district heating system. Development of a heat network here will be partly dependent additional significant redevelopment in this part of the town centre which is anticipated up until 2027. The existence of housing, a large retail food store and various other mixed uses within the area offer the potential to provide a base load from both existing uses and new developments, resulting in a broad load profile. Some land is currently in the ownership of the council (at Butts Road) and existing uses in this area are approaching the end of their economic life and the land could be brought forward for redevelopment. Part of this site could be reserved for the construction of a new district heat/CHP station to serve the District Heat Zone.

  Whilst we envisage that within the short term (i.e. the next 5-10 years), a district heat network would be gas fired, there are good opportunities for diversifying fuel supplies to an energy station in this location as proximity to railway sidings including a minerals and aggregates distribution yard may favour the bulk importation of biomass fuel to Woking town centre.

- **East of Victoria Way** – redevelopment is anticipated on a number of town centre sites of strategic scale in the area to the east of Victoria Way. These include proposals for the 'Gateway' redevelopment south of Commercial Way. The current mix of tenure, size and density of buildings in this part of the town centre does not favour the use of district heating, but its replacement with a significantly higher density of mixed uses including dwellings would provide a diverse heat load that could be served by a heat network. The installation of heat distribution mains in Commercial Way to serve this scheme could be co-ordinated with a refurbishment of the public realm.

  Other major development opportunities in this proposed District Heat Zone include the vacant former post office building, fire station and market square. The existing heat demand arising from these uses is low, but redevelopment to provide a mix of uses including retail, A3, business uses and apartments would increase demand and diversity within the area.

  There is the potential to link the proposed District Heat Zones east and west of Victoria Way. The furthest extents of these areas are over 0.5km distant and the viability of providing a single network serving both areas will depend on the timing of a number of separate development schemes. For the purpose of strategic planning, we would recommend each proposed District Heat Zone be considered as standalone networks served by their own generating plant, with the potential for linking up if the phasing of development enables this.

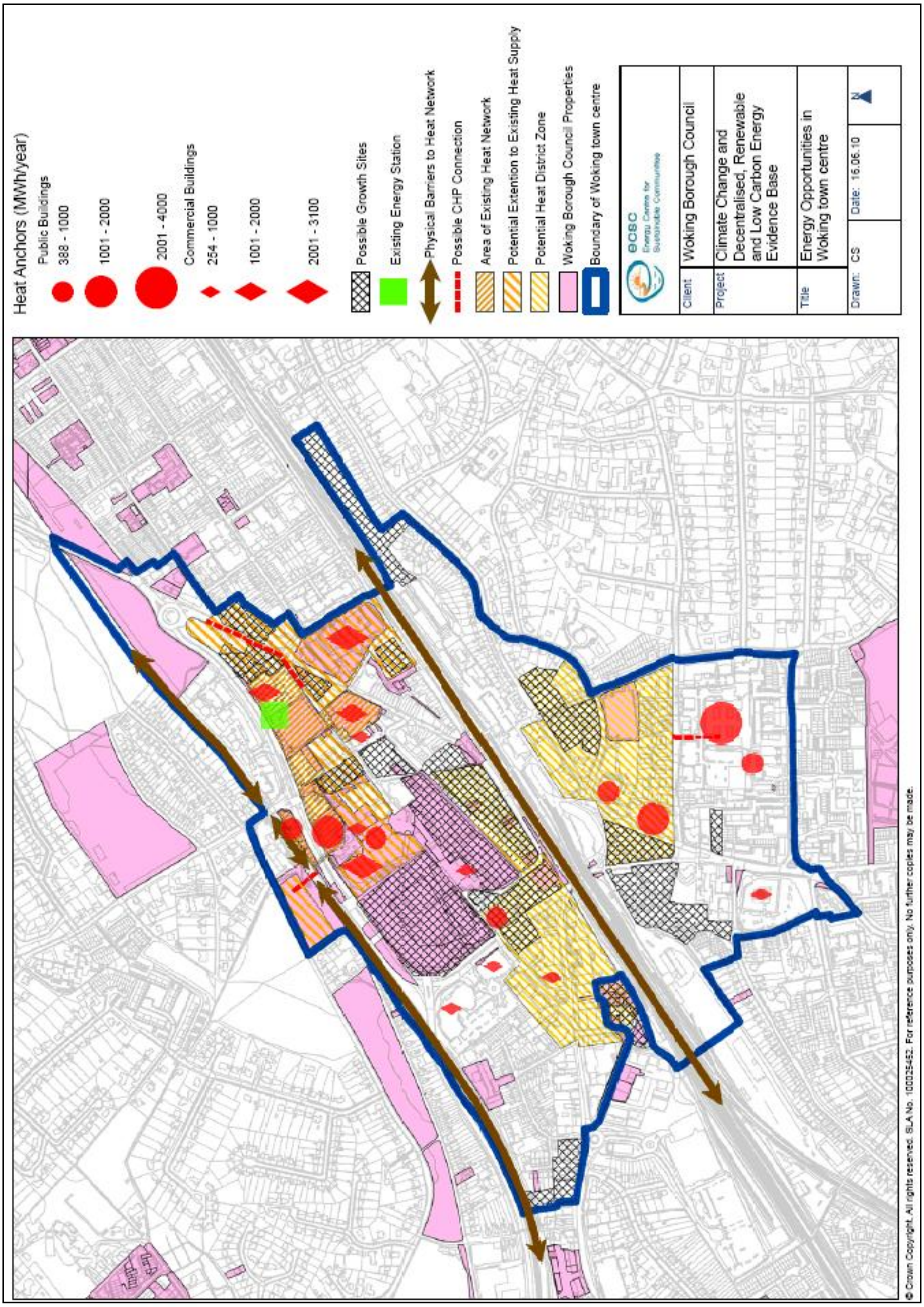


Figure 30 Energy opportunity areas in Woking Town Centre

- **South of the railway** – this proposed District Heat Zone includes a number of sites where major redevelopment may be anticipated over the plan period. These comprise the sorting office, the former St.Dunstans church site in Heathside Crescent and units in Guildford Road (the 'Evans Cycles triangle'). In addition to the heat demand and load diversity that would arise from these redevelopments, there are also a number of public buildings that would provide anchor loads including the Magistrates Courts, Woking police station, Woking community hospital and the hospice (the latter buildings are located approximately 150m to the south of the Heat Zone).

  This Zone is separated from the other Heat Zones by the railway line which is a significant physical barrier to linking this zone to any of the others. Therefore, it is critical that consideration be given to the allocation of a site within this Zone to locate an energy station. The approach that has been used in the existing town centre heat network where the energy station has been constructed as a small extension to a multi-storey car park, could be applied in this Heat Zone by locating an energy station adjacent to the Heathside car park on land currently used as a surface car-park for the Magistrates Courts.

7.8 Development and future energy demand and supply and outside of Woking town centre

A number of small decentralised energy networks have been established outside the town centre. These include the CHP installations in Woking Leisure Centre and the Pool in the Park and smaller heat networks serving primarily council-operated sheltered housing schemes throughout the borough (Figure 28). However, there is limited potential for extension of these schemes as they have limited excess capacity.

Over the last three years, the council has successfully sought low and zero carbon energy as a requirement of planning consent for new development, resulting in widespread installation of solar thermal and PV installations, ground and air-source heat pumps, small gas fired CHP and some biomass boilers are now operating in the borough. The use of renewable energy micro-generation is now an established element of new development throughout Woking, and is set out to continue in order to capitalise on market incentives (such as Feed in Tariff and Renewable Heat Incentive), and to comply with increasingly demanding mandatory standards required by Building Regulations and the Code for Sustainable Homes. The council is continuing to apply the principle established in the revoked South East Plan in seeking at least 10% of predicted energy use in new development to be provided through on site renewable energy generation. In locations where there is no existing heat network and District Heat Zones are not proposed, it is recommended the council maintains the momentum it has achieved through negotiating energy efficient building design and provision of low and zero carbon energy through on-site generation.

With the introduction of mandatory lower limits on carbon emissions from energy through revision of Part L of the Building Regulations in October 2010, and planned further revisions anticipated in 2013 and 2016, it is anticipated that incremental improvements in the energy efficiency of all new development will be accompanied by greater adoption of micro-generation in order to achieve the mandatory standards, especially from 2013 onwards. However, planning will continue to play a vital role in permitting and encouraging the additional low and zero carbon energy supply measures that will be necessary to achieve the 'carbon compliance' components and 'allowable solutions' that are proposed to deliver zero carbon homes from 2016 (and ultimately all other buildings). Work is ongoing on the detailed definition of carbon compliance measures and the mechanisms that are to be used allowable solutions (including a proposed community energy fund), with the consequence that their cost and viability impact cannot be quantified at this stage.

As a result, we recommend the council's policy framework for setting carbon and energy reduction targets for housing be kept under close review during the next 12 months during which time it is expected that greater certainty will emerge regarding the practical and financial implications of delivering zero and near zero carbon developments.

A number of industrial and business locations have been identified in the borough where good opportunities exist to provide decentralised energy as part of their redevelopment for new business uses (Figure 31). The installation of small-medium wind turbines in these sites may be appropriate where they can be positioned away from sensitive receptor sites, and large roof areas of warehouse or industrial buildings can support extensive arrays of solar panels. In addition, ancillary parking and storage areas may be suitable for accommodating free-standing solar arrays. Subject to the size of heat demand, these locations may also be more appropriate for biomass boiler and CHP plant, especially if connections can be made to buildings with high process heat demand or neighbouring housing stock. Therefore, the council's policy for development in these locations can seek to secure significant levels of sustainable energy generation, either as a requirement as part of a development proposal or, by adopting policies that encourage use of existing of industrial estates as suitable sites for 'stand-alone' renewable and low carbon energy installations.

The potential for growth in demand for data centres has already been identified in section 6 of this study. Whilst these facilities may offer some benefits over other industrial and warehouse uses within the urban area (particularly in terms of lower vehicle movements), the level of energy demand required for their operation, and in particular their cooling loads, can be very significantly higher than almost any other building of equivalent size. Even a highly efficient large data centre can have a peak power demand measured of over 300 MW[37], which is broadly equivalent to the entire peak domestic power demand for the borough. The council should consider how it wishes to address this type of development within the broader context of its strategic ambitions to stabilise and lower carbon emissions from energy consumption within the borough. Opportunities should be sought to re-use waste heat from data centre buildings, and ensure a proportion of energy demand is met through renewable energy. The adoption of a common set of metrics by which the energy efficiency of data centres can be assessed is also recommended, such as the Power Usage Effectiveness (PUE) and, Data Centre infrastructure Efficiency (DCiE) metrics advocated by Green Grid.[38]

7.9 The Code for Sustainable Homes

The Code for Sustainable Homes is becoming a well-established mechanism for assessing a number of aspects of the sustainability of new homes. The Code remains a voluntary standard (with the exception of publicly funded housing schemes), but its use is encouraged in the climate change Supplement to PPS1.

The Evidence provided to Government on the additional build cost of achieving high levels of the Code for Sustainable Homes identifies a range of values depending to a large degree on the type of development and the strategy for meeting the energy and carbon credits required by each level of the Code.[39] These are summarised in Table 4

Code Level	2-bed flat		2-bed terrace		3-bed semi		4-bed detached	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
1	£230	£320	£160	£350	£250	£430	£260	£320
2	£1,550	£1,770	£1,490	£1,840	£890	£1,260	£810	£1,090
3	£2,090	£2,760	£2,000	£2,420	£2,640	£3,020	£2,310	£2,680
4	£4,290	£6,360	£6,200	£7,410	£6,580	£8,150	£5,860	£7,190
5	£14,690	£17,740	£23,210	£27,250	£25,580	£29,550	£28,790	£32,560
6	£17,650	£28,510	£26,550	£37,690	£28,390	£41,090	£31,230	£45,510

Table 4: Upper and lower extra-over costs of meeting overall Code levels

The extra-over costs of meeting the higher levels of the Code are particularly significant in cases where development cannot connect to a district heat network supplied by biomass CHP or electricity demand can be met by wind energy. The limitations imposed by scale and density of development, along with technology and renewable resource, make Code level 6 very challenging, and we are not able to foresee wholesale adoption of this standard in Woking being economically viable within the next five years on the basis of evidence currently available to us. Therefore we would recommend that, with the exception of sites where by virtue of their scale or other exceptional circumstances it may be economically viable to achieve the highest Code level, the council sets its policy targets in respect of the Code for Sustainable Homes in step with the planned revisions to the Building Regulations. However, we would further recommend the council reviews this position within the next five years in order to ensure its policies continue to reflect changing economic and technical circumstances that may enable earlier adoption of the highest standards of sustainability within a shorter timescale than currently envisaged.

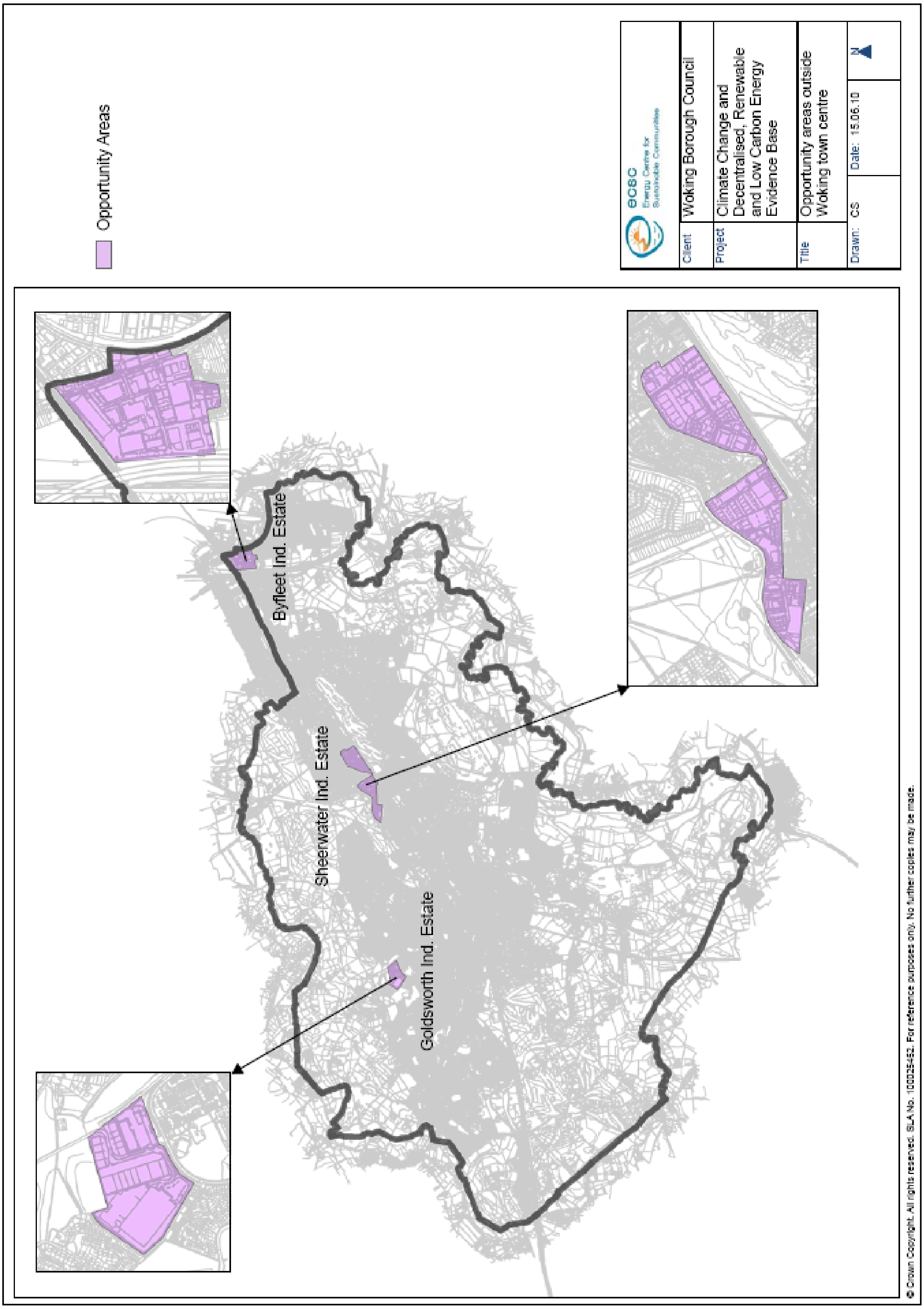


Figure 31 Energy opportunity areas at industrial locations outside Woking Town Centre

7.10 Promoting the use of sustainable transport energy

Nearly 20% of the UK's domestic CO_2 emissions come from road vehicles and the Committee on Climate Change had highlighted the need to address barriers to the delivery of infrastructure to support the roll-out of electric cars[40]. Research suggests electric vehicles could realise up to a 40% benefit in CO_2 savings compared with a typical petrol family car in the UK over the full life cycle with larger emission reductions achievable over time if the UK moves to lower carbon sources of power generation[41]. Electric vehicles also provide a potential means of capturing and storing electricity at night from renewable sources like wind power and bring further advantages in terms of reducing noise pollution and improving air quality.

As part of a number of measures to reduce the level of vehicle emissions, Government has sought to stimulate the take up of electric and plug-in-hybrid vehicles and has introduced a range of measures including funding vehicle research and development programmes and providing £250m of consumer incentives. The UK's Strategy for Ultra Low Carbon Vehicles also identifies the development of electric vehicle changing infrastructure as key to increasing use of electric vehicles and is seeking to significantly increase coverage of electric vehicle charging infrastructure enabling wider use of ultra-low carbon vehicles over the next 5-10 years.[42]

The previous government sought to reduce planning barriers to development of the infrastructure required for charging electric vehicles. In its consultation, it proposed introduction of permitted including the introduction of a new class to Part 2 to permit the installation of infrastructure for charging points within both public and private car parking areas.[43]

Figure 32 Electric vehicle charging points can be very low cost plug spurs (left) or dedicated kerbside points (Image © Chargemaster)

In Woking, the council has provided a small number of vehicle charging points in its public car parks connected to its private wire supply of low carbon electricity. In addition, it has used its planning powers to require the installation of vehicle charging points in a number of office and residential developments, especially where basement and under-croft parking is provided. In these locations, it is possible to provide secure charging points for vehicles where it would otherwise be impractical for private individuals to connect vehicles to conventional 'three-pin' plug points.

The council has the opportunity to promote the take up of plug in electric vehicles through using its planning powers to encourage or require the provision of electric vehicle charging points as part of the infrastructure provision made by development. These can be provided at low cost within dedicated private off-street parking courts or could be secured by seeking a financial contribution towards the provision of purpose-made kerbside charging points on the highway or in public car parks. Developments where this infrastructure could be sought could include new housing (particularly apartments and dwellings without private driveways), offices and employment uses and large retail schemes. It is recommended the detailed policy implementation be designed and specified within a Supplementary Planning Document.

8. Delivery of LZC energy within new development in Woking

8.1 Cost impacts of District Heat Networks

A comparison of the relative extra-over costs of providing district heating distribution infrastructure and connecting to dwellings is set out in Figure 33. This shows a clear relationship between type and density of units, with infrastructure provision and connection cost for larger, lower density dwellings typically being more than twice as much per unit than smaller, higher density units. This supports the principle that the cost (per dwelling)of building district heat networks within Woking town centre and connecting to apartments will be lower than providing new district heat infrastructure to serve lower density residential developments outside the town centre. In addition, the greater diversity of heat demand associated with mixed use developments in the town centre and other central urban areas adds to the operational viability of heat networks.

Where infrastructure and connection costs are relatively low, this can provide the least-cost strategy for low or zero carbon energy supply in new dwellings. However, this must be balanced with the reduced overall heat demand that arises through increased insulation, and where very well insulated dwellings are constructed, the economic viability of connecting to district heat networks is reduced due to lower revenues from energy supply. Therefore, the capital cost of connecting to distributed heat has to be weighed against the level of heat demand if there is to be investment in new energy infrastructure.

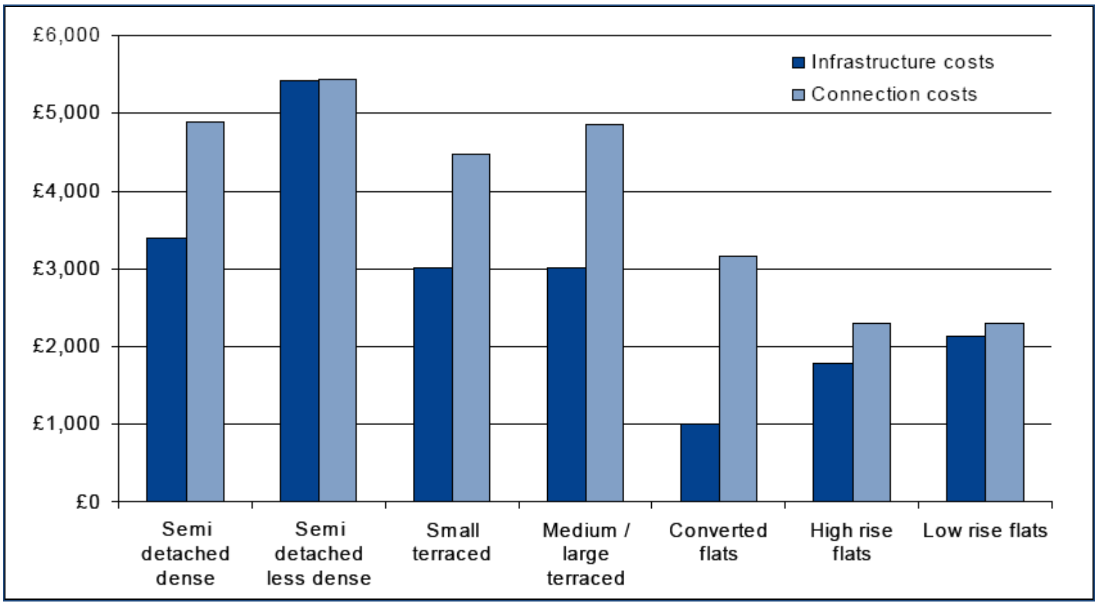


Figure 33 District heating infrastructure and connection costs by built form (source: Poyry Consulting *The Potential and Costs of District Heating Networks*, DECC, 2009)

8.2 Cost impacts of heat generating plant

Figure 34a compares the relative costs of heat supplied by district heat networks from different heat sources, compared with stand-alone renewable heat and conventional gas/electricity heating. This reveals the scale economies that can be derived from constructing community-scale heat supply compared with stand-alone systems operating at individual building level. It should be noted that the cost of heat tariff does not necessarily reflect the carbon efficiency of a heat source. For example, heat pumps and community boiler schemes provide very low carbon emissions savings in proportion to the effective heat tariff charges (based on current carbon intensity of the electricity grid). Conversely, the model suggests that whilst anaerobic digestion linked to CHP results in the highest heat tariff required to recover the investment and operating costs, it also produces the greatest carbon saving (Figure 34b).

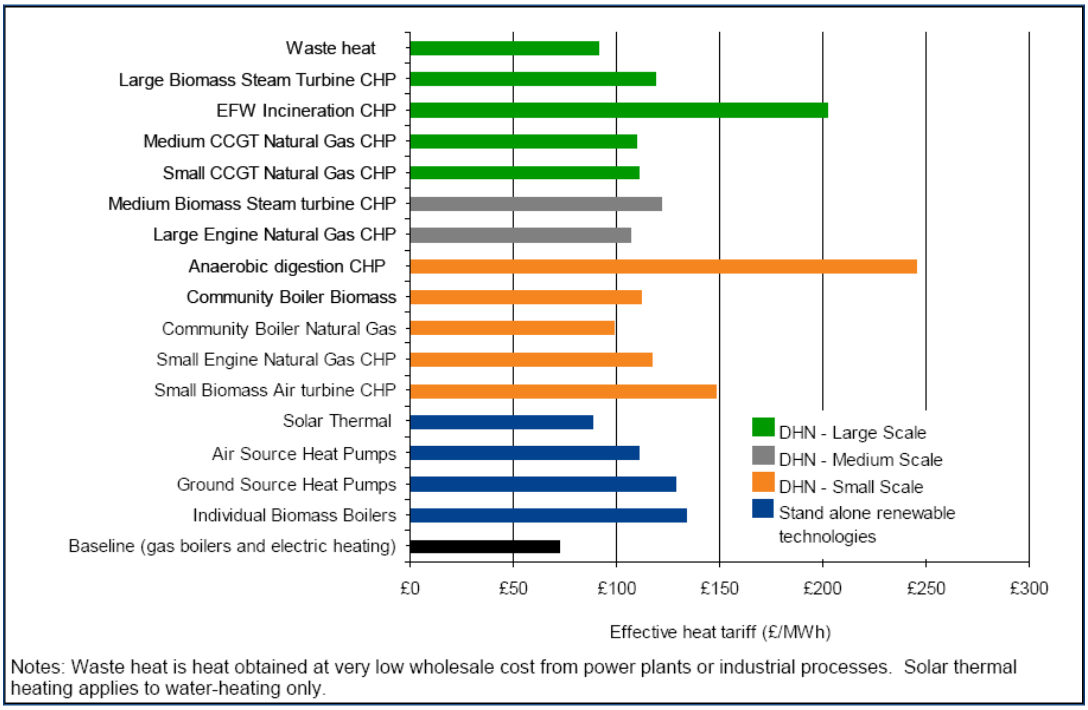


Figure 34a Cost of heat provision by technology -current market conditions (source: Poyry Consulting *The Potential and Costs of District Heating Networks*, DECC, 2009)

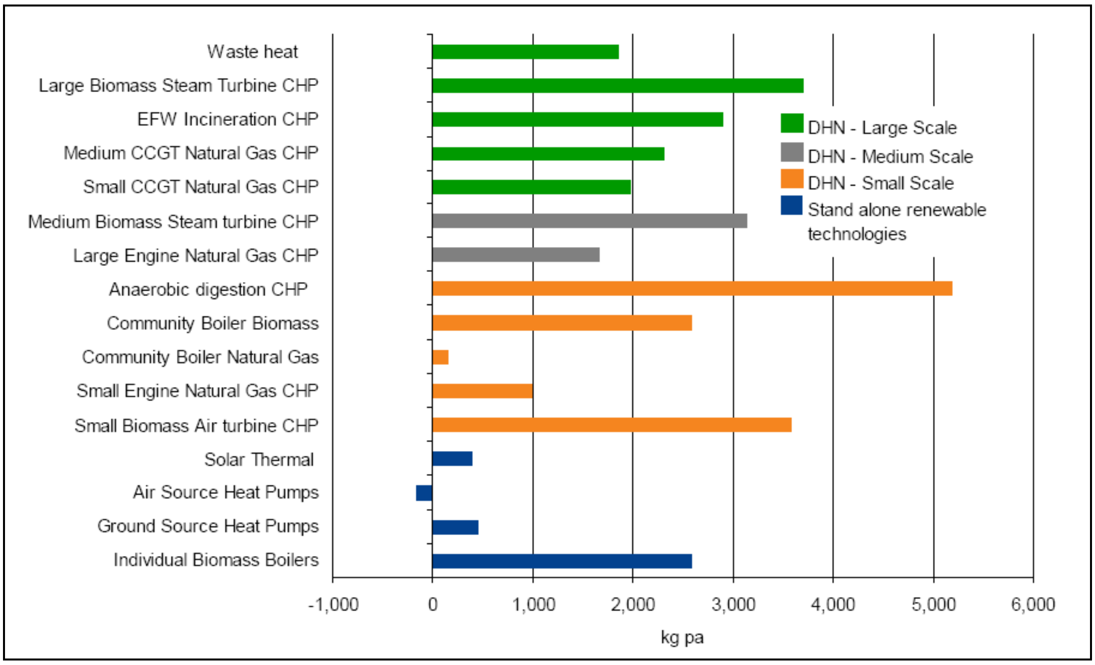


Figure 34b Carbon savings compared to baseline (source: Poyry Consulting *The Potential and Costs of District Heating Networks*, DECC, 2009)

8.3 Cost impacts of providing micro-generation

The use of a number of market intervention schemes introduced by government to stimulate investment in renewable and low carbon can have a serious impact on the cost and return on investment of micro-generation technologies. There is evidence that the introduction of the Feed in Tariff (FiT) in April 2010 has been effective in driving up investment in renewable energy technologies, with speculative investors now entering the PV and wind energy markets at scale. The FiT scheme has been designed to provide a guaranteed rate of return within the operating life of the equipment, with the consequence that some building owners are being offered PV installations at zero capital cost on a 'roof rental' basis, with building occupiers being offered free daytime electricity in return.

The government has also confirmed the introduction of a Renewable Heat Incentive (RHI) in 2011. Further details have yet to be announced regarding the details of the scheme, including RHI tariffs and technologies supported, but over £850 million of treasury funding is to be made available to renewable heat technologies from June 2011. As with the introduction of the FiT, it is too soon to quantify the impact of the RHI on the capital cost and payback of renewable heat technologies, but it is anticipated that these mechanisms will result in significant reduction in the capital costs for developers meeting planning policy objectives for low and zero carbon buildings.

8.4 Capitalising on existing delivery systems within Woking

Woking has a significant advantage over many similar boroughs in having already made significant investments in sustainable energy infrastructure, and having established a delivery partner in the form of an ESCo that is largely owned by the council. It has gained expertise and experience in the planning, financing and operation of CHP plant, district heat networks and the generation of renewable electricity in Woking and Milton Keynes (through its subsidiary, Thameswey Central Milton Keynes Ltd.). The total investment value of these assets exceeds £30 million. Woking has also considerable experience in securing investment in sustainable energy through the development process, and is actively pursuing a number of programmes to promote take up of energy efficiency measures and micro-generation by local communities and businesses.

The wealth of experience and existence of sustainable energy infrastructure in the borough places the council in a strong position to support the delivery of its policy objectives for low carbon energy supply. It is able to demonstrate the technical and fiancial viability of energy schemes, can offer to partner developers in the provision of new infrastructure or extensions to existing networks, and is able to provide secure arrangements for the operation and management of these assets, including engineering and customer services. These factors enable the council to offer a greater level of certainty regarding the successful delivery of its policy objectives, and in turn to seek greater commitment from development to achieving these objectives.

8.5 Implementing and Monitoring Policy

The implementation of a number of the policy recommendations set out in this study will require detailed supporting guidance underpinning the core policies. This can be used to set design standards, to provide the means of defining financial contributions to be made towards investment in new infrastructure and as a source of technical guidance to ensure compatibility between building systems and energy supply networks. In addition, it will be important to define the level of information required to support a planning application, and the format in which this is to be provided to the council to enable compliance with policy to be assessed. This information can be set out in the form of Supplementary Planning Guidance (SPG).

In addition to an SPG, the council is recommended to consider the use of decision support tools to enable close dialogue between the applicant and the planning authority. Resolution of complex and technical issues can be assisted through the use of such tools to provide clarity and certainty to developers and planners. Woking has pioneered the use of such tools to assist implementation of climate change policy through the use of its Climate Neutral Guidance for developers and the C-Plan carbon and energy impact assessment tool. We recommend continued use of such tools in order to enable the implementation of new policies to be effective and avoid undue delay and inefficiencies for applicants and planning officers. These tools can also provide transparency for other stakeholders by making complex technical issues more readily understood, and ensure consistency in the evaluation of evidence and supporting information. Finally, the use of appropriate tools can also assist in collecting relevant information for the purpose of monitoring policy implementation.

The Climate Change Supplement PPS stresses the importance of monitoring the impacts of climate change policy to ensure the desired outcomes are achieved. Where complex technical issues are included in the development process, such as carbon reduction measures and the installation and connection to community energy networks, it is vitally important that monitoring and analysis of the final outcome of planning decisions is included in the development management process and we recommend thought be given to the design and use of monitoring and reporting systems.

9. The Potential for Reducing Water Consumption in New Development

Water is an essential requirement for all new major development and demand for water as a result of new development is expected to increase. In the South East of England this increase in demand will be particularly influenced by growth in population The South East of England has already been identified by the Government as an area of water stress[44] whilst demand for water from this new development will extend beyond the lifespan of the South East Plan. Furthermore, during the lifetime of this development other factors such as Climate Change are also forecast to have a potential impact on the supply of water.

This section of the study considers whether new planning policies in Woking Borough Council's Core Strategy can play a role in regulating the demand for water that will arise from new development. In doing so it identifies and takes into consideration the Government's own targets and national planning policies for achieving this. The study also highlights the roles and responsibilities of other stakeholders and identifies the opportunities for controlling the demand for water supply in addition to the potential factors that may hinder this issue being addressed.

9.1 The impact of future development on water demand in Woking Borough

The Council's emerging Core Strategy will form part of the Woking's Local Development Framework and will set out a strategy and vision for meeting known and anticipated development requirements up to 2026. This will include planning policies against which proposals for new development will be considered.

Water-related services are supplied to Woking Borough by two separate companies, Veolia (formerly known as Three Valleys Water) and Thames Water. Thames Water is the statutory sewerage undertaker for the Borough whilst Veolia supplies potable water to all properties within the Borough.

Veolia's water resources planning is conducted at a zonal level (Northern, Central and Southern), and Woking Borough is located within the Southern zone. The zones are set up to act as a 'water grid' whereby for each of the three grids there are a number of available ground and surface water resources, and treatment works capable of preparing the water for potable supply. The grid in each zone therefore allows water in the zone to be moved via the strategic mains to anywhere in the zone.

The consequence of this arrangement is that no single resource is considered to supply any single development. Veolia uses a supply and demand balance to check that it has in each zone an ability to supply a certain amount of water above the daily requested volume in order to give 'headroom'. Veolia will only consider providing new water resources infrastructure if available headroom falls below a certain level and has confirmed that it has available resources to supply the proposed broad areas in our operating area at this time.

The national average for water use in England is estimated by the Government to be 150 litres per person per day (l/p/d)[45] . This is equivalent to one tonne of water per person per week. However, information submitted by Veolia indicates that currently its 2010 estimate for average annual water consumption per head in the Southern Water Resources Zone (based on its revised Draft Water Resources Management Plan), is 170 litres per person per day for metered customers and 195 litres per person per day for unmetered customers. This is based on a 'Dry Year' planning scenario[*]. Veolia Water has estimated in its Draft Water Resources Management Plan 2010 that 44% of domestic properties within its area of operations have a water meter.

The following table sets out the estimated current level of demand for water in Woking on a litre per person per day (l/p/d) basis and, on the basis of forecast growth in new dwellings, estimated consumption in 2026. It should be noted that this assumes 90% of dwellings are metered by 2026 (based on Veolia Water's plans to introduce meters to 90% of all properties by 2030[46]), and also assumes that dwellings built between 2010 and 2026 will have been constructed to the current Building Regulations standards of 125 l/p/d.

	Average water consumption l/p/d March 2010 (assumes 44:66 split between metered/non non-metered properties)	Expected level of water demand March 2026 (assumes 90:10 split between metered/non non-metered properties)
Total number of dwellings	40,887	45,400
% metered	44	90
% non-metered	66	10
Consumption l/p/d metered	170	170
Consumption l/p/d non-metered	190	190
Consumption l/p/d new dwellings 2010 – 2026		125
Average occupancy rate	2.41	2.12
Total domestic consumption per day (litres)	17,855,026	16,104,981
Annual total domestic consumption (m^3)	651,708	587,831

Table 5 Estimated future water consumption in Woking

It is interesting to note that as a result of the expected drop in average occupancy of dwellings by 2026 combined with an increase in use of meters, the overall demand for water (based on the existing status quo in terms of average use) would decrease by 1,750,045 litres per dwelling per day.

9.2 Water Supply and Climate Change

The impact of climate change on water supply and demand must also be considered. In predicting the impact of climate change the Government, using a methodology devised by the Met Office, has assumed 3 different scenarios based on low, medium and high emissions of greenhouse[47]: This indicates that across the three scenarios there is the potential for a change to annual mean precipitation of between 0% and 2%. In addition it is predicted that

[*] Identified in Veolia's water's Water Management Plan as "A year of rainfall below long term average and is characterised with high summer temperatures and high demand."

climate change will lead to hotter drier summers, warmer wetter winters and an increase in extreme events such as heatwaves, droughts and floods in the South East of England. Under the UKCIP09 medium scenario projections by 2050 it is likely that:

- Average summer temperatures will increase by 2.8 degrees Celsius
- Winter rainfall will increase by 16%
- Summer rainfall will decrease by 19%
- There will be an overall increase in temperature and rainfall variability
- There will be more frequent and extreme summer heat-waves and very wet winters.

These predicted changes in climate need to be considered against the current position with regard to water supply. In the South East of England, water demand exceeds the volume licensed for abstraction, with the shortfall being met from ground water[48].

The Environment Agency has identified the area supplied by Veolia as an 'area of serious water stress' for the purposes of Regulation 4 of the Water Industry (Prescribed Condition) Regulations 1999 (as amended)[49] . This states that:

> *The Secretary of State may, after consulting the Environment Agency, determine the whole or any part of a water undertaker's area to be an area of serious water stress for the purposes of these Regulations, where the Secretary of State considers that—*
> *a) the current household demand for water in that area is a high proportion of the current effective rainfall which is available to meet that demand; or*
> *b) the future household demand for water in that area is likely to be a high proportion of the effective rainfall which is likely to be available to meet that demand.*

In making this assessment the Environment Agency considered the following criteria:

- Current household demand for water.
- Forecast growth for household demand for water.
- Forecast population growth.
- Resource availability – current.
- Resource availability – forecast.

It should also be recognised that the process of making water useable for public consumption uses energy and therefore contributes towards to climate change through the emission of greenhouse gases. Domestic consumption of hot water is responsible for 35 million tonnes of greenhouse gas emissions each year, equivalent to over 5% of total UK greenhouse gas emissions.[50] Measures to reduce domestic water consumption will therefore contribute to reducing greenhouse gas emissions. Changes in water management and behaviour resulting in lower levels of water consumption are required to avoid 'serious threats both to the security of our water supplies and to the health of our water environments and nature conservation sites.'[51]

9.3 Water Resource Management Plans

Both Veolia Water and Thames Water are required to produce Water Resource Management Plans (WRMP) which set out how they intend to provide a secure and sustainable water supply over a 25 year period. As the supplier of potable water to Woking Borough, Veolia's WRMP is of particular relevance to this report. Veolia's Revised Draft

Water Resource Management Plan 2008 for Water recognises the need to supply the predicted 25% increase in the number of new dwellings within their area in combination with a predicted 13% increase in the population.

The WRMP predicts that by 2026 within Veolia's Southern Zone average consumption will be 151.8 litres l/p/d for a metered dwelling and 168.4 litres l/p/d for a non-metered dwelling. However, it also recognises the Government's aspiration to achieve an average l/p/d consumption of 130 litres by 2030[44]. In order to achieve this, the WRMP identifies the following measures as being necessary:

- Full metering.
- Seasonal tariffs.
- Innovation (Automated Meter Reading and smart metering).
- Facilitating the introduction of new, more efficient appliances for each household.

The WRMP identifies a number of objectives in order for Veolia to meet the anticipated demand for water within its Southern Zone up to 2030. This includes continued compulsory metering of properties to achieve 90%, in addition to the improvement of customer information in order to sustain demand reductions in the longer term.

9.4 Woking's Climate Change Strategy (2008 – 2013)

The Council's Climate Change Strategy provides guidance on water-related issues and identifies the need to reduce water consumption. The strategy sets a target to reduce water use to 130 l/p/d by 2018 and recognises that reduced consumption can be achieved through behaviour change and by adopting measures such as:

- Water efficient appliances.
- Water meters.
- Water harvesting.

Figure 35 compares current average water consumption in Woking with the supplier's predictions for consumption at the end of the end of the Core Strategy period, and the government's target for average UK consumption.

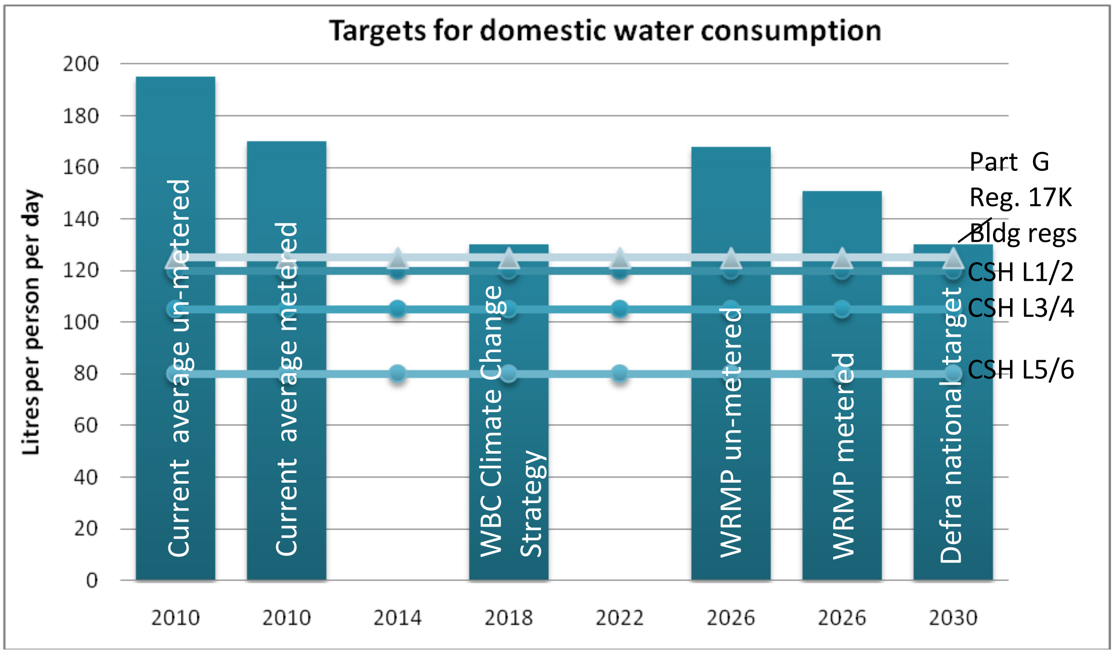


Figure 35 Current levels of water consumption, standards and future targets

9.5 Opportunities to address water supply in the Core Strategy

Government policy provides strong justification for the inclusion of specific policies in relation to water use in new residential development. This case is strengthened by the fact that Woking is within an area that has been identified as an area suffering from serious water stress. There is also compelling evidence that the predicted impact of climate change is expected to further exacerbate this problem.

In terms of the approach to be taken by the Core Strategy an option would be to not include any specific policies which require the more efficient use of water as a resource within new development, and simply rely on the existing requirements of Building Regulations and the introduction of stricter national targets through future amendments to part G of the Building Regulations. However, the Government has given no firm commitment as to when this may take place, and this option would represent a missed opportunity in terms of having a policy framework requiring higher than existing standards for Building Regulation consent.

To put this in context, Woking Borough Council is required to deliver, on average, 292 dwellings over the SEP period. On the basis that such a figure is delivered within a year this would represent an additional demand of 87,965 litres per day (based on an average requirement per dwelling of 301.25 l/p/d i.e. an average occupancy of 2.41 people multiplied by 125 litres). This would equate to an average demand of nearly 110,000 litres for an individual dwelling over a calendar year and a total annual demand of over 32 million litres for all 292 dwellings.

An alternative option would be to set higher standards than currently required under Building Regulations. Having regard to the Government's emerging policy, as set out in the draft Planning Policy Statement on Climate Change it is recommended that such an approach should be based on the nationally recognised standards set out in the Code for Sustainable Homes. The requirements stipulated by Code Levels 1 and 2 (120 l/p/d) are only marginally less that the current requirements of the Building Regulations. On the other hand, the introduction by the council of policy aligned with the maximum water consumption target in Code Levels 5 and 6 (80 l/p/d) would represent a significant reduction in consumption over the standard required by current Building Regulations. However, this would also incur significant additional construction costs (Table 6) and risk 'setting the bar too high' with the consequence that it may ultimately prevent development from coming forward, at least during the early years of the Core Strategy period.

It is recommended the council considers setting its policy requirements at a figure of 105 l/p/d (equivalent to Code Level 3). This would result in an average sized dwelling's total water demand of a little over 250 litres per day (i.e. 2.41 x 105). This would equate to an average demand of 92,363.25 litres for an individual dwelling over a calendar year and a total annual demand of just under 27 million litres for all 292 dwellings. This represents a daily saving of 17,593 litres and an annual reduction, in terms of water use, of nearly 6.5 million litres. In expressing the benefits of this approach an assumption is made that the Core Strategy would be adopted in advance of any further amendments to Building Regulations.

In order to assist with the delivery of a standard in excess of that required by Building Regulations it is recommended that this should be combined with a policy framework that requires SuDs to be provided as part of the development. Again there are a number of policy drivers at both regional and national level that would justify this as it would assist with reducing the overall water demand for an individual dwelling.

Clearly the application of such policies would also provide benefits in terms of reducing the impact of climate change. Although not fully quantified in this report, the reduction in demand for water would result in less energy required for its provision and therefore a reduction in CO_2 emissions. The introduction of policies requiring SuDs would also assist with ensuring that new development adapts to the impacts of climate change.

In addition to the importance of design and fit-out of new buildings, measures to reduce the demand for water in new development include influencing the behaviour of occupants of new dwellings to reduce water consumption. For example, the Council may wish to consider the introduction of a policy requiring developers to provide 'information packs' to new occupants of that development providing advice on the need for and benefits of restricting water use. Given Veolia Water's aspirations for the introduction of water meters in Woking Borough the potential monetary savings of using less water, in addition to the environmental benefits, would help in this respect. Consideration should also be given as to whether a legal agreement to secure this requirement could be structured in a manner that would ensure that the 'information pack' is passed on when ownership of the new dwelling changes.

9.6 Potential cost implications

Whilst a number of drivers justify the introduction of a new policy requiring more efficient use of water in new dwellings it is important to consider the cost implications for new development. The cost implications of meeting water standards of Levels 3 and 4 of the Code for Sustainable Homes have been identified in the Government's publication 'Code for Sustainable Homes: A Cost Review' (published March 2010).

Code Level	Specification	Cost
Level 1	6/4 litre flush toilets 2 litre/min washbasin taps 7.5 litre/min shower 120 litre bath 6 litre/min kitchen taps	**Flat £0** **Terraced £0** **Semi £0** **Detached £0**
Level 2	4/2.5 litre low flush WCs 2 litre/min washbasin taps 7.5 litre/min shower 120 litre bath 6 litre/min kitchen taps	**Flat £0** **Terraced £0** **Semi £0** **Detached £0**
Level 3	4/2.5 litre low flush WCs 2 litre/min washbasin taps 7 litre/min shower 100 litre bath 6 litre/min kitchen taps	**Flat £200** **Terraced £200** **Semi £200** **Detached £240**
Level 4 (based on a requirement of 90 l/p/d)	4/2.5 litre low flush WCs 2 litre/min washbasin taps 7 litre/min shower 100 litre bath 6 litre/min kitchen taps Rainwater harvesting	**Flat £1,550** **Terraced £3,200** **Semi £3,200** **Detached £3,500**
Level 5 and 6	4/2.5 litre low flush WCs 2 litre/min washbasin taps 7 litre/min shower 100 litre bath 6 litre/min kitchen taps Greywater recycling Water efficient washing machine	**Flat £1,750** **Terraced £4,200** **Semi £4,200** **Detached £4,500**

Table 6 Relative cost impacts of achieving the water consumption targets for each Level of the Code for Sustainable Homes

The same report also provides approximate figures of the costs associated with introduction of elements that would provide SuDs. These are summarised as follows:

Issue	Example	Cost
Management of Surface Water Run-off	Sustainable Drainage System	£1,100 (The report notes this figure is based on feedback from one developer only).
Flood risk	Flood risk assessment	£30 - £50 per dwelling.
Flood risk	Flood risk mitigation	£4,160 per flat £16,635 per house (figures based on data from Association of British Insurers)

Table 7 Costs of providing SuDS for new homes

In summary, meeting the requirements of Code level 3/4 (of 105 l/p/d) for water consumption would in the worst case scenario add an extra £240 to the cost of constructing a detached dwelling. Even allowing for changes to these figures since the report they are based on was published it is suggested that the cost of meeting this requirement would not be prohibitive so as to make a development unviable. Should specific requirements for elements that comprise surface water run-off, again the costs do not appear to be prohibitive. However, measures to address flood risk mitigation are likely to potentially more expensive.

10. Recommendations for informing emerging policy

On the basis of the evidence set out in this study, we recommend the following objectives be addressed in the council's preferred options for its Core Strategy:

Climate Change Mitigation and Sustainable Energy

I. District Heat Zones be identified in Woking town centre as shown in Figure 30 where development shall be expected to connect to heat networks and/or contribute funding towards the development of the networks and be designed to ensure the building services within the development are designed to be compatible with the network.

II. Detailed arrangements for specifying the Heat Zones, financial contributions to be made and building services standards for compatibility be set out in an SPD.

III. Consideration be given to identifying potential sites for new energy stations to serve the Heat Zones, and measures adopted to ensure land is reserved for the installation of distribution pipes and other infrastructure

IV. Developments that propose generating additional heat energy (such as stand- alone boilers or heat pumps) be resisted in the Heat Zones in order to encourage the viability of the low carbon community energy schemes.

V. All new housing developments be built to meet the equivalent of Code Level 3 in respect of energy and emissions until 2013, when this standard is to be revised to code Level 4, unless special circumstances warrant the adoption of higher standards.

VI. Emerging guidance in relation to the technical and economic impacts of achieving Zero Carbon homes be taken into account in reviewing the standards for housing development, such that the council can require all new housing to be built to the Zero Carbon homes standard at the earliest opportunity from 2016.

VII. The council should give early consideration to how it wishes to direct the use of 'allowable solutions' in meeting its objectives for reducing carbon emissions in the borough and supporting the development of sustainable energy.

VIII. Development proposals for data centres and other uses with exceptionally high energy demand be given particularly careful consideration in order to assess the potential for re-using waste heat and meeting a proportion of the development's energy demand through locally generated renewable energy.

IX. In exceptional cases where the proposed standards for carbon emissions reductions are demonstrated not to be possible for reasons of technical feasibility or economic viability, planning consent only be granted subject to payment of a contribution to fund the provisions of community renewable energy equivalent to offset the carbon excess emissions of the development.

X. Until the adoption of core strategy policies, the existing practice of seeking a significant proportion (at least 10%) of energy demands in all new developments though on site generation by renewable means be continued.

XI. The council is recommended to require new development to contribute to the provision of electric vehicle charging infrastructure in the borough, with further detail to be set out in an SPD.

Climate adaptation

XII. It is recommended the council considers setting its policy requirements for domestic water consumption at a figure of 105 l/p/d (equivalent to Code Levels 3 and 4).

XIII. The council should actively promote the use of SuDs and where-ever possible encourage an integrated approach to water management that addresses the objectives of water run-off and reduced water consumption.

XIV. The Council may also wish to consider the introduction of a policy requiring developers to provide 'information packs' to new occupants of that development providing advice on the need for and benefits of restricting water use.

Policy Implementation, Monitoring and Review

XV. That the council continues to work closely with its local partners (including its ESCo) to ensure delivery mechanisms are in place provide and operate new infrastructure.

XVI. The council considers how it proposes to implement its policies, with particular consideration given to the use of guidance, advice and decision support tools (such as checklists and online collaborative tools).

XVII. Monitoring systems be designed and used to ensure the effectiveness of the council's planning policies in meeting their objectives, and the policy framework reviewed as necessary.

Appendix I
Heat and Energy Modelling Methodology

Overview of Data Modelling Process

A key objective of the baseline report is to provide a visual representation in terms of the spatial distribution of energy use across Woking town centre. In order to provide a street/block-scale representation of energy use within the town centre 32 zones were defined on the basis of postcode and property type. A geographic information system (GIS) was used to create a composite base map showing these zones (Figure 36) The base map has then be used to apply visual representations of the spatial distribution of current and predicted future energy across Woking town centre.

Built Environment Data

Using GIS information provided by Woking Borough Council, existing domestic and non-domestic addresses contained within each zone where extracted and tabulated. The non-domestic addresses were then cross referenced with data obtained from the Valuation Office Agency (VOA), which is an executive agency of HM Revenue and Customs (HMRC). The VOA maintains a database of non-domestic properties in the UK for the purposes of assessing property values for the taxes administered by the HM Revenue and Customs. The VOA data set provided quanta of treated internal floor area of the commercial and industrial buildings within the borough.

For domestic properties building types were distinguished by map-based study backed up by site visits. Dwelling sizes were estimated on the basis of typical stock type of property and estimated number of bedrooms using the standards below.

Building Type	Gross Internal Area (GIA)
Terraced House	85
Detached House	120
Semi Detached House	90
1 Bed Flat	60
2 Bed Flat	70
Maisonette	70

Table 8: Gross Internal Areas of Dwellings

Energy Performance Benchmarks

Energy performance benchmarks were developed for present and future energy performance standards. Existing energy demand was modelled on the basis of non-domestic energy consumption benchmark data (CIBSE TM:46 2008 Energy Benchmarks weather adjustment figures defined by region). Future projections were based on future building regulations, CLG's projected carbon reductions[1] and the EU directive document[2]. Amendments to Building Regulations for non-domestic buildings are proposed for 2010, 2013, 2016, with the proposed introduction of standards for new non-domestic buildings to be zero carbon by 2019.

Domestic benchmarks for typical building types were estimated using the NHER energy assessment software for new and existing dwellings. This methodology is based on the BREDEM-12 model which includes un-regulated energy uses from cooking and appliances.

[1] Department for Communities and Local Government - Zero carbon for new non-domestic buildings 2009

[2] European Union Energy Performance of Buildings Directive

Future projections were derived based on future building regulations, and zero carbon homes[3]. Amendments to Building Regulations changes for domestic buildings are proposed for 2010, 2013 and 2016 when new build housing is planned to achieve zero carbon standards.

Growth Projections

Information provided by Woking Borough Council's planning department was used to identify a number of potential future redevelopment schemes in the town centre. Energy consumption projections for these schemes incorporated both planned demolition of existing stock and planned new developments.

The latent use of the existing building regulations currently permits buildings to be constructed to meet the Building Regulations minimum requirements in force at the time of being granted full planning permission for a period of three years. This means that a building which gains planning permission in 2013 prior to a revision in Building Regulations could be constructed to meet the 2010 minimum standard right up to 2016. This has an impact on the energy consumption and emissions of building stock over time.

In order to incorporate as many of these issues as possible in future growth, bands covering 2010 – 2017 and 2017 – 2027 were created for the analysis of the projected heat demand of the growth phasing.

Heat Density

Average heat density was modelled on the basis of individual energy zones based on internal floor areas and benchmark heat energy consumption and expressed in MWh/m^2. The methodology used by Poyry consulting in its report on the potential for district heating[4] was also used to calculate average instantaneous heat loads for each zone on the basis of the kW/km^2.

[3] Department for Communities and Local Government - Zero carbon for new domestic buildings 2009
4 The Potential and Costs of District Heatin. Poyry Consulting/Aecom 2009

Appendix II -
Heat and Power Mapping Zones in Woking Town Centre

No.	Name	Description
1	**Vale Farm Road**	Primarily residential area comprising mainly early 20th terraced/semi detached housing and some recent low rise residential infill.
2	**CAP Gemini/SAB Miller**	Two late 20th century corporate head office buildings
3	**Peacocks**	Late 20th century covered shopping centre and parking facilities
4	**Brewery Road/Kingswood Ct.**	Surface car park and single low rise post war flatted development
5	**Civic Quarter**	Principal public buildings including Civic Offices, library, theatre and cinema, and late 20th century medium rise offices
6	**Waterside and Century Ct.**	Two flatted 3/4/5 storey flatted developments built over the last 10 years
7	**Chertsey Road (north side)**	Edge of central business district comprising a number of small, medium -rise late offices built within last 30 years, Holiday Inn hotel and new high density apartments. Also includes the town centre energy station.
8	**Brookhouse Common**	Undeveloped common land
9	**Chertsey Road (south side)**	2/3 storey late Victorian properties and inter-war mid 20th century buildings with ground floor shops, food outlets and bars, and storage/office/residential uses above.
10	**Eastern Office Quarter**	Large office developments circa 1980 (Dukes Ct. and Cornerstones)
11	**Leisure and Entertainment Quarter**	Conference centre, indoor entertainment complex, nightclub, small hotel, pub and refurbished late 20th century offices
12	**Chertsey Road/The Broadway**	Late Victorian and early 20th century two/three storey buildings with numerous ground floor bars, restaurants and take-away outlets, small shop units, storage and flats over
13	**Christ church/BHS**	BHS store, Christ church, ground floor retail units to east of Mercia Walk with offices over (Alexander House) and early 20th century shop units with offices over in Commercial Way.
14	**Commercial Way (east side)**	Retail and office uses and some bars and restaurants in mainly 2-3 storey buildings ranging from early 20th century to 1970's with one 8 storey office building.
15	**Wolsey Place/Export House**	Shopping centre including various retail units, small take-away outlets and supermarket with two storeys of apartments over and 1970s office tower

16	**Commercial Way (west side)**	2-3 storey early and mid 20th century buildings with ground floor retail and food uses, offices and ancillary uses over.
17	**Church Street West**	Mixed uses including offices, bars, retail, the fire station and modern church. Age range from early 20th century, with numerous 3-4 storey office blocks built since 1980 and a new block of apartments
18	**Goldsworth Road (north side)**	Mixed age and use including 2 storey Victorian buildings with ground floor bars and restaurants, 3-4 later 20th century in-fill office and recent 4 storey apartments over retail units
19	**Goldsworth Road (south side)**	Small old retail and business warehouses, light industrial units and late 20th century 3-4 storey offices
20	**Aggregates Depot**	Land used for stone aggregates storage and distribution
21	**Sovereigns/Barratts site**	Large sire currently under redevelopment. Only occupied building is a public house/reatuarant
22	**Centrium Quarter**	High density apartments built within the last ten years and Woking telephone exchange
23	**Woking Station**	Railway station ticket halls, platforms and ancillary buildings
24	**Station car park**	Surface car park
25	**Oriental Road**	Semi-detached and detached inter-war dwellings
26	**Heathside Crescent/Station Approach**	Police station, Magistrates Courts, three-storey 1980s offices and flats
27	**Evans Cycles triangle**	Stock of mixed age including early inter 20th century
28	**Consort Ct/York Road**	3-4 storey retirement homes and apartments built within the last ten years and a small parade of early 20th century shops with flats and offices over
29	**Quadrant Ct.**	Large 1980's 3-4 storey office building and a few apartments built at approximately the same time
30	**Guildford Road and Hillview Ct.**	Edge of town centre residential area 2-3 storey late 1960's/1970s flats and three storey apartments built within the last ten years.
31	**North side of Heathside Road**	Late 20th century semi-detached and short terraced houses and low rise flats
32	**Community health campus**	Woking community hospital, Woking hospice and small surgeries and clinics, all built within the last twenty years
33	**Hillview Roads/White Rose Lane**	As zone 33.

Table 9 Description of town centre energy zones

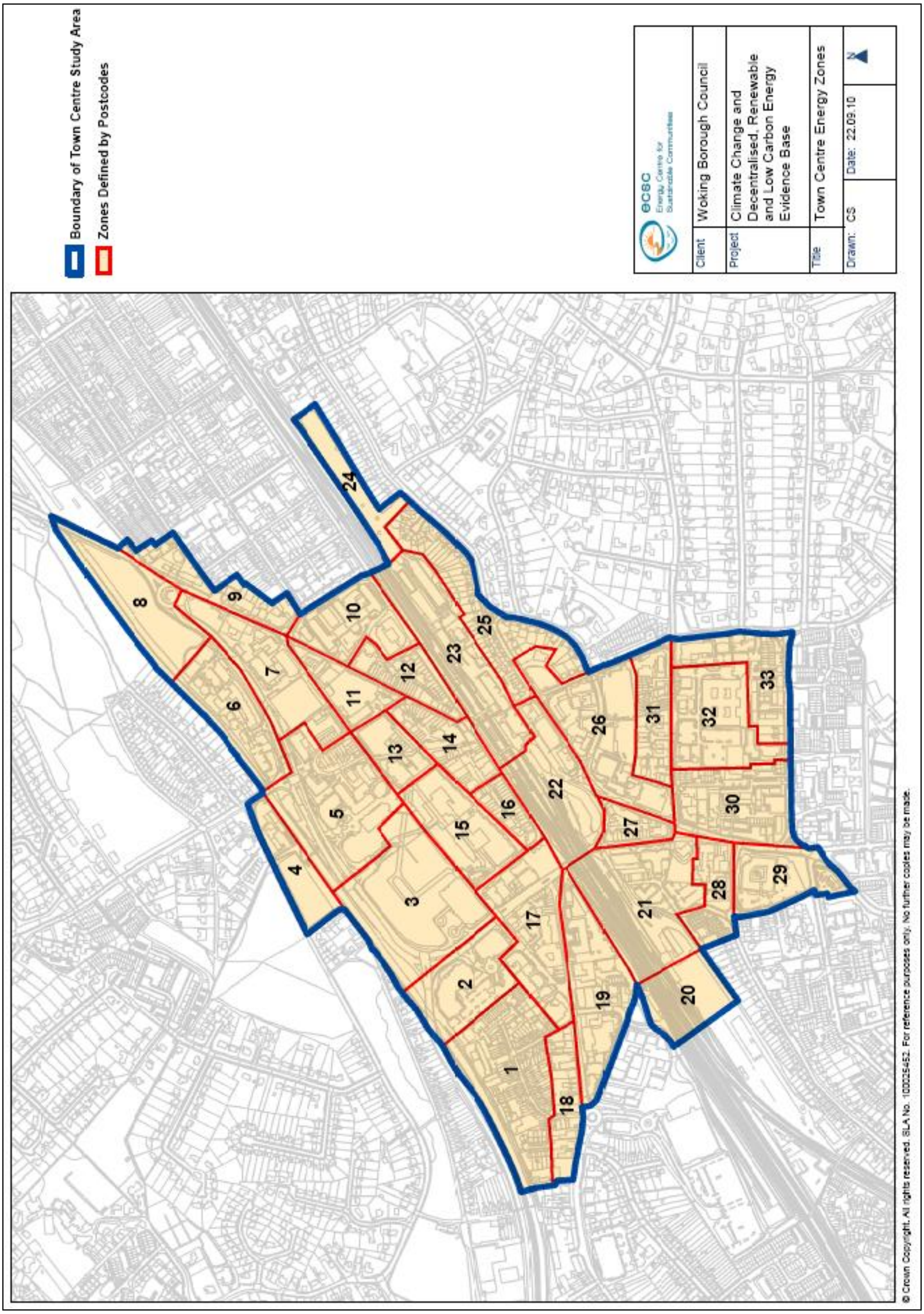


Figure 36 Town Centre Energy Zones

Appendix III

Woking Town Centre Heat and Electrical Demand

Existing energy baseline

Projected energy demand 2017

Projected energy demand 2027

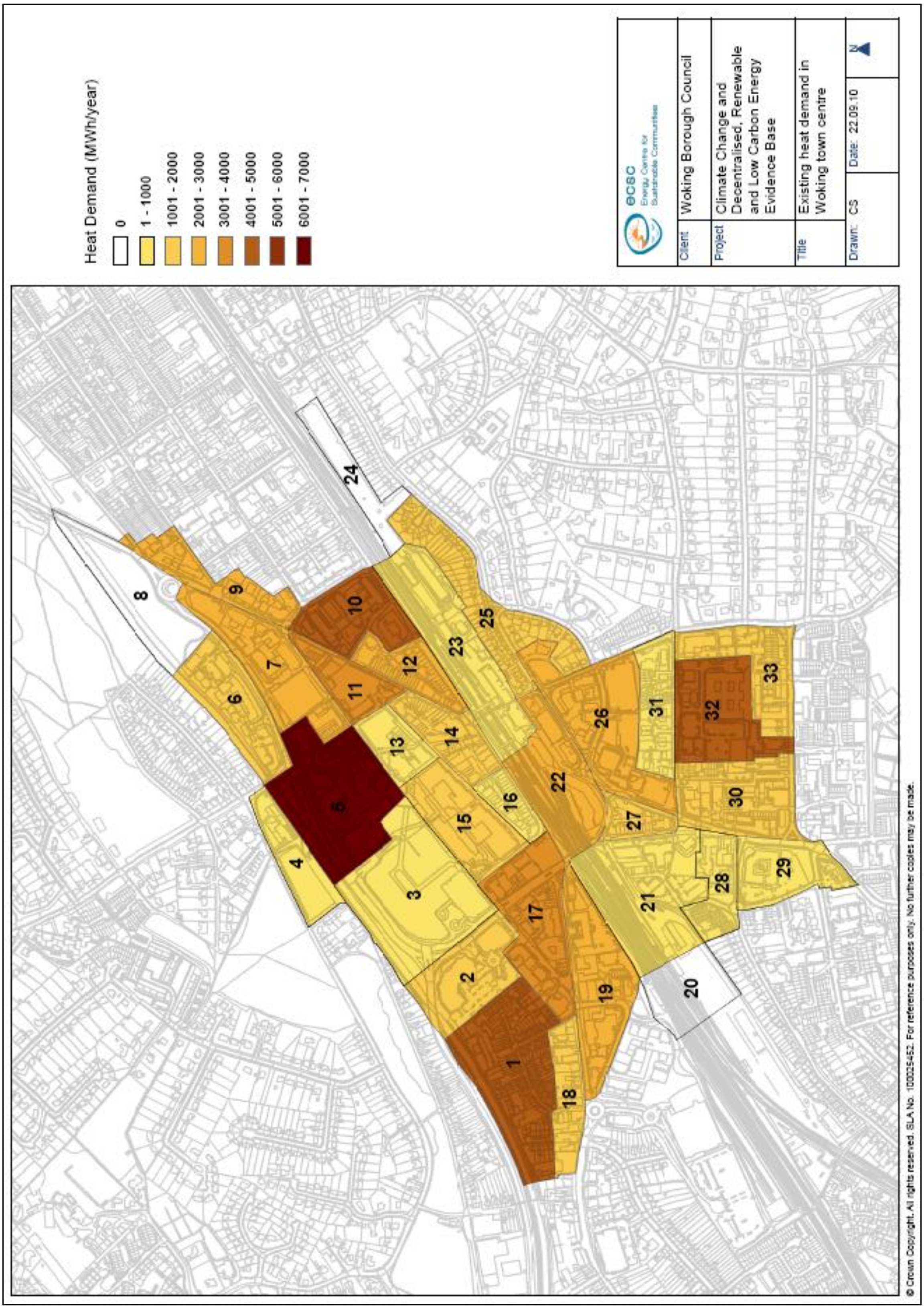


Figure 37 Existing Heat Demand in Woking Town Centre

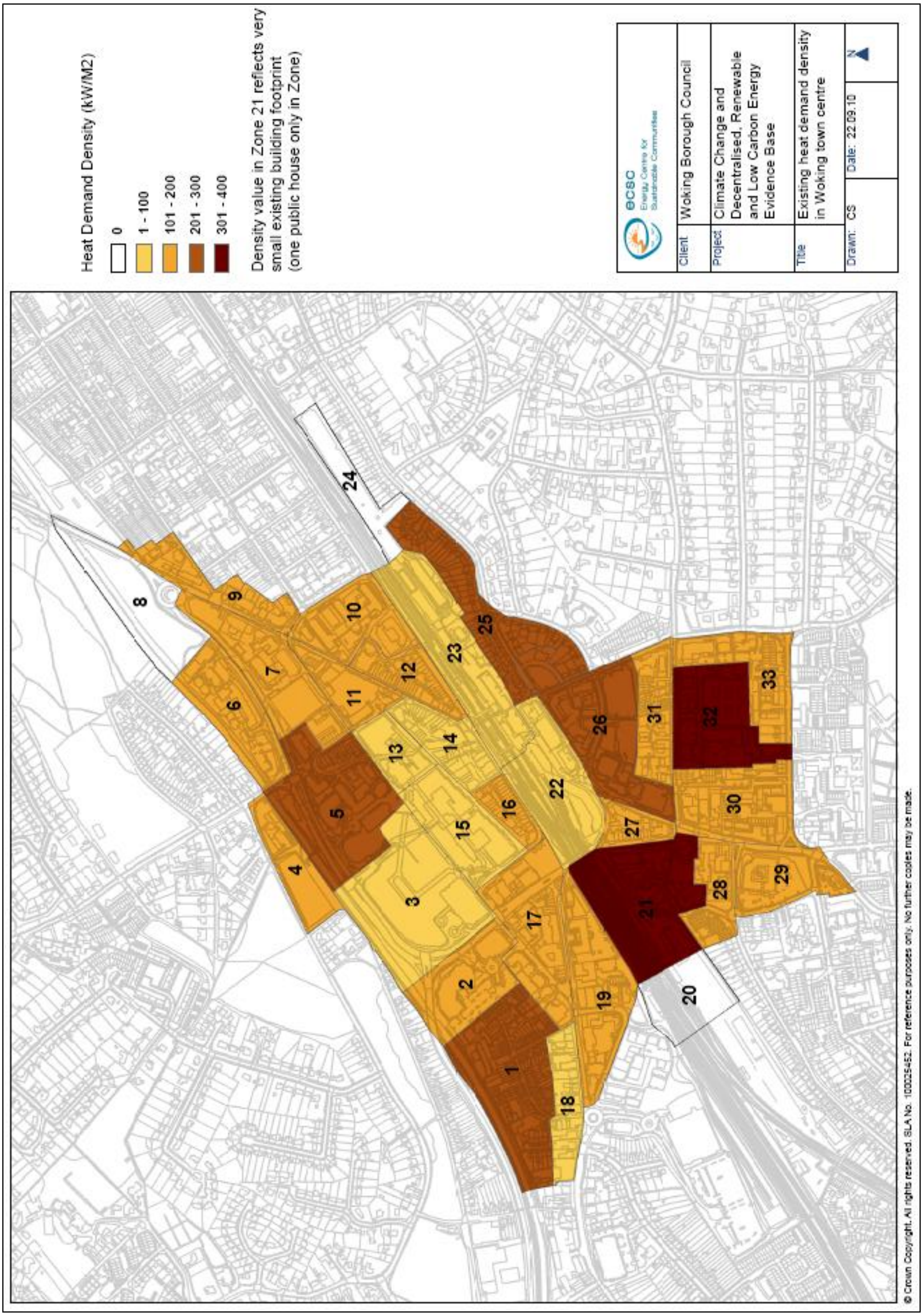


Figure 38 Existing Heat Demand Density in Woking Town Centre

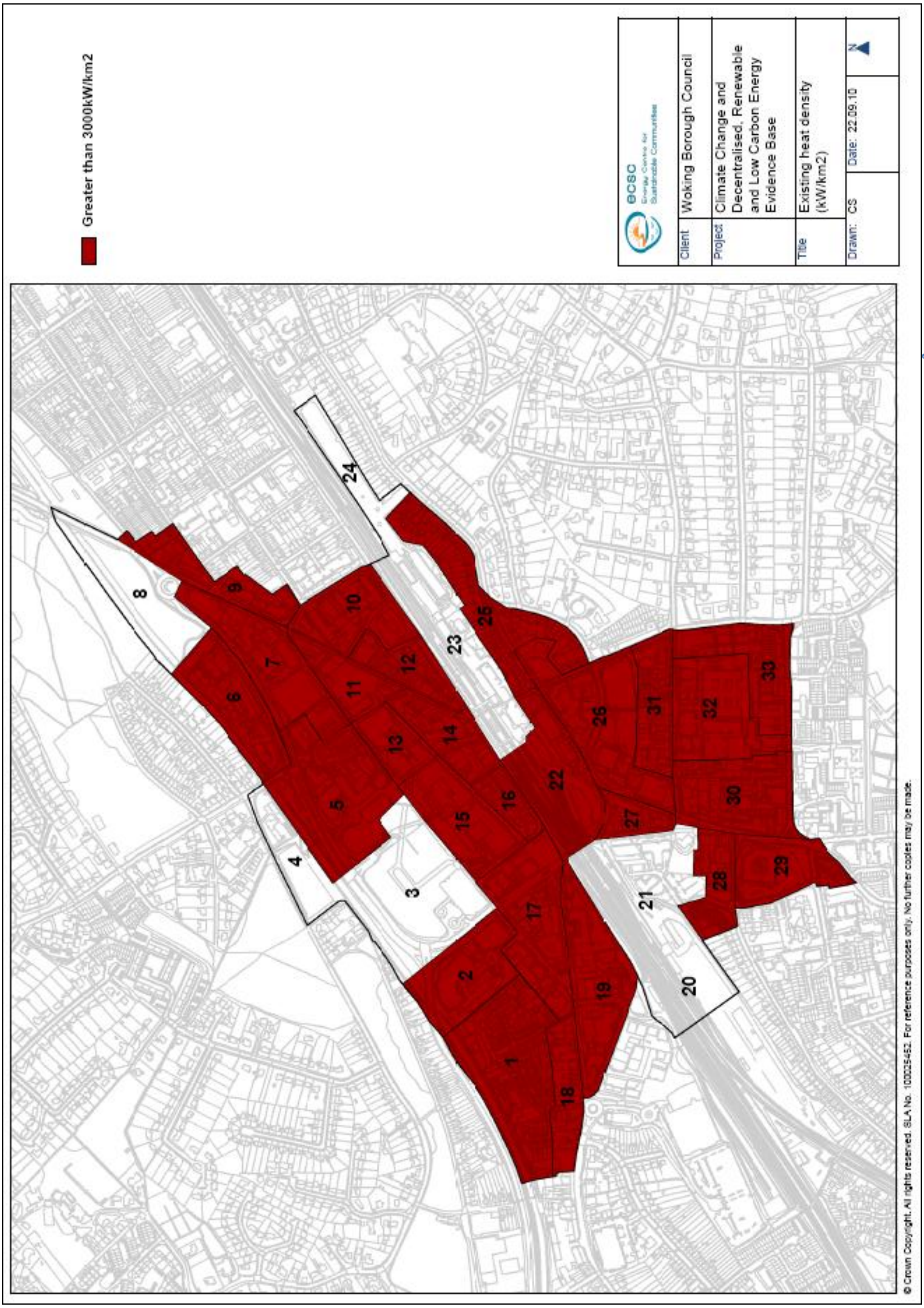


Figure 39 Existing Heat Demand Density in Woking Town Centre (kW/km^2)

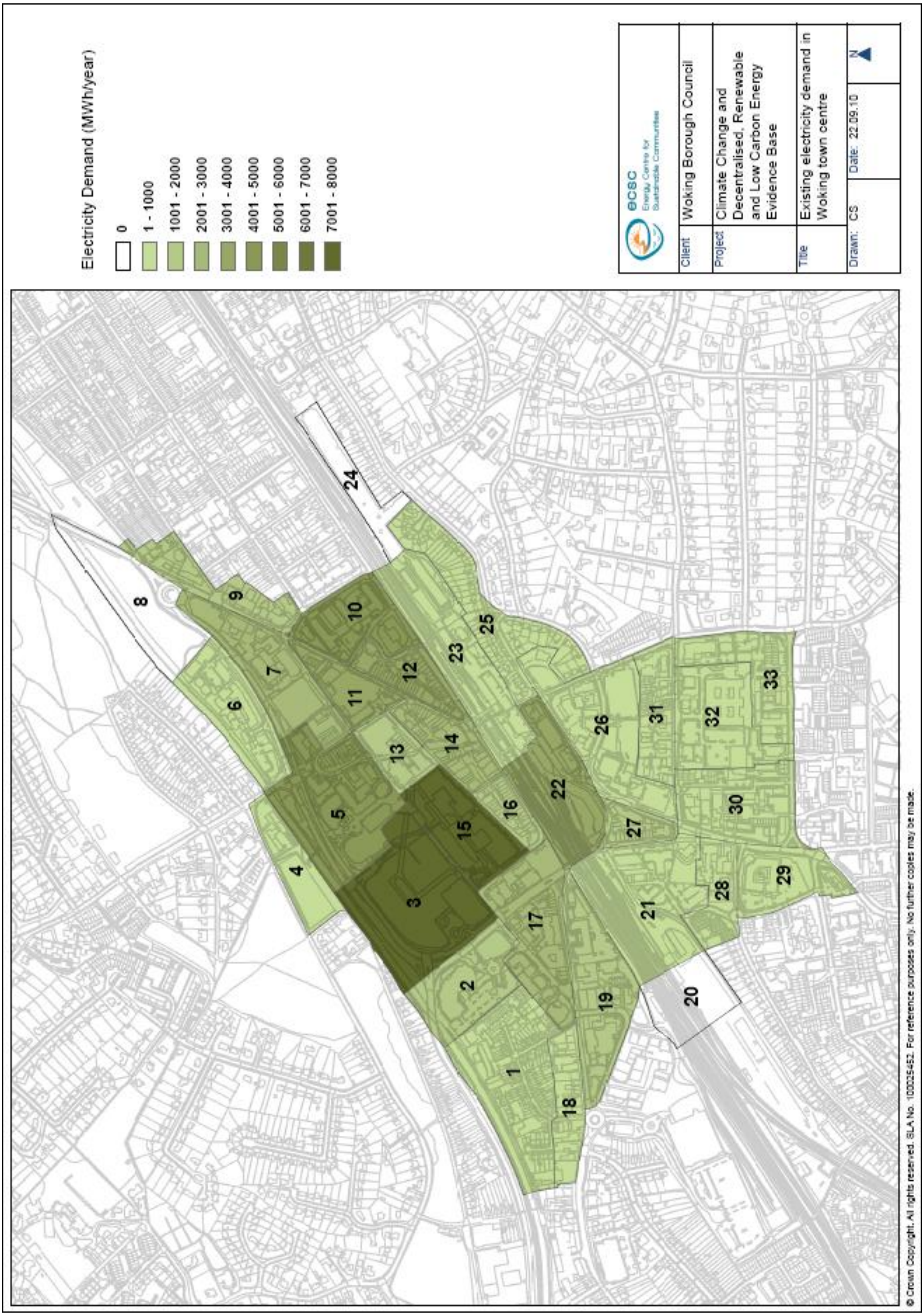


Figure 40 Existing Electricity Demand in Woking Town Centre

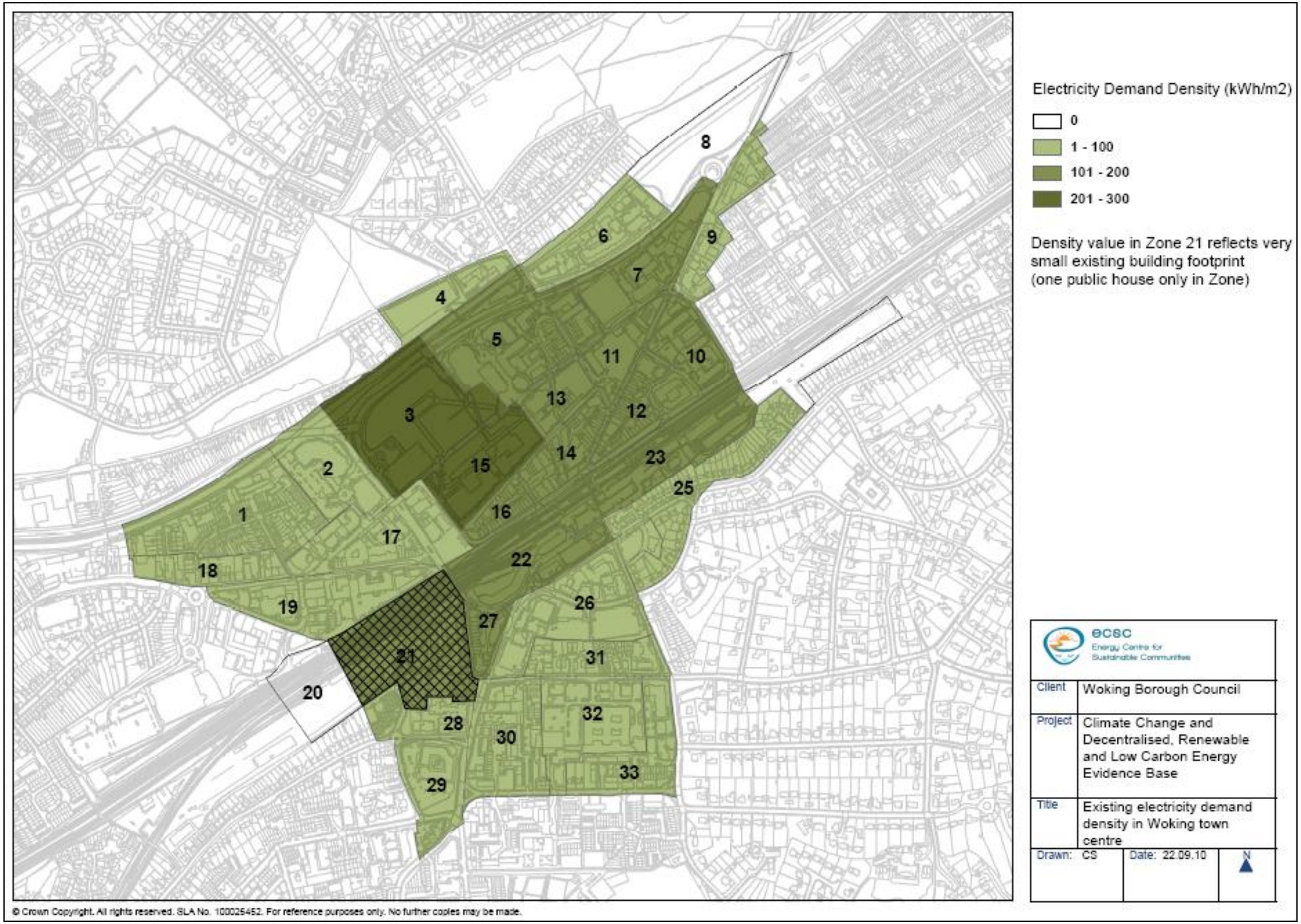


Figure 41 Existing Electricity Demand Density in Woking Town Centre

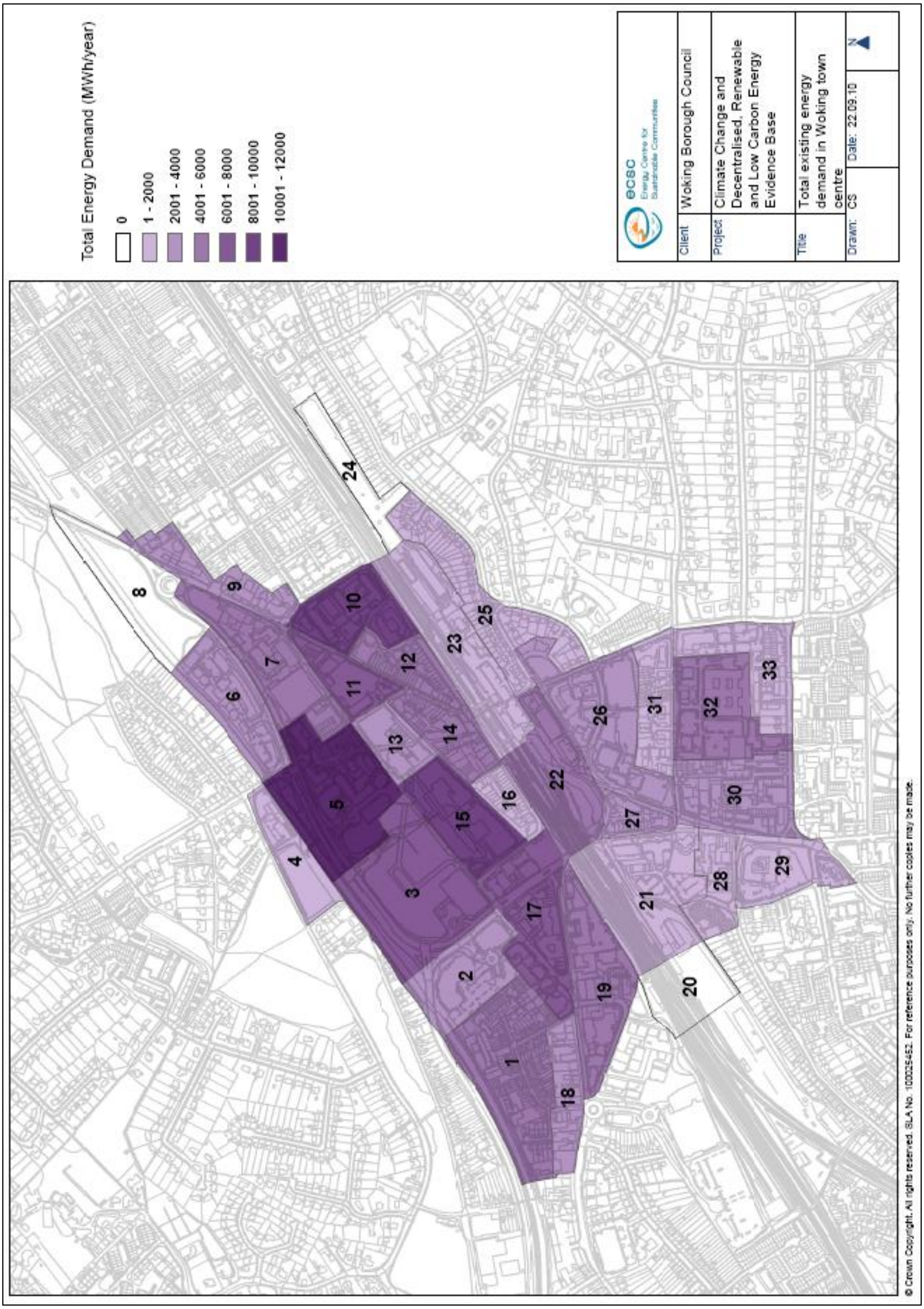


Figure 42 Total Existing Energy Demand in Woking Town Centre

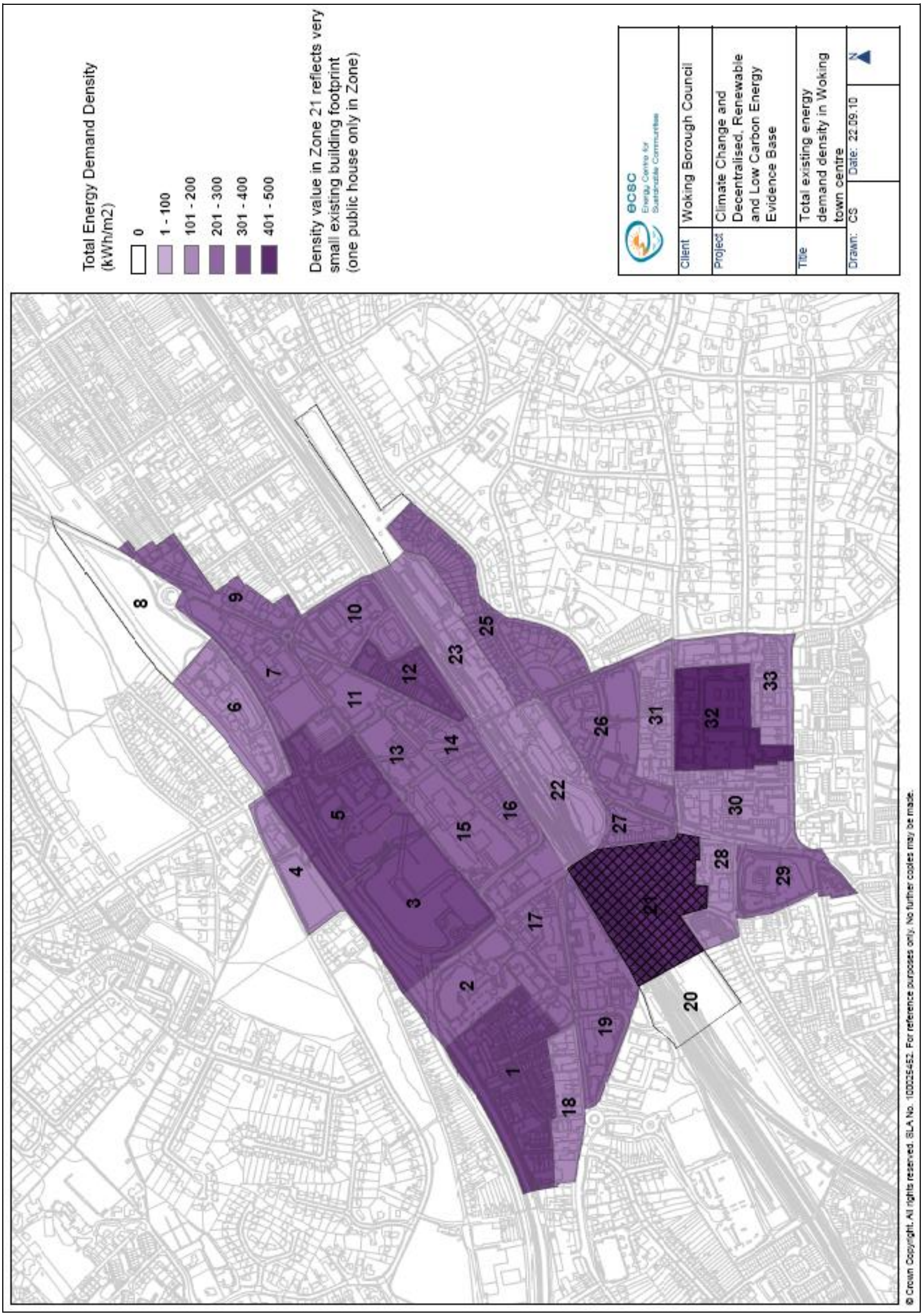


Figure 43 Total Existing Energy Demand Density in Woking Town Centre

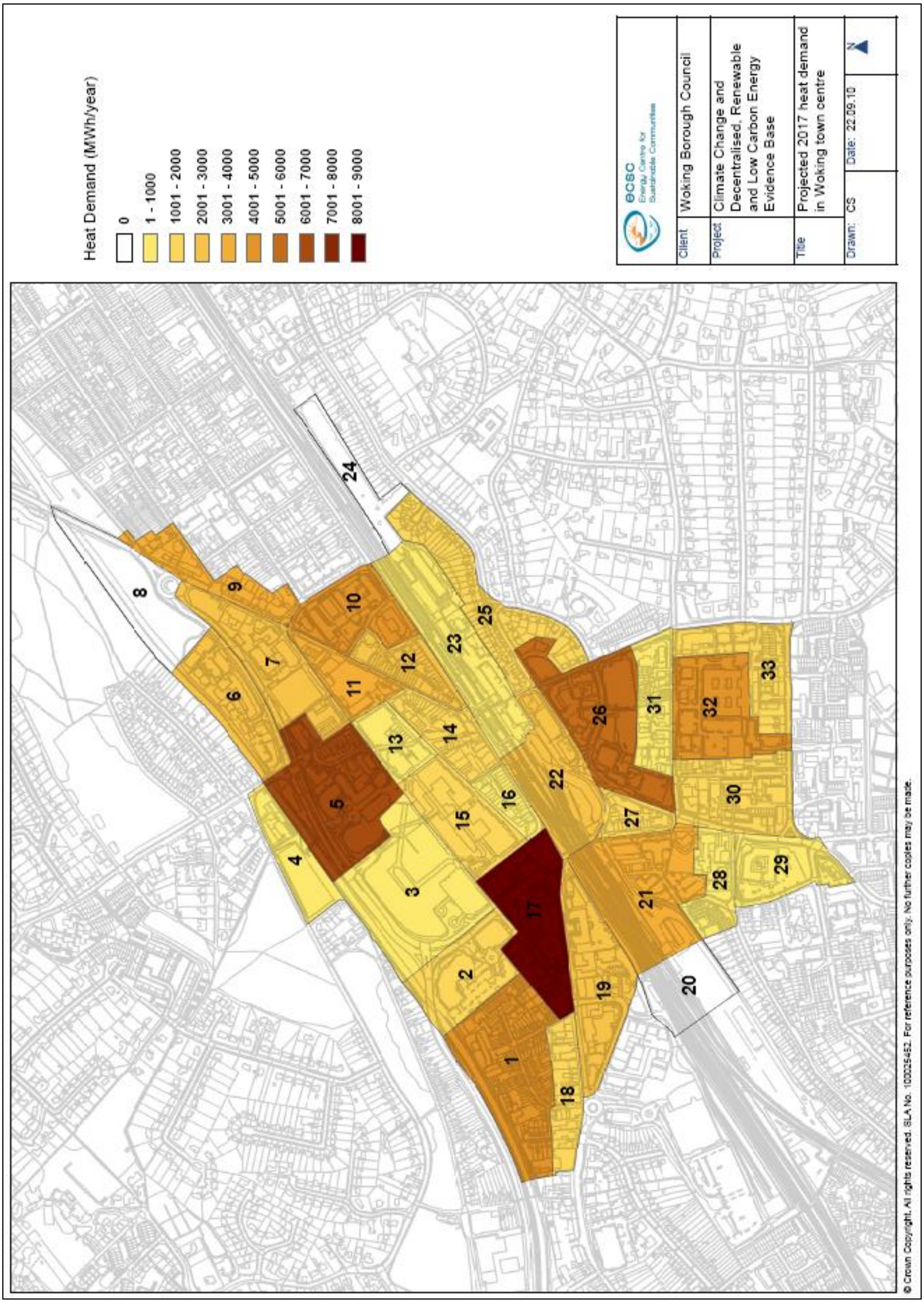


Figure 44 Projected heat demand in Woking Town Centre (2017)

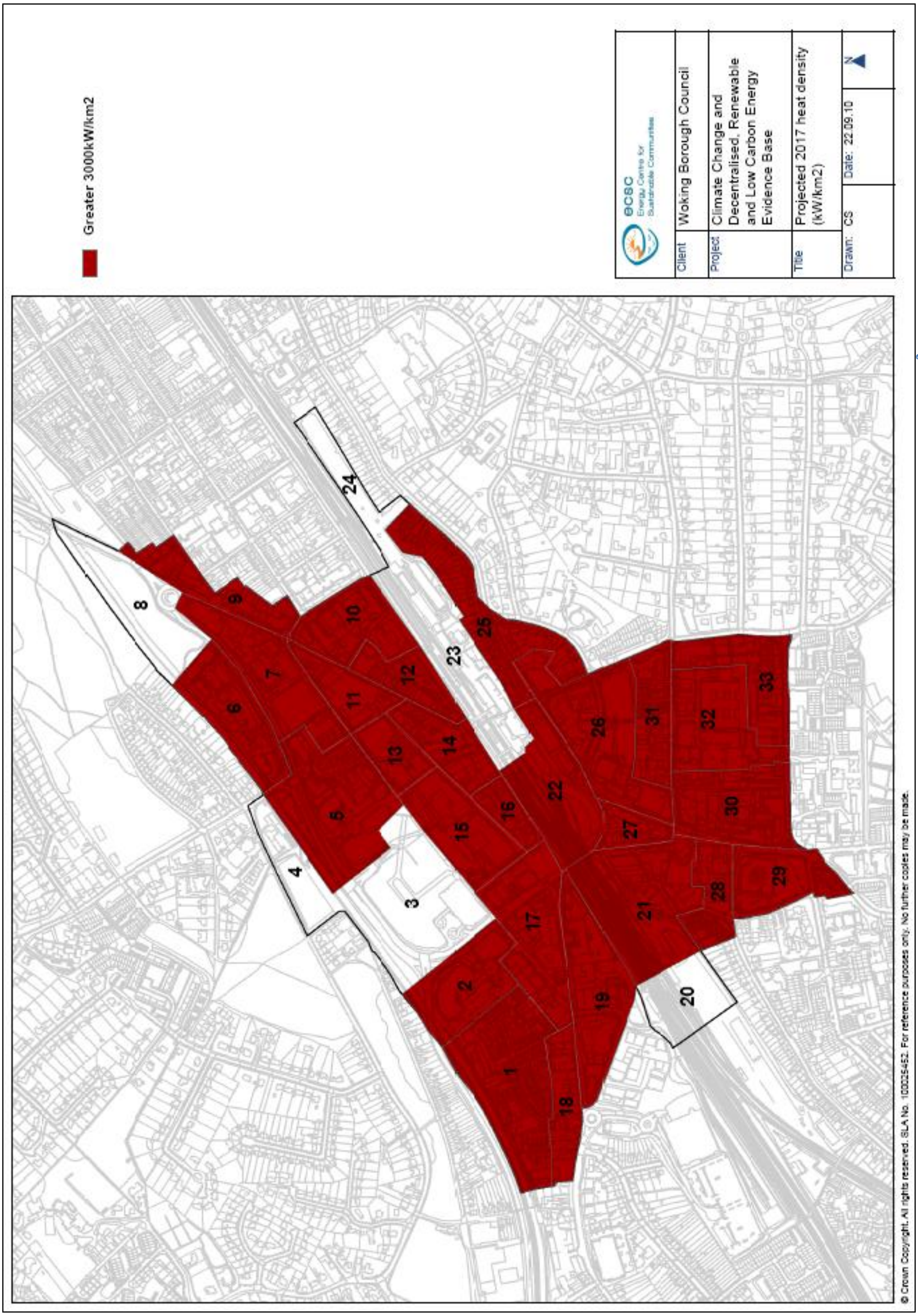


Figure 45 Heat Demand Density in Woking Town Centre in 2017 (kW/km^2)

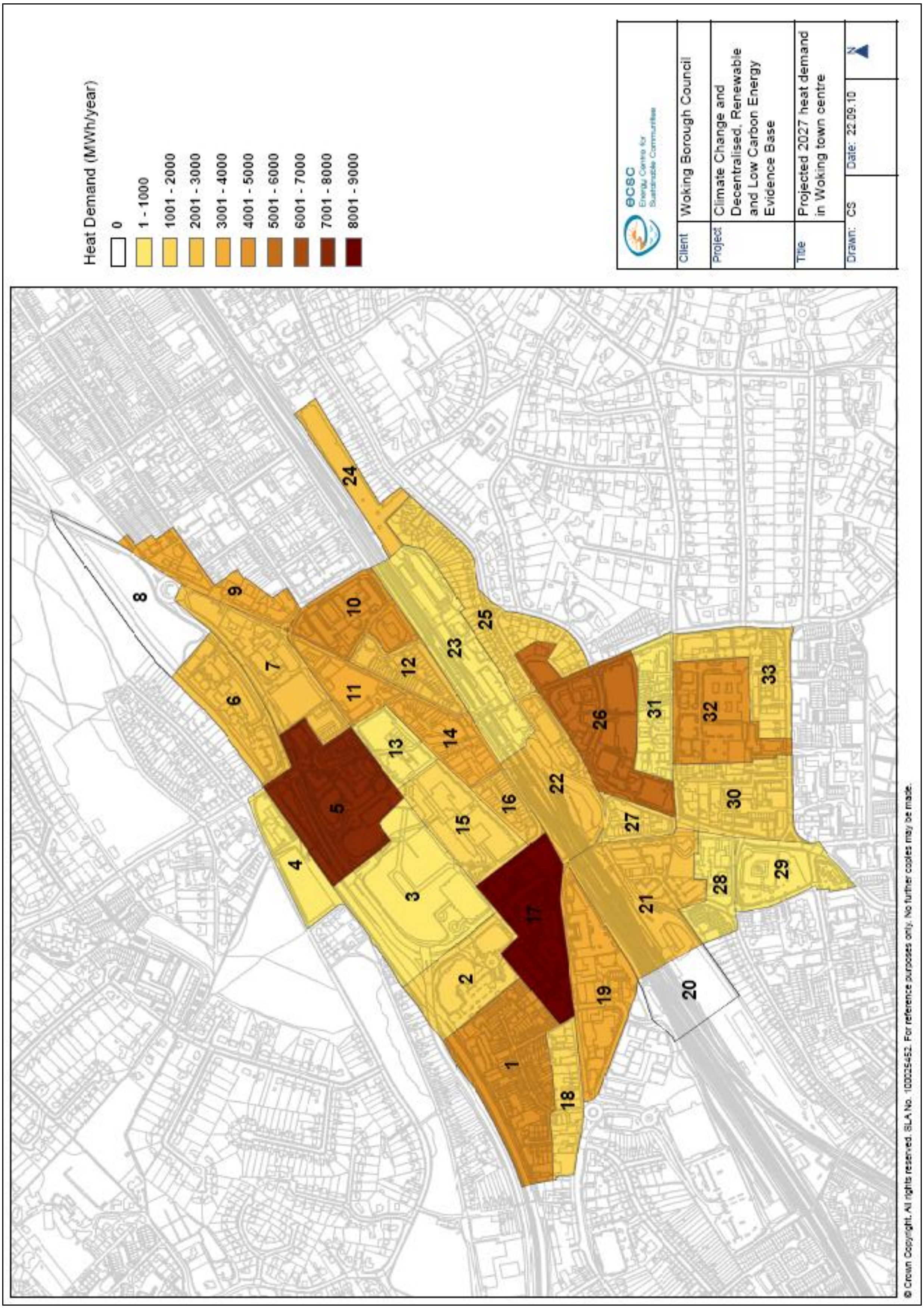


Figure 46 Projected heat demand in Woking Town Centre (2027)

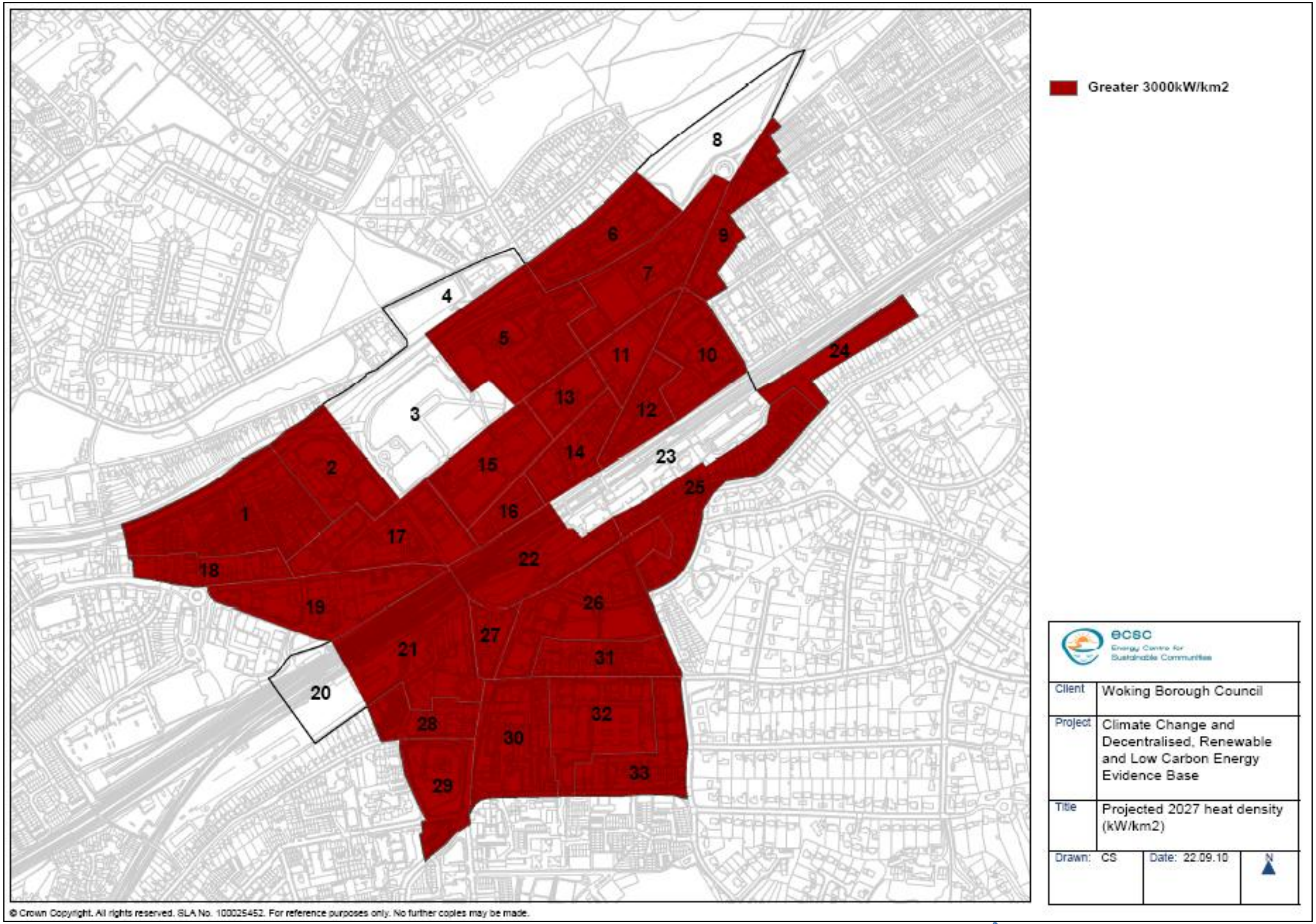


Figure 47 Projected Heat Demand Density in Woking Town Centre in 2027 (kW/km^2)

Appendix IV
Low and Zero Carbon Energy Technologies

Non technical overview of Combined Heat and Power generation

Conventional power stations generate steam from the combustion of fossil carbon fuels (oil, coal and gas) or nuclear fission to drive a turbine, which in turn drives a generator to produce the electricity. The heat is then released into the atmosphere via cooling towers, or discharged into rivers or the sea.

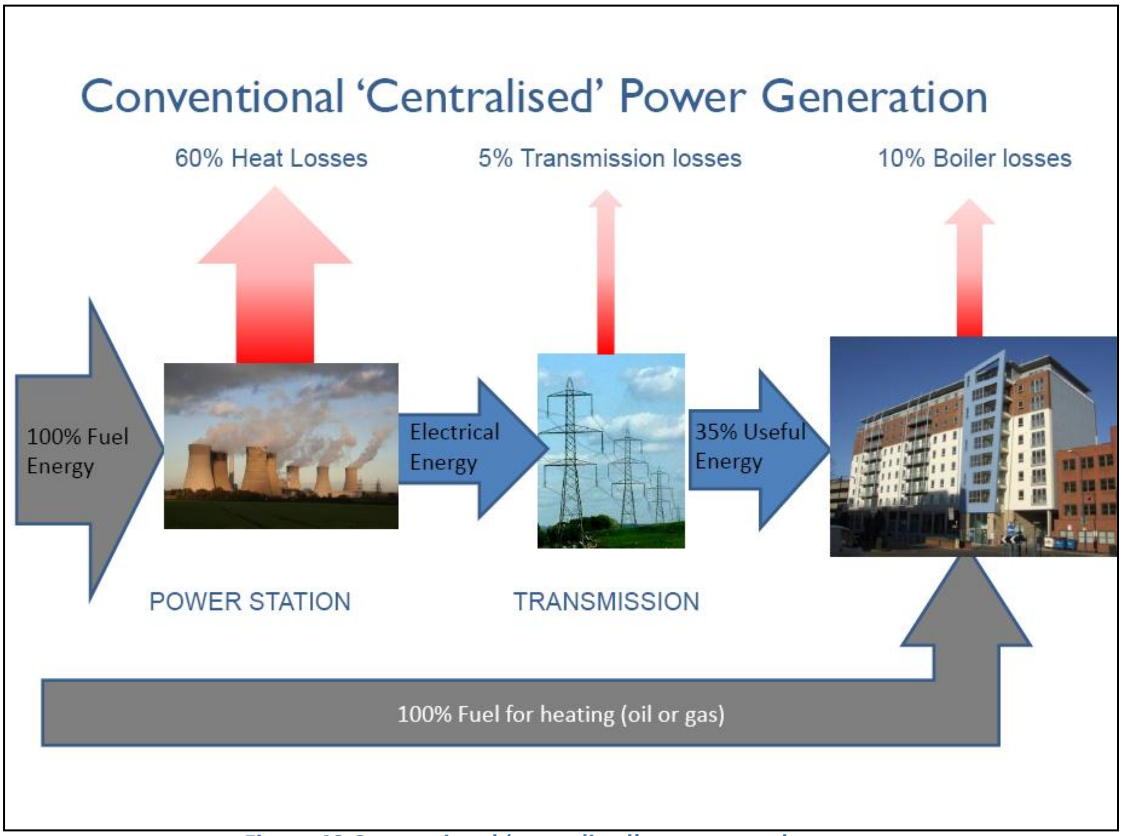


Figure 48 Conventional 'centralised' energy supply system

Whilst conventional supply systems have been highly effective in the UK in providing reliable energy supplies to the consumer, the heavy reliance on combustion of fossil carbon fuels to generate electricity at a point remote from the consumer, along with the high levels of heat disposed as 'waste product', mean they have relatively low overall efficiency in terms of conversion from primary fuel to useful energy. In a Combined Heat and Power (CHP) installation, the heat is recovered and distributed via insulated pipes to provide hot water and comfort heating in buildings. A variation of this principle is Combined Cooling, Heat and Power (CCHP) or 'Trigeneration' which uses the energy in the hot water via absorption chillers to provide chilled water for cooling in buildings.

CHP is a more efficient means of generating energy than a conventional power station because the total output of useable energy generated is significantly higher. As a consequence, even when the primary fuel used in a CHP (or CCHP) installation is fossil carbon it has lower CO_2 emissions associated with it compared with the combined emissions arising from conventional centralised power generation and heating provided through boilers within buildings.

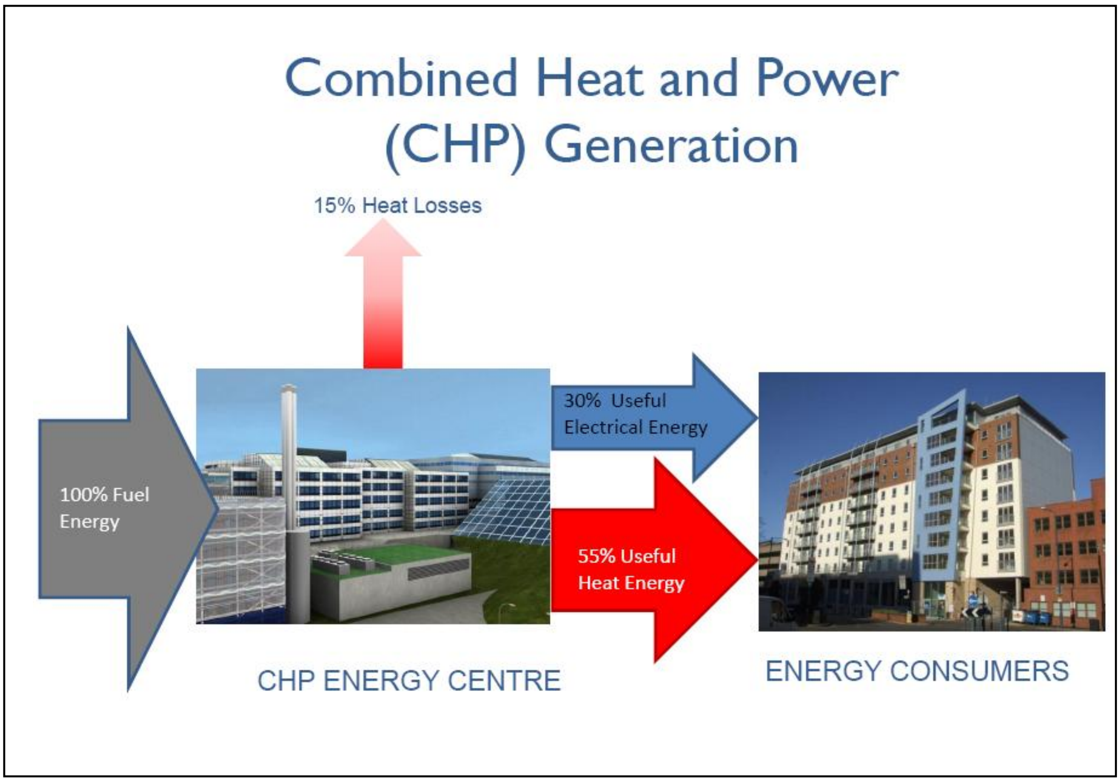


Figure 49 CHP 'decentralised' energy supply systems

CHP can be fuelled by a number of fossil fuels including natural gas and oil, or biofuels, such as biomass or biogas. Many use a 'prime mover' internal combustion engine to mechanically drive a generator, with heat from the engines' cooling system and exhaust gases captured. However, CHP generators can also be driven by steam turbines burning a variety of fossil or biomass fuels. The heat generated from a CHP can be used and distributed in a number of ways:

- Hot water can be distributed via insulated pipes to buildings where it is used to provide comfort heating and hot water. Heat exchangers are often used to transfer the heat from the CHP supply to the distribution system within a building, where it can be passed through radiators or under-floor pipes.
- Hot water can be used to energise an absorption chiller. This uses the energy in the hot water supply to drive the cooling process and can be valuable by ensuring there is a demand for hot water produced by CHP even during the summer months of the year when high temperatures reduce the demand for space heating.
- Hot water can be stored in a large insulated tank (a thermal store) to provide additional sources of heat to meet high levels of demand at peak times.

The size of CHP plant is largely dependent on the size output, which is measured in terms of both electricity generation and heat output. Figure 50 provides an indication of the relative size of plant, its output and its network capacity.

Description	Equipment	Building/plant room	Electrical/ Heat Output	Network size (heat supply)
Small scale CHP can be effective in providing low carbon heating and electricity where there is a reasonably constant heat demand such as hotels, retirement and care homes, schools, universities and health care buildings.			15kW electrical 30 kW thermal	 x 20 or x1 Community or single commercial/public building
Large CHP installations can be used in conjunction with district heating and private wire networks where they provide heat and power (and cooling) locally to a mixed use development. Distribution infrastructure includes pipes to carry hot water and ‘private wire’ electricity networks. Flue chimneys, thermal stores and back-up boilers are required in purpose-built energy centres. Controls and switch gear along with small substations will also be needed to connect to the electricity grid.			1500 kW (1.5MW) electrical 1600 kW (1.6MW)heat	 Town quarter/ neighbourhood
			6000kW (6 MW) electrical 7.5MW thermal	 Small town centre

Figure 50 Relative size of CHP plant and output

Wind energy
There are two main types of wind turbine - horizontal and vertical axis machines. They both operate by the wind turning a turbine's blades which in turn moves a rotor which generates electricity.

The minimum wind speed required for most medium-large turbines to operate commercially is often quoted to be 5.5 – 6.0 metres per second. The conversion of wind energy to electricity generation is a cube ratio – doubling wind speed increases the power output by a factor of 8 (and vice-versa). Therefore, the amount of electricity generated is dependent on a number of factors including the swept area of rotor blades, generator efficiency, and the speed and consistency of wind. Wind speed and consistency is influenced by geographical location, elevation of site, local terrain, proximity of buildings, trees or other structures and the height of the turbine above ground level. Wind speeds at 50m above ground level are approximately 75% faster than at head height. Hence, whilst an area's average wind speed can be identified by searching a national database using a postcode, measurement of local wind speeds over a period of time is necessary to ascertain if there is an adequate wind resource for a turbine.

Performance (energy output and CO2 savings)
Output of wind turbines depend on size of turbine and average wind speeds. Typical output of a 1.8 MW turbine is approximately 4.7million kWh/yr, equivalent to the power consumption of 1,000 households (source: BWEA). 1 kilowatt of electricity generated by wind displaces over 0.5kg CO_2 emissions arising from grid generated electricity.

Cost (capital and life cycle)
Installation costs for large wind turbines are approximately £800 per kW capacity (source: BWE), a 1.8 MW turbine costing in the region of £1.5 million. The average lifetime of a wind turbine is approximately 20 years. Small turbines are more costly in terms of cost/energy output, ranging from approximately £20,000 for a 6kW turbine to approximately £50,000 for 15kW installation (source: Proven Energy). When wind turbines are connected to the national grid, local electricity network infrastructure may require modifications to accommodate increased voltage and current flows. This can result in costly upgrading of transformer stations and distribution lines.

Planning issues (noise, visual impact, etc)
Planning considerations include visual impact, noise, light flicker and potential impacts on wildlife and radio communications including radar, microwave communications and television signals. Guidance on measuring and predicting noise levels from wind turbines is set out in The Assessment and Rating of Noise from Wind Turbines (ETSU-R-97) and is often used by planning authorities to set acceptable noise levels.

Description	Equipment	Size		Output		Energy provided
		Rotor diameter	Typical mast height	kW (peak)	kWh/y*	
Small wind turbines 2.5 kW peak to 50kW peak	 3.2kW and 6 kW wind turbines (image: Proven Wind turbines/Solar Energy Allianc	3.5m	7.5 – 10m	3.2	4,200	 Part electricity demand in small house
		10m	15-25m	15	20,500	
		15m	25m	50	65,000	 10 apartments or 1 small commercial building
Medium – large turbines 100kW – 3MW	 1.8 MW wind turbine at Ford's engine plant, Dagenham, Essex	50m	55m	750 (0.75 MW)	1,300,000 (1.3MW)	 Mixed use development
		70m	85m	1,800 (1.8MW)	3,100,000 (3,100 MWh)	
		112m	90-120m	3,000 (3MW)	5,200,000 (5,200 MWh)	

Figure 51 Relative size and output of wind turbines

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