Brighton and Hove Renewable and Sustainable Energy Study

Prepared by:

Mary Livingstone
Consultant

Checked by:

Matthew Turner
Principal Consultant

Approved by:

Miles Attenborough
Technical Director

Rev No	Comments	Prepared by	Checked by	Approved by	Date
2	Final report	ML	MJT	MA	13/12/12

MidCity Place, 71 High Holborn, London, WC1V 6QS
Telephone: 020 7645 2000
Website: http://www.aecom.com

Job No: 60275051

Date Created: 13th December 2012

This study investigates the outline technical feasibility and financial viability of various carbon reduction opportunities in Brighton and Hove, based on plans and information available at the time of writing. Before implementation of any of the options further detailed study, design and costing will be necessary.

\\uklon4fp006\uklon4fp006-v1se\sdg\jobs\sdg - brighton and hove energy study\06 reports\121214-ml&mjt-brighton energy study final.docx

Table of Contents

Executive Summary ..... **i**

1 Introduction **1**
1.1 The Need for an Energy Study 1
1.2 Study Methodology 2
1.3 Overview of Brighton and Hove Area 2
1.4 Key Stakeholders 3

2 Policy Context **9**
2.1 National and International Policy 9
2.2 Local Policy 12

3 Baseline Energy Use and CO2 emissions **15**
3.1 Current Energy Use and CO2 emissions from Buildings in Brighton and Hove 15
3.2 Projecting Emissions to 2012 19
3.3 Emissions from New Development 19
3.4 Mapping Brighton and Hove's Energy Consumption and CO Emissions 22

4 Impact of National Action **30**
4.1 Introduction 30
4.2 Grid Decarbonisation – Emission Factor Calculation Methodology 30
4.3 Impact of Grid Decarbonisation in Brighton and Hove 34

5 Introduction to Assessment of CO_2 Reduction Opportunities **36**
5.1 Background 38

6 Low and Zero Carbon Energy Generation **38**
6.1 Existing and Planned Low and Zero Carbon Energy Generation in Brighton and Hove 38
6.2 Energy Opportunities Mapping 46
6.3 Energy Opportunities Mapping Methodology 53
6.3.1 Wind: Commercial Scale 53
6.3.2 Wind: Small Scale 55
6.3.3 Biomass 56
6.3.4 Biomass: Managed Woodland 57
6.3.5 Biomass: Energy Crops 58
6.3.6 Microgeneration and Energy Efficiency 62
6.3.7 Heat Networks 62
6.4 Note on the South Downs National Park 62
6.5 Renewable Energy Capacity Assessment: South East Study 64
6.6 Recommendations for Further Work 68

7 Heat Network Assessment **69**
7.1 Identifying district heating opportunities 69
7.2 Initial identification of clusters 71
7.3 Analysing the clusters 75
7.4 Selecting clusters for further analysis priority clusters 122
7.5 Technical and financial assessment of key heat network opportunities 123
7.5.1 Energy demands 123
7.5.2 Network Design 123
7.5.3 Energy Centre 124
7.5.4 Plant sizing 124
7.5.5 CO_2 savings 124
7.5.6 Financial assessment 124
7.6 Sensitivity Analysis 144

7.6.1 Electricity sales revenue 144
7.6.2 Heat sales revenue 145
7.6.3 Developer contributions 145
7.7 Key Conclusions and Recommendations 146
7.7.1 General Conclusions and Recommendations for all heat network opportunities 146
7.7.2 Conclusions and Recommendations for the Eastern Road network opportunity 150
7.7.3 Conclusions and Recommendations for the Edward Street network opportunity 151
7.7.4 Conclusions and Recommendations for the London Road network opportunity 152

8 New Buildings Planning Policy Assessment 155
8.1 Policy Targets 155
8.2 New Development Policy Testing Methodology 156
8.2.1 Technology Options for Meeting Targets 156
8.2.2 Developments Used to Test Policies 157
8.2.3 Future Building Regulations Assumptions and Code for Sustainable Homes and BREEAM Requirements 158
8.2.4 Allowable Solutions 161
8.3 Policy Testing Results 162
8.4 Conclusions from Modelling 173
8.4.1 Domestic 173
8.4.2 Non-Domestic 174
8.5 Code and BREEAM 176
8.5.1 Cost of the Code 176
8.5.2 BREEAM Excellent and Outstanding 180
8.6 Conclusions and Recommendations for Planning Policy 183
8.6.1 New Development Requirements 183
8.6.2 Heat Network Policy 185
8.6.3 Energy Opportunities Mapping 187
8.6.4 Energy Efficiency 187

9 Existing Buildings Measures 188
9.1 Introduction 188
9.2 Domestic Measures 189
9.2.1 Energy Efficiency 189
9.2.2 Renewables 200
9.3 Non-Domestic Measures 202
9.3.1 Energy Efficiency 202
9.3.2 Renewables 203
9.3.3 CHP 205
9.3.4 Biomass Boilers 206
9.4 Cross-Sector Measures: Large Scale Energy Projects 207
9.4.1 District Heating 207
9.4.2 Solar Farms 208
9.4.3 Medium-Large Scale Wind 208
9.5 Other Measures not Included in Scenarios 210
9.5.1 Biomass CHP 210
9.5.2 Small-Scale Wind 210
9.5.3 Energy from Waste 210
9.6 Note on Uptake Rates 211
9.7 Note on Data Uncertainties 211
9.8 Note on Potential Savings Overlap 212

10 Scenario Development 213
10.1 Carbon Reduction Targets 213
10.2 Scenario Development 214

11 Funding and Delivery 222
11.1 Introduction 222
11.1.1 Making a case for spending 222
11.1.2 General roadmap for delivering energy projects 223
11.2 General overview of funding options 226
11.2.1 Green Deal 226
11.2.2 Energy Company Obligation 227
11.2.3 Renewable Obligations Certificates 227
11.2.4 Salix Finance 228
11.2.5 Prudential borrowing and bond financing 228
11.2.6 Best Value 229
11.2.7 Local Asset-Backed Vehicles 229
11.2.8 Community Infrastructure Levy (CIL) 230
11.2.9 Allowable Solutions 230
11.2.10 SME Support 231
11.3 General information on Delivery opportunities 232
11.3.1 Special Purpose Vehicles 232
11.3.2 ESCo services 234
11.4 Project specific funding and delivery 236
11.4.1 Energy Efficiency – Private Domestic 236
11.4.2 Energy Efficiency – Public domestic 237
11.4.3 Energy Efficiency – Private non-domestic 237
11.4.4 Energy Efficiency – Public non-domestic 238
11.4.5 District Heating 238
11.4.6 Microgeneration 239
11.4.7 Large-scale generation 239
11.5 Delivery Matrix 240

Appendix A: Glossary 245

Appendix B: Draft City Plan Part 1 Policy CP8 Testing Assumptions 249

Appendix C: Summary of Assumptions in SEPB *Review of Renewable and Decentralised Energy Potential in South East England* 252

Executive Summary

Context for the Report

Brighton & Hove City Council has commissioned AECOM to produce a renewable and sustainable energy study for the city for the period to 2030 to investigate current and future carbon dioxide emissions resulting from energy use in the built environment.

Various targets and regulatory drivers have been created at a national and international level to incentivise action to avoid the potentially devastating impacts of climate change. The Committee on Climate Change (CCC) has recently produced a report for the Department of Energy and Climate Change (DECC) assessing the main opportunities for Local Authorities to reduce carbon emissions in their area which states that "Local authorities should draw up low-carbon plans which include a high level ambition for emissions reduction", focussing on the drivers over which they have control.[1] The National Planning Policy Framework states that "Local planning authorities should adopt proactive strategies to mitigate [...] climate change", and "design their policies to maximise renewable and low carbon energy development". Like other Local Authorities across the UK, Brighton & Hove City Council is seeking to assess opportunities for local action to mitigate climate change, recognising the contribution that it must make to enable national and international targets to be met.

Key national policies include the Climate Change Act (2008) which sets a legally binding target to reduce UK CO2 emissions by at least 26% on 1990 levels by 2020 and at least 80% by 2050, and the UK Renewable Energy Strategy (2009) which commits the UK to generating 15% of its energy from renewable sources by 2020. Locally, the Brighton & Hove Strategic Partnership (BHSP) has committed to addressing climate change in its Sustainable Community Strategy, which identifies "living within environmental limits and enhancing the environment" as a priority for the city and sets a 42% reduction in CO2 emissions by 2020 and 80% by 2050, against a 2005 baseline, and in its Climate Change Strategy which identifies key actions that city partners are already taking or planning to take to tackle climate change. In addition Brighton & Hove City Council is committed to One Planet Living principles and the BHSP to a One Planet Framework.

The Council is also in the process of developing its City Plan, the main planning document in its Local Development Framework. The Draft City Plan Part 1 proposes to require new development to achieve high sustainability standards. Part of the remit of this energy study is to test the viability of these

[1] Committee on Climate Change, *How Local Authorities Can Reduce Emissions and Manage Climate Risks*, 2012.

standards and to recommend policies which could support carbon reduction in Brighton and Hove.

The CCC report recognises that whilst there is currently no requirement on Local Authorities to take action, and limited funding is available to them, there is a significant risk to the implementation of national climate change targets, and it proposes some measures to mitigate these risks. This energy study follows the approach supported by the Committee – identifying ambitious carbon reduction measures and scenarios which focus on the emissions drivers over which the Council has some control. It also takes into account the main opportunities identified by the CCC relating to buildings, which are: energy efficiency in residential buildings (identified as the largest opportunity); non-residential buildings; supporting power sector decarbonisation (through granting planning approval for projects such as wind turbines, and providing electric vehicle charging points); reducing emissions from local authorities' own estates; and supporting the development of district energy networks.

This report also responds to some of the recommendations arising from Brighton and Hove's Scrutiny Panel on Renewable Energy Potential in April 2011, in particular recommendation 6 (long term strategic planning): to undertake a study on renewable energy potential in the city including geographical, funding and partnership opportunities; recommendation 7, to undertake a heat mapping exercise; and recommendation 11, raising the profile of renewable energy.

The policy context for the report is further discussed in Section 2.

Purpose of the Report

The primary purpose of this study is to investigate the potential for delivering local carbon reductions relating to buildings in Brighton and Hove and to provide an evidence base to support carbon reduction projects and policy. The study covers the period of the City Plan (2013-2030) and has three focus areas:

- Low and zero carbon energy generation – identifying opportunity areas for low and zero carbon energy technologies and testing the viability of heat networks;
- New buildings – projecting emissions from new development over the period of the City Plan and testing draft City Plan policies relating to carbon reduction;
- Existing buildings – investigating the potential for energy efficiency measures and microgeneration in existing buildings.

Together these three strands will help Brighton & Hove City Council to identify the local opportunities where it has the potential, either directly or

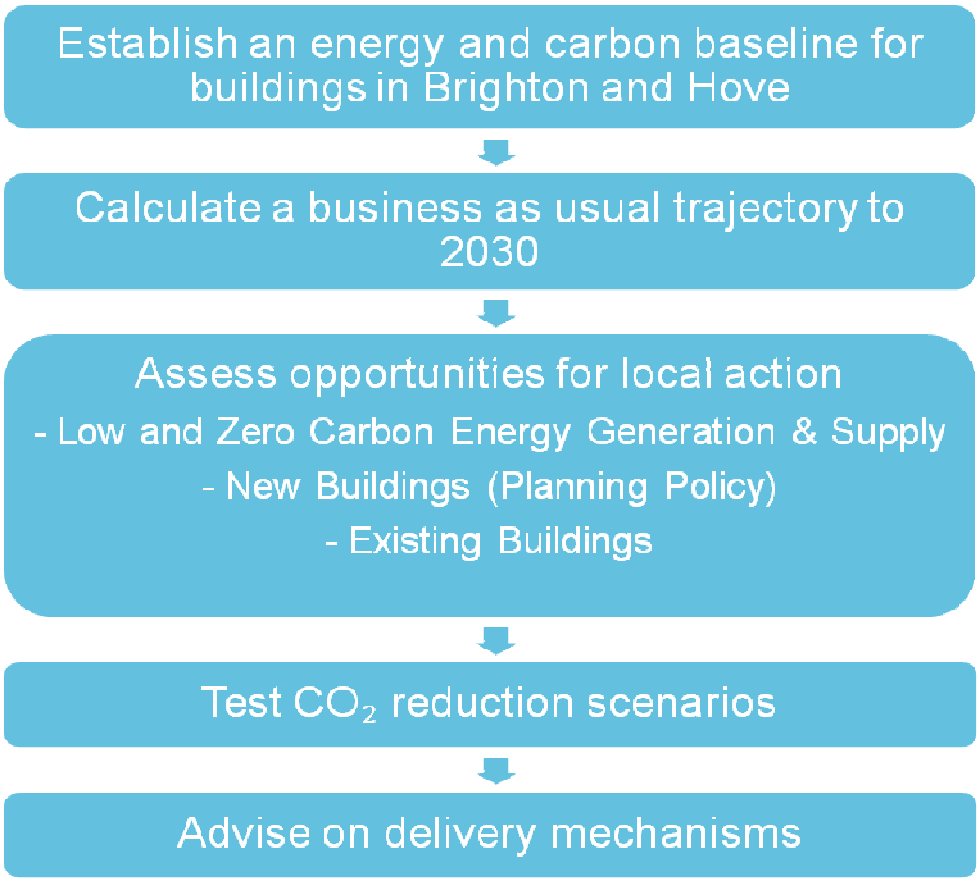
indirectly, to significantly reduce its CO2 emissions relating to energy use in buildings by 2030 in ways that are technically feasible and financially viable.

The third element of the study covers both private sector and Council housing, and links to a further study being undertaken by AECOM for Brighton & Hove City Council which focuses in more detail on the opportunities for carbon reduction within Council housing.

Methodology

The above aims have been addressed through providing a high-level assessment of the feasibility of potential carbon reduction measures, identifying the contribution of different measures and delivery partners to achieving carbon reduction in Brighton and Hove, and investigating what level of local intervention would be required to achieve a range of targets.

The process which has been followed is set out in the diagram below and is explained in more detail in Sections 3 to 10 of the main report.



Summary of Report Methodology

Baseline CO2 emissions for Buildings

The energy consumption and CO2 emissions from the existing buildings and planned developments in Brighton and Hove have been calculated to set a baseline against which the effectiveness of potential measures can be assessed. The baseline has been set as 2005, which is the first year in which Local Authority carbon emissions statistics were produced and is the baseline for Brighton and Hove's existing carbon reduction targets. The city's baseline carbon dioxide emissions from the built environment have been calculated to be 1,049**ktCO2**/yr. A baseline for the Council's own emissions has also been set based on data provided by the Council on their energy consumption in 2011-2012; a total of around 31.8**ktCO2**/yr, with the majority of emissions arising from electricity use. These figures exclude other

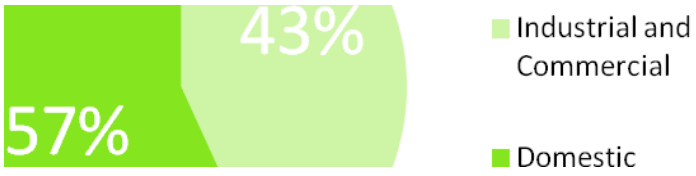
sources of emissions which do not relate to buildings – for example emissions associated with transport or waste. Transport accounted for a further 347**ktCO2**/yr in 2005, on top of the baseline figure for buildings-related emissions used in this study.

The latest energy use and emissions figures available for the city are from 2010. The headline statistics for the city for 2010 are presented in the table and pie chart below.

Sector	Gas Use (GWh/yr)	Electricity Use (GWh/yr)	Gas CO_2 (kt/yr)	Electricity CO_2 (kt/yr)	Other Fuels CO_2 (kt/yr)	Total CO_2 (kt/yr)	% Total CO_2	% Total CO_2 - SE average	% Total CO_2 - UK average
Domestic	1,456	477	300	244	8	553	57%	53%	48%
Industrial & Commercial	498	587	103	294	17	414	43%	47%	52%
Total ($ktCO_2$/yr)						967			

Latest statistics on energy consumption and CO2 emissions from buildings (gas and electricity use) in Brighton and Hove 2010. Sources: DECC, Local and regional CO2 emissions estimates for 2005-2010 (released 23/08/12); DECC, MLSOA and LLSOA electricity and gas consumption data 2010 (released March 2012)

Brighton & Hove Baseline Carbon Emissions from the Built Environment by Sector



The impact of new development planned in the city over the period to 2030 on the city's carbon emissions has been estimated, based on the development projections in the draft City Plan Part 1 and on anticipated future Building Regulations energy standards. The results suggest that the total carbon emissions from potential new development by 2030 would be equivalent to around 4.6% of the emissions from the existing buildings in the city (at 2005 levels); an estimated total of around 39.6 ktCO2/yr by 2030. The vast majority of these emissions are expected to come from unregulated energy use (i.e. energy consumed for cooking and appliances), which is not covered by Building Regulation requirements.

The methodology for setting the baseline and calculating projected emissions from new development is explained in Sections 3 and 4 of the report.

Key Findings from Opportunity Assessment

The delivery of a range of carbon reduction projects and high levels of ambition are needed to meet Brighton and Hove's proposed targets.

The measures assessed fall under the categories of new development energy efficiency and low and zero carbon energy generation; existing domestic and non-domestic energy efficiency and low and zero carbon energy generation; and cross-sector measures such as large-scale energy projects. Through the scenario development it has become clear that a range of these measures will need to be targeted in order to achieve significant carbon reductions, and that there are significant and exciting opportunities locally. To meet Brighton and Hove's existing carbon reduction targets high uptake rates will be needed over the period to 2030. Particularly significant local opportunities include private sector retrofit measures – particularly solid wall insulation.

There are also significant barriers to implementing some of the measures, which are considered in the report. The measures which have been assessed are presented in detail in Sections 6 to 9.

Energy efficiency measures are key to meeting carbon targets

The assessment has shown that energy efficiency measures will be vital in meeting the carbon targets proposed in Brighton and Hove. It is recommended that further work is undertaken to explore the measures and suggested next steps are outlined in section 11.

The Council has good opportunities to reduce carbon in its own housing stock

These opportunities are considered further in the Strategic Housing study undertaken by AECOM in parallel with this study.

Brighton and Hove has significant potential for low and zero carbon energy generation which is not currently being realised - including significant potential for the development of heat networks

The analysis undertaken shows that there are good opportunities for various low and zero carbon energy technologies, in particular microgeneration and heat networks. It is recommended that these opportunities are further explored and detailed feasibility work is undertaken to provide the basis for business plans to develop these projects. The maps below identify potential opportunity areas.

The new development building standards proposed in the draft City Plan Part 1 over the period 2013-16 will be challenging to deliver in some circumstances, in particular the proposed non-domestic requirement for BREEAM Outstanding

Section 8 sets out the full results of the policy testing and discusses the implications of these.

This study can provide the evidence base to support additional planning policies aimed at delivering CO_2 emission reductions

Recommendations for the use of the results of this study are given in section 8.

There are significant additional benefits for the local community and the Council from carbon reduction measures

Benefits additional to mitigating climate change include potential to reduce fuel poverty and protect residents against future energy price increases – particularly through domestic energy efficiency measures; cost savings to organisations; potential for new income streams through renewable energy generation; job creation and development of local skills, and health benefits from better-insulated homes. Often these benefits cannot be included in the costing of measures but they should be taken into account when making the case for action.

Significant resource will be required and delivery mechanisms will need to be developed

One barrier in delivering Brighton and Hove's carbon reduction targets will be the amount of resource which will be required for delivery, although it should be recognised that funding should come from a range of sources, and many measures potentially provide income or savings for the Council which in many instances will exceed their cost over the lifetime of the measure. Potential funding and delivery mechanisms are discussed in Section 11.

A range of stakeholders must take responsibility for delivering the projects that

will be needed to meet the proposed carbon reduction target.

The delivery of Brighton's carbon reduction target will depend on a range of stakeholders and should not be seen as the responsibility of Brighton & Hove City Council alone.

The key stakeholders which need to be involved include private sector housing occupants and landlords, private sector organisations, other public sector organisations, social housing providers, community groups and individuals.

National action is vital for meeting the proposed targets

National government support will be vital in achieving carbon reduction targets - through providing financial incentives and sources of funding and setting a supportive framework for delivery. Achieving carbon reduction targets at the local level also relies significantly upon delivery of national government's plans to decarbonise the electricity grid as well as upon local action.

The government expects the electricity grid to decarbonise due to decreasing consumption of coal for power generation and increasing amounts of renewable and low carbon energy generation. Current emission factors for the UK – which represent the amount of carbon emitted for every kilowatt hour of energy used – are around 0.542kgCO2/kWh for electricity and 0.206kgCO2/kWh for gas.[2] In DECC's Central Scenario projections, used in this report, the electricity grid carbon emission factor is expected to drop to below 0.2 by 2030 (a reduction of over 60% compared to 2012).[3] The gas grid carbon emission factor is projected to rise slightly due to the increased use of liquefied natural gas.[4]

Overall, based on these projections, grid decarbonisation is projected to result in a very significant reduction in CO2 emissions in Brighton and Hove over the period 2013 to 2030 of around 317ktCO2, equivalent to around 30% of the city's 2005 baseline emissions and nearly 70% of the overall savings over the period to 2030. If the grid decarbonises more slowly then it will be significantly harder for Brighton and Hove's local carbon reduction targets to be met.

The estimated impacts of grid decarbonisation are illustrated in the carbon reduction scenario shown below and are discussed in more detail in Section 4 of the main report.

---

[2] SAP 2009 figure for gas; AECOM analysis of DECC *Updated energy and emission projections* (baseline case projections), October 2011 for electricity.

[3] AECOM analysis of DECC *Updated energy and emission projections* (baseline case projections), October 2011

[4] SAP 2012 consultation projected figures, January 2012, http://www.decc.gov.uk/en/content/cms/consultations/sap/sap.aspx

Carbon reductions in the private sector (both domestic and non-domestic) must be achieved to deliver significant city-wide emissions reductions

The domestic stock currently accounts for the majority of Brighton and Hove's emissions. There are around 121,540 homes in Brighton and Hove and around 85% of the domestic stock is in private ownership, including around 20% in the private rented sector. Around 10% is owned by the Council and 5% by housing associations.[5] The non-domestic sector makes up around 43% of Brighton and Hove's emissions from buildings, most of which are likely to be due to the private sector. Therefore it is vital to target reductions in these sectors.

Brighton and Hove City Council has several important roles to play in delivering significant reductions in CO2 emissions

The Council has already taken a leading role through the commissioning of this study and through committing to challenging carbon reduction targets for the city and its own estate. It has assets of its own within the city which provide opportunities for reducing carbon emissions – including offices, schools and land. There are also opportunities for energy efficiency and renewable energy measures to improve the performance of Council owned housing stock. The Council is already seeking to set challenging carbon reduction targets for new development through policies in its City Plan, which this study helps to test and inform. Other opportunities which would have a larger scope for carbon reductions include becoming directly involved in delivering wider schemes in the city, such as the delivery of the Green Deal or district heat networks. The Council will also be looked to as a trusted source of information and support by public and commercial organisations, and has the ability to provide supportive mechanisms to drive the uptake of energy efficiency and low carbon energy generation through policy setting or coordination of funding.

Brighton and Hove Energy Opportunities Map

An energy opportunities map has been developed for Brighton and Hove which highlights the areas of physical potential for various low and zero carbon energy technologies. This map is shown below. It should be noted that further assessment will be needed to realise any of these opportunities, particularly those which are identified within the South Downs National Park. The opportunities map methodology is explained in section 6.

Brighton and Hove Heat Network Opportunities Maps

Heat network opportunities maps have also been developed for Brighton and Hove – one covering

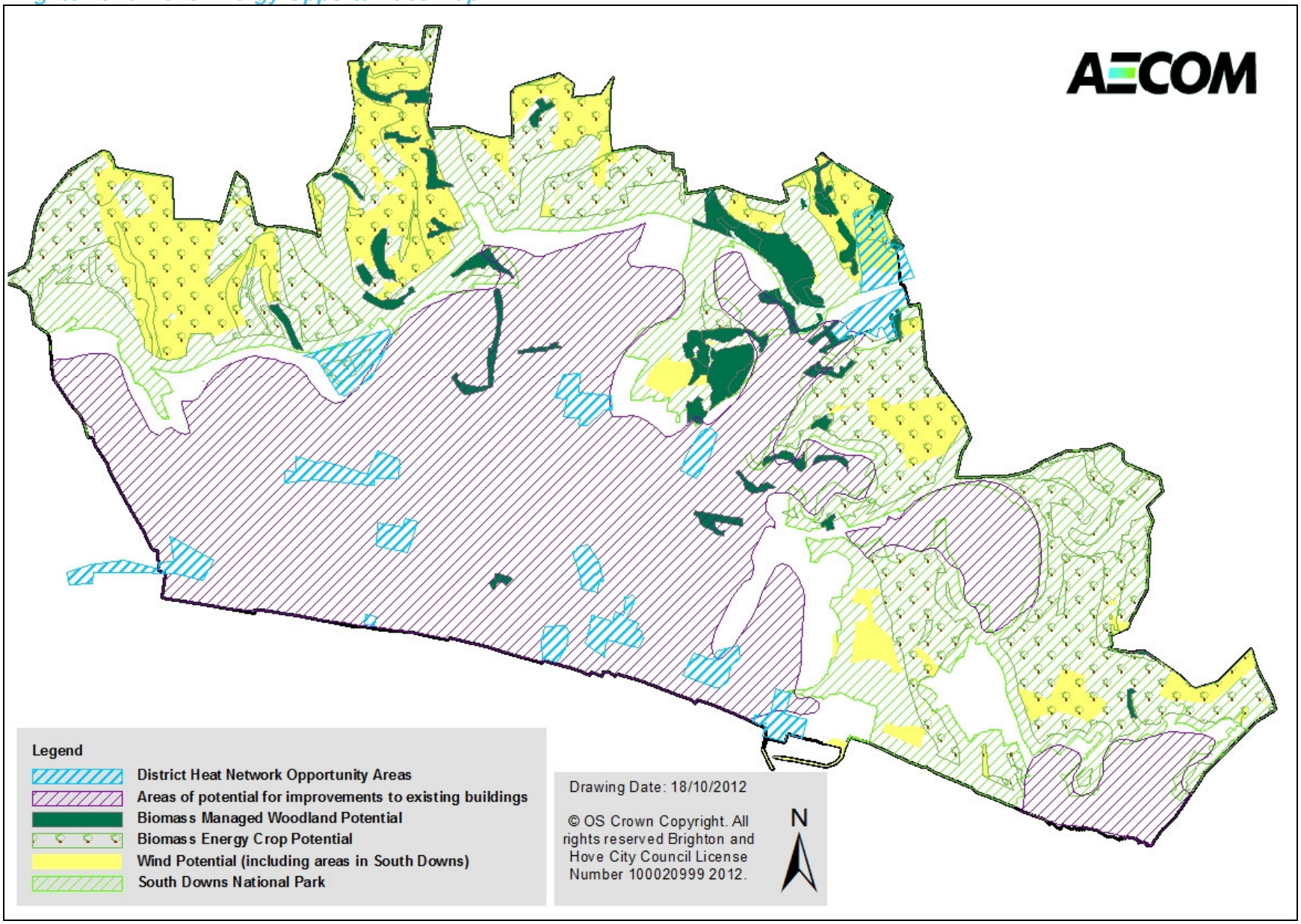
[5] ONS 2011 census for number of households, 2001 census for ownership figures.

the whole area, which highlights the 14 longlisted clusters which have been identified as areas of opportunity; plus separate detailed maps showing the three indicative network options for the 3 shortlisted sites which have been used to provide an indication of the potential technical and financial viability of developing schemes in these locations. The map showing the location of the long-list of clusters is shown below and the full methodology and results from the heat network opportunities assessment is explained in section 7.

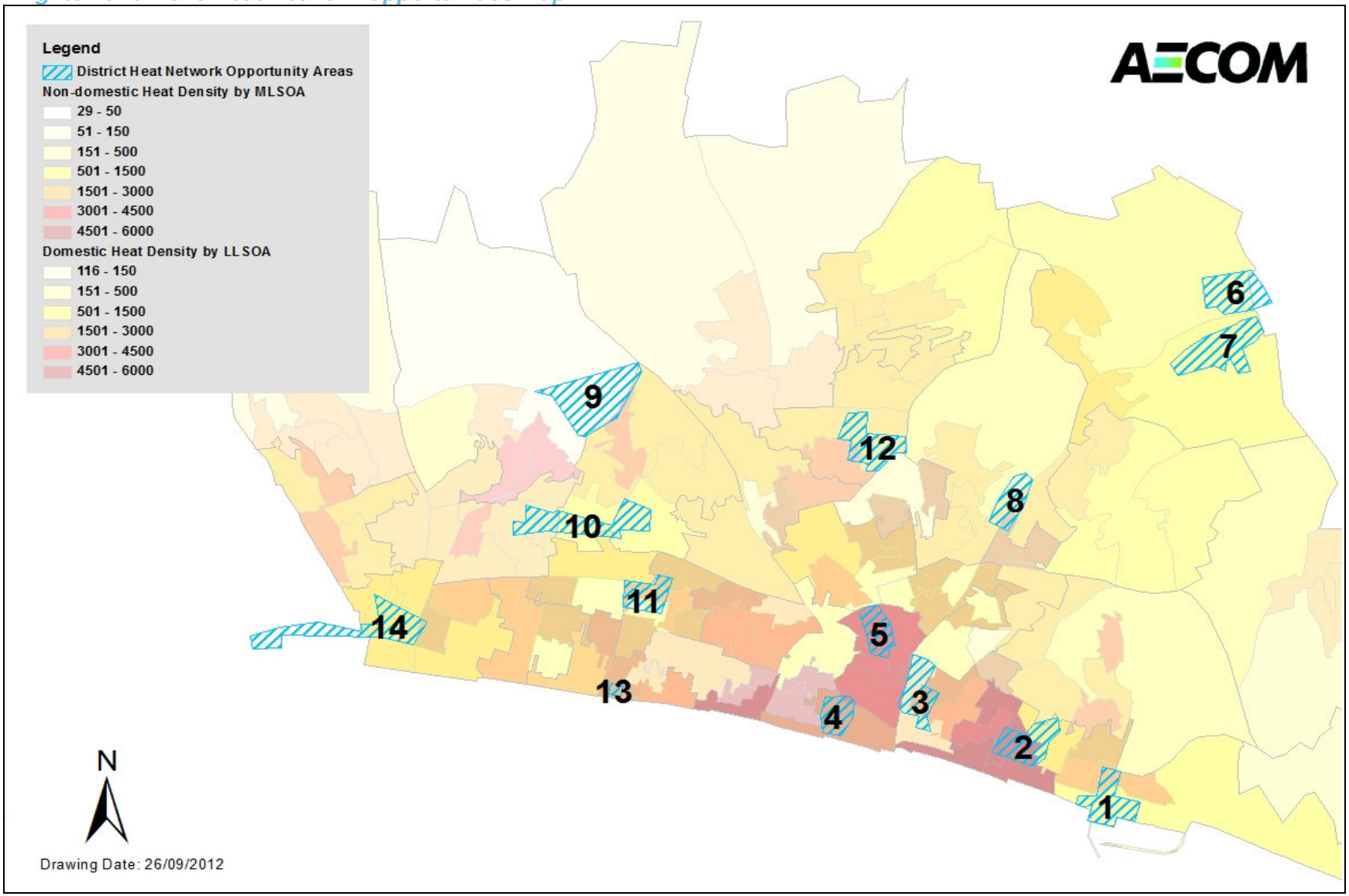
Brighton and Hove Carbon Reduction Scenarios

Various carbon reduction scenarios were modelled to illustrate potential trajectories for reducing emissions in Brighton and Hove over the period to 2030. Two potential scenarios are presented below which puts Brighton and Hove on a trajectory to meet its 2050 carbon target (which, assuming a steady trajectory, implies a 55% reduction in 2030) – one scenario including a high level of low and zero carbon energy generation, and the other with a greater focus on energy efficiency measures. These indicate that Brighton and Hove has some flexibility in how it meets its carbon reduction targets, though a wide range of measures will need to be delivered in order to achieve the challenging levels of carbon reduction required. The scenario tool assumes steady uptake of nearly all measures across the plan period (with the exception of large scale energy projects which are phased in at discrete points, and the smart meter roll-out which is assumed to complete by 2019 in line with government targets). It shows that as grid decarbonisation is expected by government to speed up post-2020 according to the projections used in this report, it may be difficult to reach Brighton and Hove's 2020 target of a 42% carbon reduction over 2005, and uptake of local measures will actually need to be weighted towards the earlier years (2012-2020) in order for this to happen. Additionally, should national grid decarbonisation be slower than assumed in the projections used in this report, it will become even more challenging to meet local carbon reduction targets as a significant portion of overall local carbon savings is projected to come from grid decarbonisation. The scenarios presented are just two indicative scenarios of how carbon reductions could be delivered in Brighton and Hove and the Council and local stakeholders will need to consider further which measures they wish to target, taking into account the indicative information this study provides on the potential scale of carbon savings, costs and the delivery agents who need to be involved for different measures. Further details on the assessment of all the measures are given in section 9.

Brighton and Hove Energy Opportunities Map



Brighton and Hove Heat Network Opportunities Map



Note: Lower Layer and Middle Layer Super Output Areas (LLSOA and MLSOAs) are statistical geographies developed by ONS for the 2001 census to be as consistent in population size as possible – each LLSOA includes a population of around 1500, whereas other geographical units (e.g. wards) vary greatly in population numbers. MLSOAs are built from groups of LLSOAs and each include a population of around 7200.

Carbon Reduction Scenario 1: High Energy Efficiency

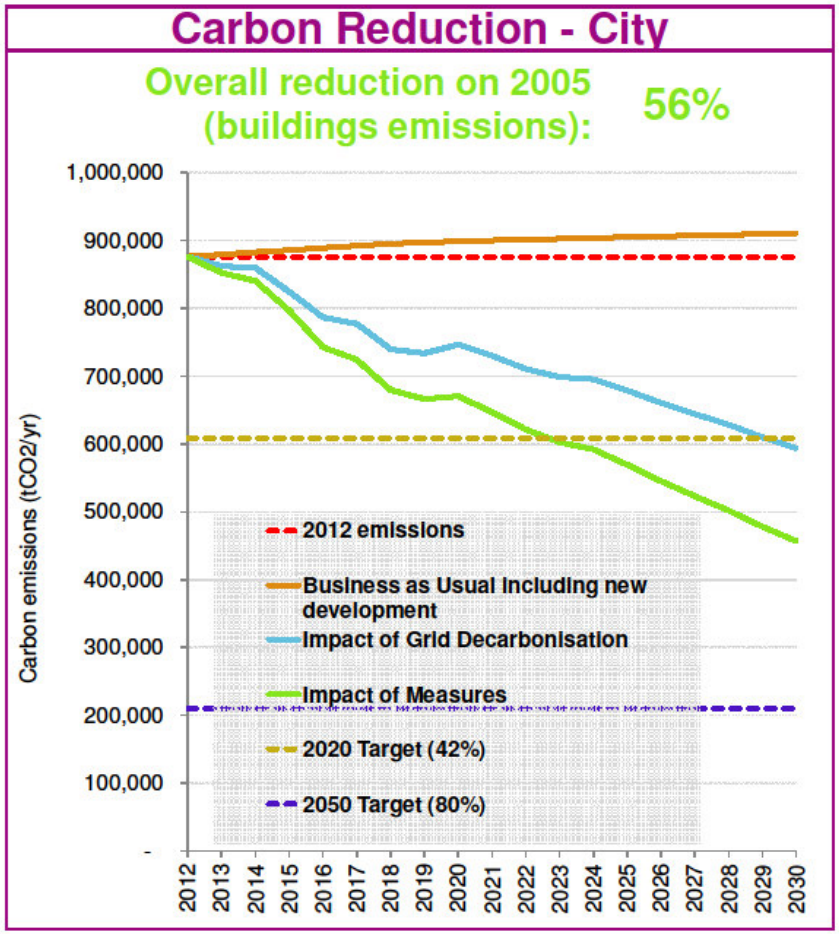
AECOM

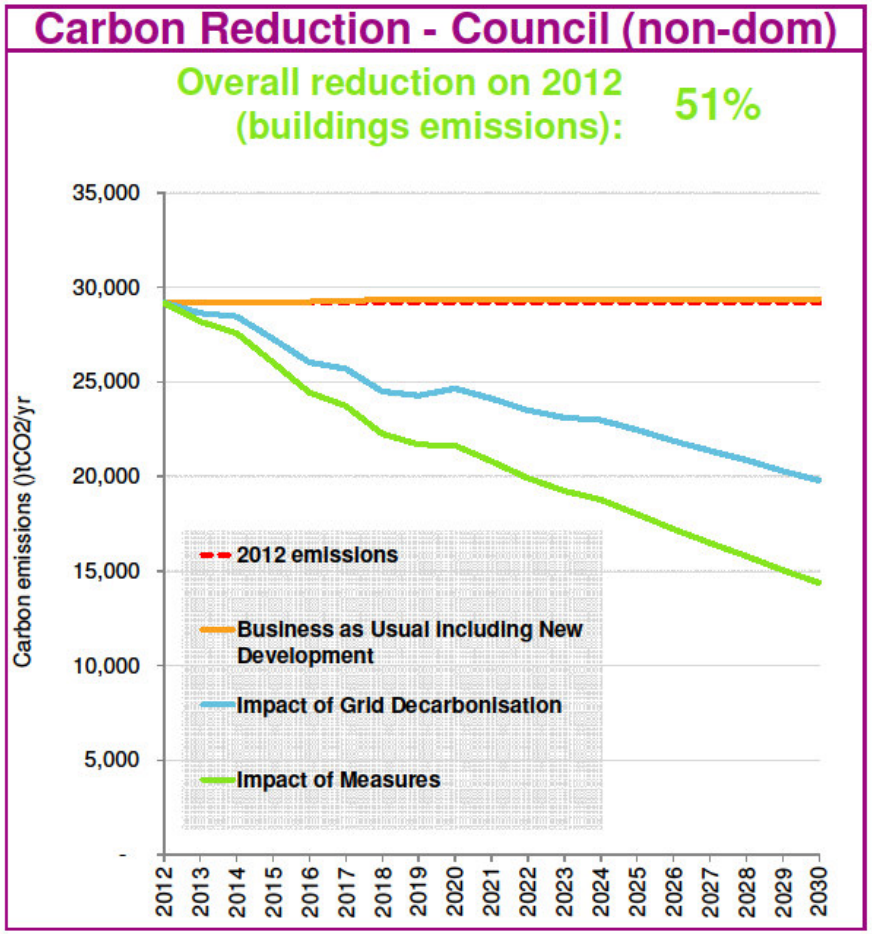
BRIGHTON AND HOVE ENERGY STUDY - SCENARIO MODELLING TOOL

Measures

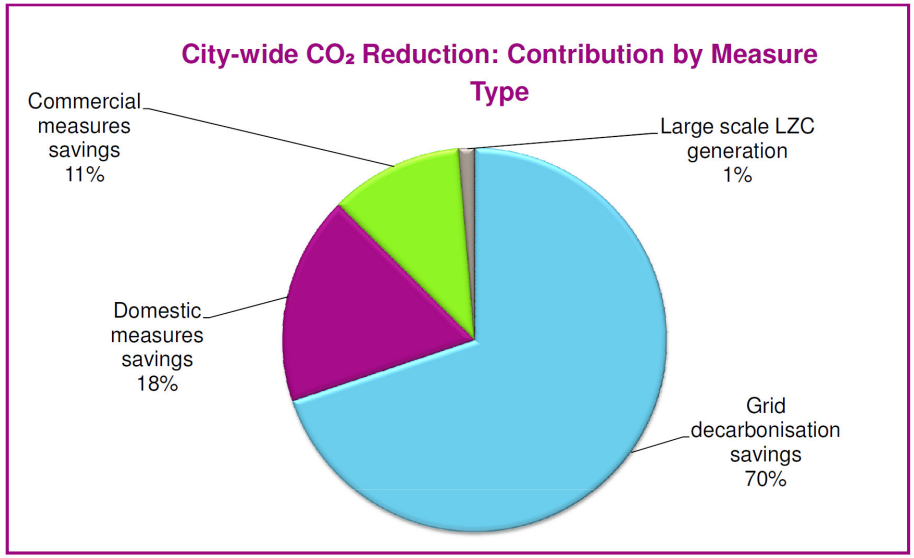
	Latest Revised Scenario	$ktCO_2$ Saved/yr by 2030 (rounded)	% Total CO_2 Savings Achieved by Measure	Indicative Capital Cost (£ 000s)	% of estimated Brighton and Hove capacity implemented by 2030	Target	Historic installation trend	Source for historic installation trend	Lead Delivery Agent
Domestic Building Measures (excl Council)									
Cavity wall insulation - Easy	High	5.6	1.2%	£6,000	100%	881 homes per year	2230 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Cavity wall insulation - Hard	Medium	2.3	0.5%	£10,400	22%	358 homes per year			Homeowners (government support)
Solid wall insulation	Medium	23.1	5.1%	£163,500	64%	1572 homes per year	250 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Loft insulation	High	7.6	1.7%	£4,300	76%	1257 homes per year	4220 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Loft top-up	High	2.3	0.5%	£4,700	76%	1392 homes per year			Homeowners (government support)
Boiler replacement	Medium	13.6	3.0%	£41,100	75%	906 homes per year	3870 homes per year	EHCS 2003-10	Homeowners (government support)
Window replacement	Medium	8.7	1.9%	£25,700	60%	1133 homes per year	3750 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Smart meters	High	4.6	1.0%	£21,600	100%	17891 homes per year	-	-	Homeowners / Energy companies
PV	Medium	1.1	0.2%	£16,300	13%	100 4kWp installations per year	170 4kWp installations per year	Ofgem FIT installations 2010-12	Homeowners (government support)
Solar Thermal	Medium	0.9	0.2%	£11,500	13%	100 4sqm installations per year	130 installations per year	BRE for CCC	Homeowners (government support)
Biomass	Low	0.1	0.0%	£400	-	2 15kWe installations per year	Near Zero	AECOM assumption	Homeowners (government support)
ASHP	Low	0.6	0.1%	£3,300	2%	25 7kW installations per year	Near Zero	AECOM assumption	Homeowners (government support)
GSHP	Low	1.9	0.4%	£12,500	3%	50 10kW installations per year	Near Zero	AECOM assumption	Homeowners (government support)
Non-domestic Building Measures (excl Council)									
Energy Efficiency	Medium	38.0	8.4%	Unknown	20%	20% reduction in emissions	Unknown (range of measures)		Commercial / Public sector
PV	Medium	0.3	0.1%	£3,600	12%	100kWp installed per year	14 kWp installed per year	Ofgem FIT installations 2010-12	Commercial / Public sector
Solar Thermal	Low	0.2	0.1%	£2,400	6%	100sqm installed per year	c300sqm total known	BHCC/AECOM	Commercial / Public sector
ASHP	Low	2.1	0.5%	£4,000	25%	5 100kW installations per year	Near Zero	AECOM assumption	Commercial / Public sector
GSHP	Low	2.2	0.5%	£8,800	25%	5 100kW installations per year	3 installations in total known	BHCC/AECOM	Commercial / Public sector
CHP	Medium	1.9	0.4%	£2,200	-	2 60kWe installations per year	c.1.78MW total existing (not per year)	BHCC/AECOM	Commercial / Public sector
Biomass Boilers	Low	0.7	0.2%	£400	-	1 MW by 2030	c.1MW total existing (not per year)	BHCC/AECOM	Commercial / Public sector
Council Building and Infrastructure Measures									
PV on Schools	High	0.2	0.0%	£2,200	83%	4 15kW installations per year	4 installations in total known	BHCC/AECOM	Council (own estate / housing)
PV on Council Buildings	Medium	0.1	0.0%	£700	35%	20kW installed per year	1 installation in total known	BHCC/AECOM	Council (own estate / housing)
Solar Thermal on schools	Medium	0.0	0.0%	£200	52%	25 7kW installations per year	8 installations in total known	BHCC/AECOM	Council
ASHP in Schools	Low	0.1	0.0%	£200	103%	0.25 100kW installations per year	4 ASHP installations in total existing	BHCC/AECOM	Council (own estate / housing)
GSHP in Schools	Low	0.1	0.0%	£400	103%	0.25 100kW installations per year	4 GSHP installations in total existing		Council (own estate / housing)
Energy Efficiency in non-domestic stock	Medium	4.9	1.1%	TBC	25%	25% reduction in emissions	-	-	Council (own estate / housing)
Council Housing Measures									
Cavity wall insulation - Easy	High	0.7	0.1%	£900	90%	124 homes per year	30 homes per year	ELASH 2012	Council (own estate / housing)
Cavity wall insulation - Hard	Medium	0.8	0.2%	£4,500	60%	153 homes per year			Council (own estate / housing)
Solid wall insulation	Medium	0.3	0.1%	£1,700	60%	18 homes per year	50 homes per year	ELASH 2012	Council (own estate / housing)
Loft insulation	High	0.4	0.1%	£200	90%	68 homes per year	200 homes per year	ELASH 2012	Council (own estate / housing)
Loft top-up	High	0.4	0.1%	£900	90%	248 homes per year			Council (own estate / housing)
Boiler replacement	High	2.6	0.6%	£8,500	100%	188 homes per year	920 homes per year	ELASH 2012	Council (own estate / housing)
Window replacement	Medium	1.0	0.2%	£3,000	60%	167 homes per year	190 homes per year	ELASH 2012	Council (own estate / housing)
Smart meters	High	0.6	0.1%	£2,900	100%	2366 homes per year	-	-	Council (own estate / housing)
PV	Medium	0.5	0.1%	£6,500	41%	40 4kWp installations per year	25 installations per year	ELASH 2012	Council (own estate / housing)
Solar Thermal	Medium	0.4	0.1%	£4,600	41%	40 4sqm installations per year	1 existing communal system	BHCC	Council (own estate / housing)
Large Scale Energy Projects									
District Heat Networks	Eastern Rd (2016)	6.1	1.3%	£13,400	-	Eastern Rd (2016)	4 installed/on site in total	BHCC/AECOM	Council / Energy developers
Large scale solar	Zero	0.0	-	£0	-	No action	Zero	BHCC/AECOM	Council / Energy developers
Large scale wind	Zero	0.0	-	£0	n/a	No action	Zero	BHCC/AECOM	Council / Energy developers
Emission Factors									
Electricity emission factors	DECC Central			Unknown					
TOTALS									
		$ktCO_2$ Saved/yr by 2030 (rounded)	% Total CO_2 Savings Achieved by Measure	Indicative Capital Cost (£000s)					
Grid Decarbonisation Savings		317	69.9%						
Local Measures Savings		137	30.1%	£393,429					
TOTAL SAVINGS		454							

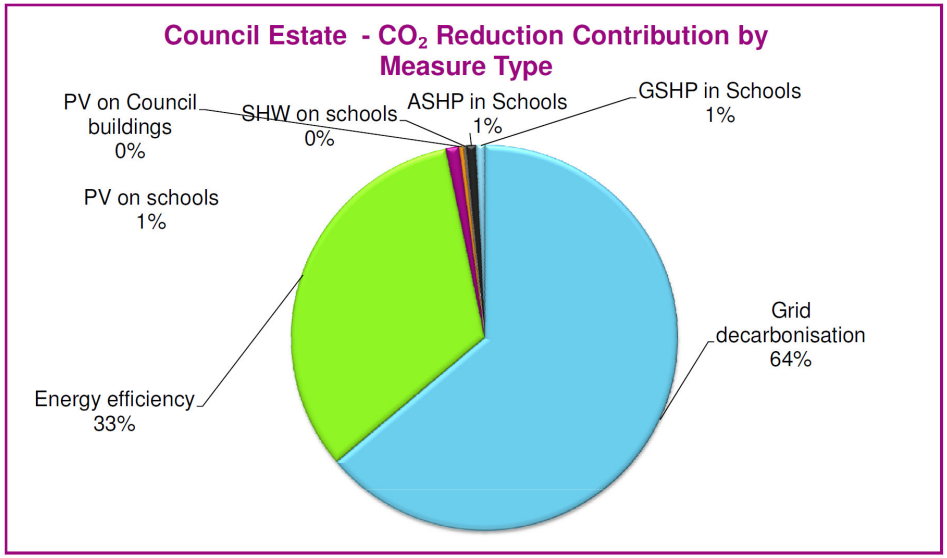
Carbon Reduction Scenario 1: High Energy Efficiency Outputs 2005 - 2030

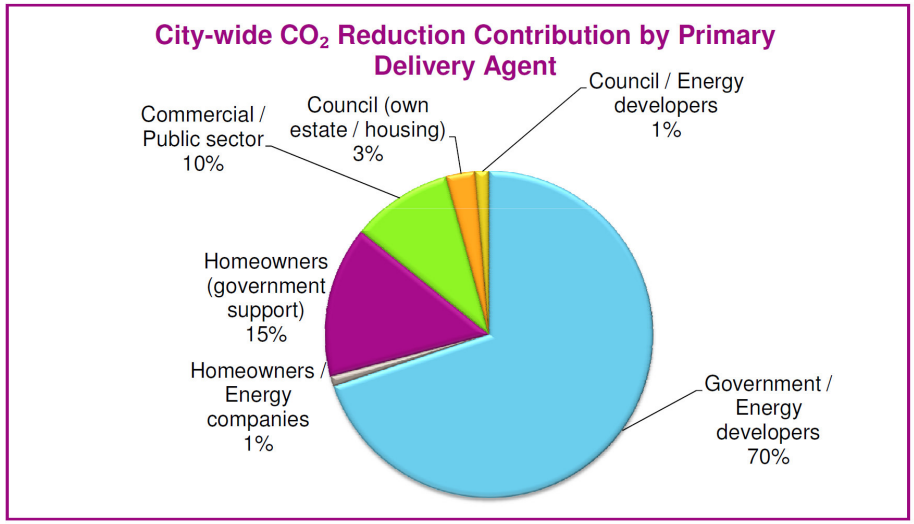




Carbon Reduction Scenario 1: High Energy Efficiency: Outputs Showing Relative Carbon Saving Contribution by Measure Type and Delivery Agent to Overall Target







Carbon Reduction Scenario 2: High Renewables/Low Carbon Energy

AECOM

BRIGHTON AND HOVE ENERGY STUDY - SCENARIO MODELLING TOOL

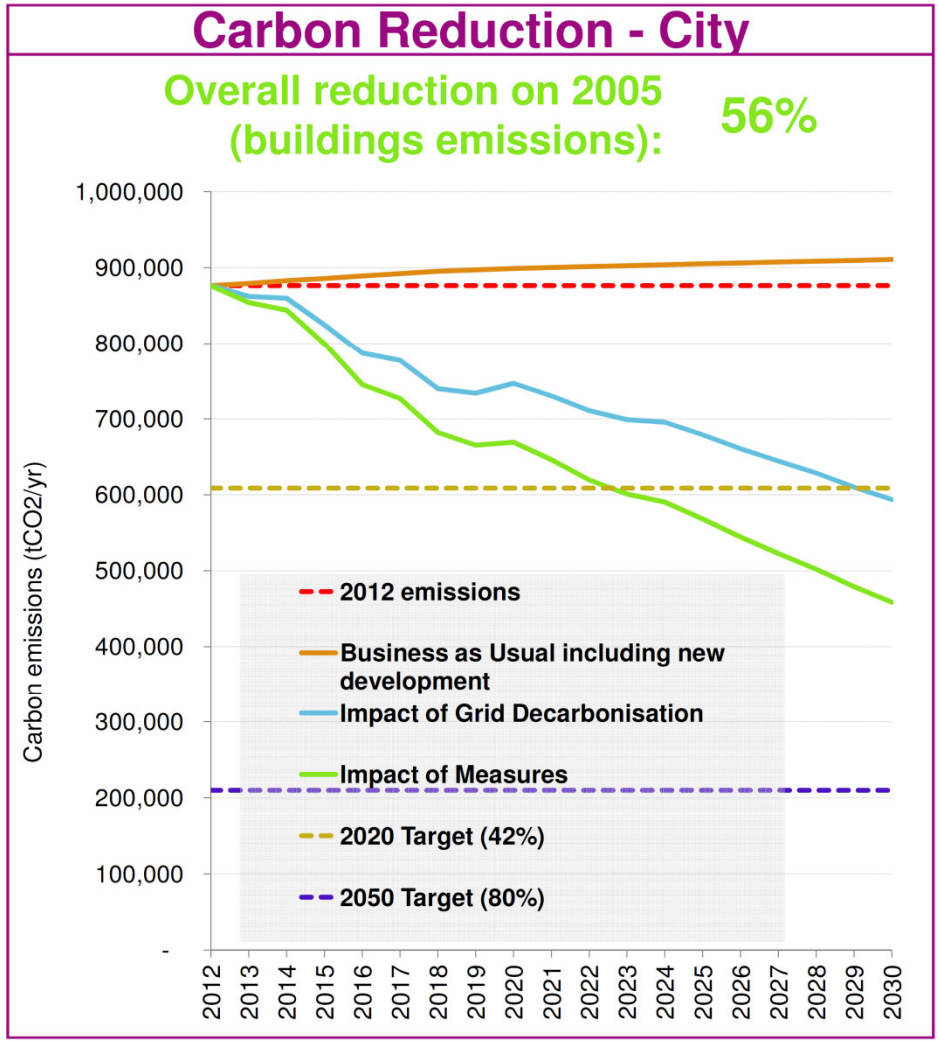
Measures

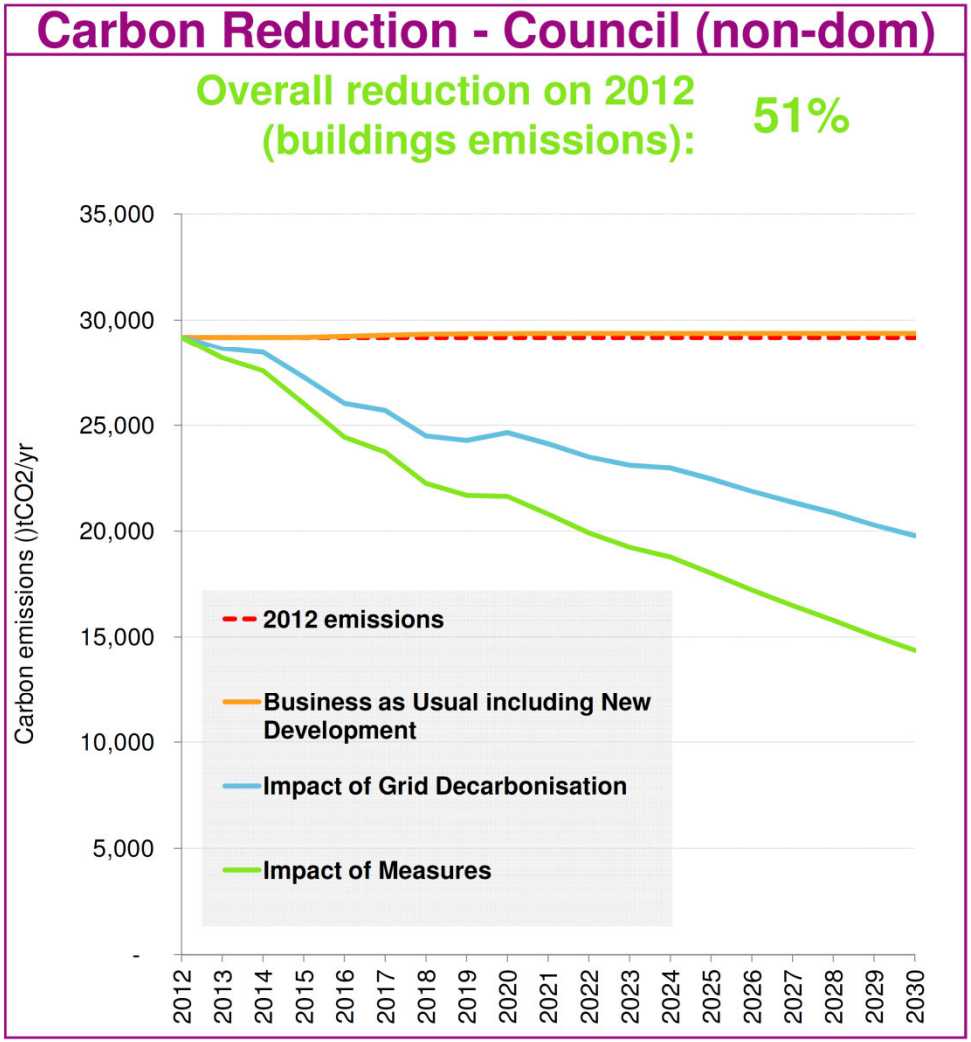
	Latest Revised Scenario	$ktCO_2$ Saved/yr by 2030 (rounded)	% Total CO_2 Savings Achieved by Measure	Indicative Capital Cost (£ 000s)	% of estimated Brighton and Hove capacity implemeneied by 2030	Target	Historic installation trend	Source for historic installation trend	Lead Delivery Agent
Domestic Building Measures (excl Council)									
Cavity wall insulation - Easy	High	5.6	1.2%	£8,000	100%	881 homes per year	2230 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Cavity wall insulation - Hard	Medium	2.3	0.5%	£10,400	22%	358 homes per year			Homeowners (government support)
Solid wall insulation	Low	20.7	4.6%	£148,700	58%	1412 homes per year	250 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Loft insulation	High	7.6	1.7%	£4,300	78%	1257 homes per year	4220 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Loft top-up	High	2.3	0.5%	£4,700	78%	1392 homes per year			Homeowners (government support)
Boiler replacement	Medium	13.8	3.0%	£41,100	75%	908 homes per year	3870 homes per year	EHCS 2003-10	Homeowners (government support)
Window replacement	Medium	8.7	1.9%	£25,700	60%	1133 homes per year	3750 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Smart meters	High	4.6	1.0%	£21,800	100%	17991 homes per year	-	-	Homeowners / Energy companies
PV	Medium	1.1	0.2%	£16,300	13%	100 4kWp installations per year	170 4kWp installations per year	Ofgem FIT installations 2010-12	Homeowners (government support)
Solar Thermal	Medium	0.9	0.2%	£11,500	13%	100 4sqm installations per year	130 installations per year	BRE for CCC	Homeowners (government support)
Biomass	Low	0.1	0.0%	£400	-	2 15kWe installations per year	Near Zero	AECOM assumption	Homeowners (government support)
ASHP	Low	0.6	0.1%	£3,300	2%	25 7kW installations per year	Near Zero	AECOM assumption	Homeowners (government support)
GSHP	Low	1.9	0.4%	£12,500	3%	50 10kW installations per year	Near Zero	AECOM assumption	Homeowners (government support)
Non-domestic Building Measures (excl Council)									
Energy Efficiency	Low	19.0	4.2%	Unknown	10%	10% reduction in emissions	Unknown (range of measures)		Commercial / Public sector
PV	Medium	0.3	0.1%	£3,600	12%	100kWp installed per year	14 kWp installed per year	Ofgem FIT installations 2010-12	Commercial / Public sector
Solar Thermal	Low	0.2	0.1%	£2,400	6%	100sqm installed per year	c300sqm total known	BHCC/AECOM	Commercial / Public sector
ASHP	Low	2.1	0.5%	£4,000	25%	5 100kW installations per year	Near Zero	AECOM assumption	Commercial / Public sector
GSHP	Low	2.2	0.5%	£8,800	25%	5 100kW installations per year	3 installations in total known	BHCC/AECOM	Commercial / Public sector
CHP	Medium	1.9	0.4%	£2,200	-	2 60kWe installations per year	c.1.78MW total existing (not per year)	BHCC/AECOM	Commercial / Public sector
Biomass Boilers	Low	0.7	0.2%	£400	-	1 MW by 2030	c.1MW total existing (not per year)	BHCC/AECOM	Commercial / Public sector
Council Building and Infrastructure Measures									
PV on Schools	High	0.2	0.0%	£2,200	83%	4 15kW installations per year	4 installations in total known	BHCC/AECOM	Council (own estate / housing)
PV on Council Buildings	Medium	0.1	0.0%	£700	35%	20kW installed per year	1 installation in total known	BHCC/AECOM	Council (own estate / housing)
Solar Thermal on schools	Medium	0.0	0.0%	£200	52%	25 7kW installations per year	8 installations in total known	BHCC/AECOM	Council
ASHP in Schools	Low	0.1	0.0%	£200	103%	0.25 100kW installations per year	4 ASHP installations in total existing	BHCC/AECOM	Council (own estate / housing)
GSHP in Schools	Low	0.1	0.0%	£400	103%	0.25 100kW installations per year	4 GSHP installations in total existing		Council (own estate / housing)
Energy Efficiency in non-domestic stock	Medium	4.9	1.1%	TBC	25%	25% reduction in emissions	-	-	Council (own estate / housing)
Council Housing Measures									
Cavity wall insulation - Easy	High	0.7	0.1%	£800	90%	124 homes per year	30 homes per year	ELASH 2012	Council (own estate / housing)
Cavity wall insulation - Hard	Medium	0.8	0.2%	£4,500	60%	153 homes per year			Council (own estate / housing)
Solid wall insulation	Low	0.1	0.0%	£800	30%	9 homes per year	50 homes per year	ELASH 2012	Council (own estate / housing)
Loft insulation	High	0.4	0.1%	£200	90%	68 homes per year	200 homes per year	ELASH 2012	Council (own estate / housing)
Loft top-up	High	0.4	0.1%	£800	90%	248 homes per year			Council (own estate / housing)
Boiler replacement	High	2.6	0.6%	£9,500	100%	188 homes per year	920 homes per year	ELASH 2012	Council (own estate / housing)
Window replacement	Medium	1.0	0.2%	£3,000	60%	187 homes per year	190 homes per year	ELASH 2012	Council (own estate / housing)
Smart meters	High	0.6	0.1%	£2,900	100%	2386 homes per year	-	-	Council (own estate / housing)
PV	Medium	0.5	0.1%	£6,500	41%	40 4kWp installations per year	25 installations per year	ELASH 2012	Council (own estate / housing)
Solar Thermal	Medium	0.4	0.1%	£4,600	41%	40 4sqm installations per year	1 existing communal system	BHCC	Council (own estate / housing)
Large Scale Energy Projects									
District Heat Networks	Eastern Rd (2016) + Edward St (2019) + London Rd (2022)	9.7	2.1%	£25,300	-	Eastern Rd (2016) + Edward St (20	4 installed on site in total	BHCC/AECOM	Council / Energy developers
Large scale solar	Higher	1.9	0.4%	£15,800	-	12 MW installed by 2030	Zero	BHCC/AECOM	Council / Energy developers
Large scale wind	High	14.5	3.2%	£32,000	n/a	One turbine per year from 2015	Zero	BHCC/AECOM	Council / Energy developers
Emission Factors									
Electricity emission factors	DECC Central			Unknown					

TOTALS

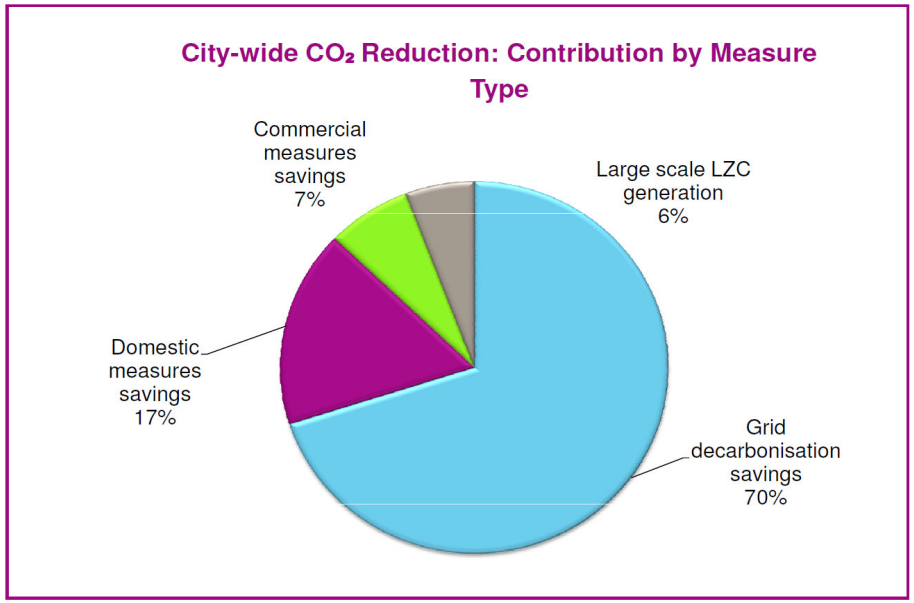
	$ktCO_2$ Saved/yr by 2030 (rounded)	% Total CO_2 Savings Achieved by Measure	Indicative Capital Cost (£000s)
Grid Decarbonisation Savings	317	70.1%	
Local Measures Savings	135	29.9%	£435,393
TOTAL SAVINGS	452		

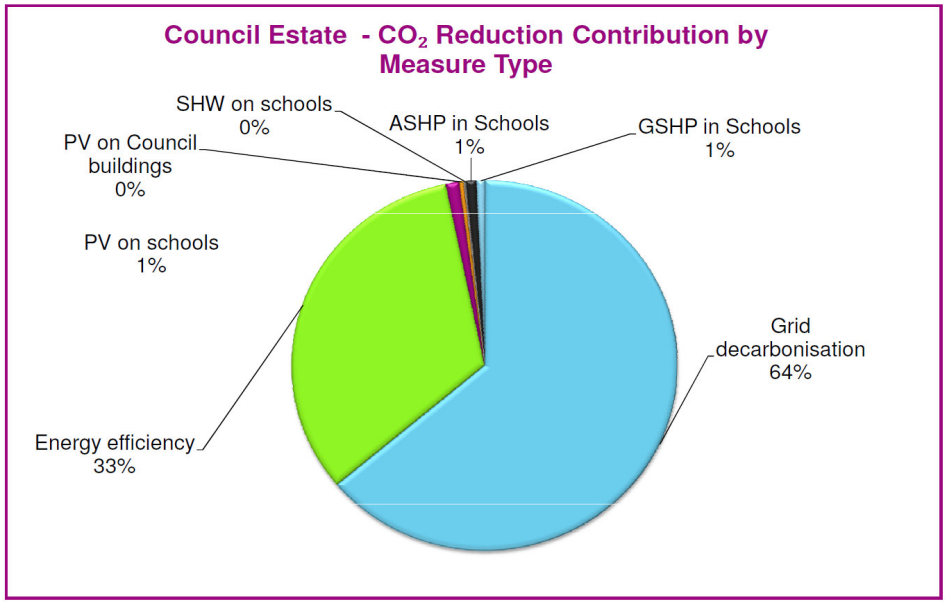
Carbon Reduction Scenario 2: High Renewables/Low Carbon Energy: Outputs 2005 - 2030

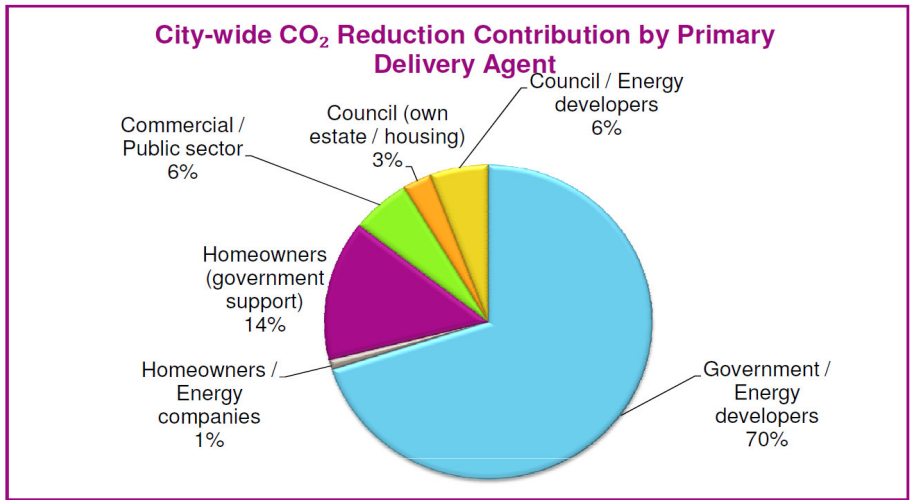




Carbon Reduction Scenario 2: High Renewables/Low Carbon Energy: Outputs Showing Relative Carbon Saving Contribution by Measure Type and Delivery Agent to Overall Target







Based on the assessment undertaken in this study and input from Brighton & Hove City Council, this study presents potential carbon reduction scenarios for 2030 to put the city upon a trajectory towards meeting its 2050 carbon reduction target of 80% for the city, based on 2005 levels, and presents a possible carbon reduction scenario by 2030 over 2012 levels for the Council's own estate and operations, over which it has more direct control. Work is currently under way on a One Planet Living Plan for Brighton & Hove which will potentially develop even more challenging targets for the city.

Whilst the short to medium term targets are ambitious it should also be recognised that in the longer term to 2050 even more demanding carbon reductions will be needed and Brighton and Hove should also take into account the need to prepare for these – for example through setting in progress additional projects now, particularly those with longer lead-in times such as large-scale local energy generation schemes.

It is also important to recognise that targets are heavily reliant upon central government action through grid decarbonisation, as well as other factors highlighted throughout this report, and the city-wide target is highly dependent upon the outcome of measures to incentivise private sector retrofit such as the Green Deal. Under the two scenarios presented in this report – which are only indicative scenarios of how carbon reductions could be achieved in the city – the breakdown of the sources of the emission reductions is shown in the table on the following pages.

Sector	Carbon Emissions (tCO_2/yr)	Reduction over 2005 Baseline	Proportion of total 2012-2030 savings (%)
2005 Baseline	**1,049,370**	n/a	n/a
Reductions 2005-2012	**172,505**	16%	
New Development Growth 2013-2030	**34,277**	-3%	-8%
Grid Decarbonisation	**316,987**	30%	76%
Total Local Measures*	**136,821**	13%	33%
Local Measures: Non-Council Housing	72310	7%	17%
Local Measures: Council Housing	7627	1%	2%
Local Measures: Non-Council Non-Domestic	45412	4%	11%
Local Measures: Council Buildings/Infrastructure	5407	1%	1%
Local Measures: Large Scale Energy Projects	6065	1%	1%
Total Reduction 2012-2030*	**419,531**	40%	100%
Total Reduction 2005-2030*	**592,036**	56%	n/a
Target Emissions 2030	**457,334**		

Carbon Reduction Scenario –City Emissions: 'High Energy Efficiency'

Sector	Carbon Emissions (tCO_2/yr)	Reduction over 2005 Baseline	Proportion of total 2012-2030 savings (%)
2005 Baseline	1,049,370	n/a	n/a
Reductions 2005-2012	172,505	16%	
New Development Growth 2013-2030	34,277	-3%	-8%
Grid Decarbonisation	316,987	30%	76%
Total Local Measures*	135,342	13%	32%
Local Measures: Non-Council Housing	69952	7%	17%
Local Measures: Council Housing	7488	1%	2%
Local Measures: Non-Council Non-Domestic	26421.6	3%	6%
Local Measures: Council Buildings/Infrastructure	5407	1%	1%
Local Measures: Large Scale Energy Projects	26074	2%	6%
Total Reduction 2012-2030*	**418,052**	**40%**	**100%**
Total Reduction 2005-2030*	**590,557**	**56%**	**n/a**
Target Emissions 2030	**458,813**		

Carbon Reduction Scenario –City Emissions: 'High Renewable and Low Carbon Energy Generation'

Sector	Carbon Emissions (tCO_2/yr)	Reduction over 2012 Baseline	Proportion of total 2012-2030 savings (%)
2012 Baseline	29,179	n/a	n/a
New Development Growth 2013-2030	197	-1%	-1%
Grid Decarbonisation	9,594	33%	65%
Total Local Measures*	5,407	19%	37%
Local Measures: Energy Efficiency	4,945	17%	33%
Local Measures: Renewables in Schools	405	1%	3%
Local Measures: PV on Council Buildings	56	0%	0%
***Total Reduction 2012-2030** **Target Emissions 2030**	14,804 14,375	51%	100%

Carbon Reduction Scenario – Council Emissions

**Note: there are small discrepancies between individual figures and totals due to rounding.*

Report Structure

The report has the following structure:

1. **Introduction** – introducing and explaining the context for the strategy, and discussing key features of the Brighton and Hove area;
2. **Policy Context** – outlining the national, regional and local policy drivers;
3. **Baseline Energy Use and CO2 emissions** – setting out the baseline, and discussing the methodology used;
4. **Impact of National Action** – assessing the potential impact of national action on carbon reduction in Brighton and Hove, focussing on grid decarbonisation;
5. **Introduction to Assessment of CO2 Reduction Opportunities** – introducing sections 6 to 9 which identify key opportunities for local action to target carbon reductions and explain the methodology for assessing these, covering the areas set out below;
6. **Low and Zero Carbon Energy Generation Assessment** – mapping potential areas for energy generation;
7. **Heat Network Assessment** – identifying potential areas for development of heat networks and assessing the viability of three heat network clusters;
8. **New Buildings Planning Policy Assessment** – testing the policies relating to carbon reduction in new development in the draft City Plan Part 1 and making recommendations on these and other policies relating to carbon reduction;
9. **Existing Buildings Measures Assessment** – assessing the potential for various energy efficiency and microgeneration measures in existing buildings in the area;
10. **Scenario Development** – explaining the scenario development process which was followed and presenting a potential scenario based on the results of the analysis from sections 6 to 9;
11. **Funding and Delivery** – discussing potential funding sources and delivery mechanisms.
12. **Appendices** – containing a glossary and details of the assumptions that have been used in the calculations and modelling.

1 Introduction

This study has been commissioned by Brighton & Hove City Council to assess the potential opportunities for delivering CO2 emissions reductions through energy efficiency and low and zero carbon energy generation in buildings in the city from 2013 - 2030; the period covered by the City Plan, the main document of the Council's Local Development Framework. It sets out to define a potential scenario for achieving the ambitious CO2 emissions to which the Council is committed, provides an evidence base for the City Plan and identifies specific carbon reduction projects that could be delivered by the Council and other key Stakeholders. The vision for the study is to identify the intervention opportunities that the Council has to create a sustainable, low carbon city that will benefit the local community, residents and businesses and help to mitigate the wider impacts of climate change.

1.1 The Need for an Energy Study

Various targets and regulatory drivers have been created at a national and international level to incentivise action to avoid the potentially devastating impacts of climate change. Like other Local Authorities across the UK, Brighton & Hove City Council is seeking to assess opportunities for delivering and influencing carbon reduction locally, recognising the contribution that Brighton and Hove must make to enable national and international targets to be met.

The Council is also in the process of developing its City Plan, the main planning document in its Local Development Framework. The Draft City Plan Part 1 proposes to require new development to achieve high sustainability standards. Part of the remit of this energy study is to test the viability of these standards and to recommend policies which could support carbon reduction in Brighton and Hove. It also responds to some of the recommendations arising from Brighton and Hove's Scrutiny Panel on Renewable Energy Potential in April 2011 which recommended that a renewable energy study be undertaken for the area.[6] The policy context for the report is further discussed in Section 2.

The purpose of this study is to identify how Brighton and Hove can reduce its CO2 emissions in a way that is technically feasible and financially viable. The study demonstrates this by:

- Providing a high-level assessment of the feasibility of potential carbon reduction measures, taking into account technical, financial and practical constraints and opportunities, costs and benefits – including

[6] Brighton & Hove City Council, *Report of the Environment and Community Safety Overview and Scrutiny Panel: Scrutiny Panel on Renewable Energy Potential*, April 2011

identifying potential carbon savings both for the Council and for the city as a whole;

- Assessing specific opportunities for:
  - Delivering low and zero carbon energy generating technologies;
  - Developing heat networks;
  - Setting planning policy to mitigate CO_2 emissions from new developments;
  - Delivering the installation of energy efficiency measures and microgeneration technologies in existing buildings.
- Identifying the contribution of different delivery partners to achieving carbon reduction in Brighton and Hove, including national and regional government; and
- Investigating what level of local intervention might be required to achieve a range of CO2 reduction targets.

1.2 Study Methodology

The methodology used is explained in more detail in Sections 3 to 9 of this report. Section 2 provides the policy context for target setting, whilst Sections 10 and 11 set out potential carbon reduction scenarios and funding and delivery mechanisms. In summary, the methodology applied is as follows:

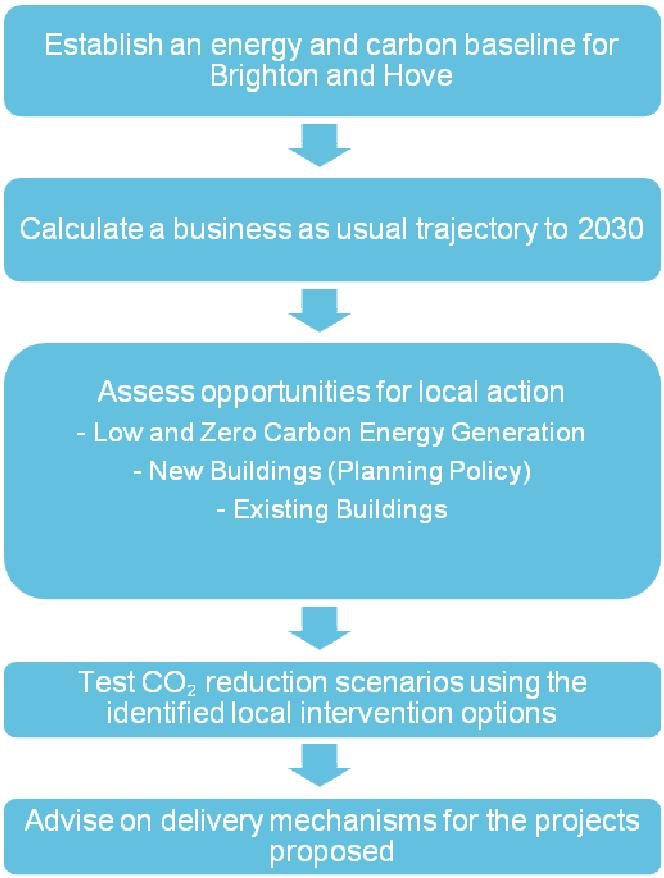


Figure 1: Summary of report methodology

1.3 Overview of Brighton and Hove Area

Brighton and Hove is a compact city bordered by the sea to the south and the South Downs National Park to the north and east. Over 40% of the administrative area of Brighton and Hove is within the National Park, the majority of which is owned and leased by the City Council. The built up area of the city covers c.8,267 hectares, around half of the city's total area. The city has a population of just under 273,400, comprising around 121,540

households[7] with approximately 11,315 additional dwellings currently expected to be built by 2030.[8] In addition to the regional centre (Brighton), Brighton and Hove has two town centres (Hove and London Rd), four district centres (St James' St, Lewes Rd, Boundary Rd/Station Rd, Brighton Marina), and seventeen local centres. There are eight major development areas identified in the city, for both housing and non-domestic growth. An estimated total of around 380,700 square metres of new non-domestic development is expected in the city by 2030, predominantly office development, along with substantial amounts of new hospital, multi-residential and school floorspace.

The city has a limited industrial sector presence, and has a strong service sector economy, with public services, education, health and financial and business services being significant employers. It has a large creative and digital media presence and a large number of small independent businesses. The environmental technology sector also has a significant presence and has been identified as one of six priority growth areas for the city.[9]

Brighton and Hove's ecological and carbon footprint has recently been calculated and the city has recognised the need to move towards a more resource efficient future. Brighton and Hove's Sustainable Community Strategy sets a challenging CO_2 target reduction of 42% by 2020 and 80% by 2050. Brighton itself is vulnerable to the impacts of climate change particularly due to its position by the sea and position within a 'highly water stressed' region. Additionally, 12% of households are estimated to be in fuel poverty, with this figure anticipated to increase further due to future rises in energy prices.[10]

The carbon reduction opportunities in Brighton and Hove will be strongly influenced by the largely residential nature of the area and this sector will be an important focus for the study. The impact of new development and opportunities for carbon reductions in industrial and commercial organisations will also be significant.

In order to assess the potential level of intervention within any of these sectors it is important to consider the main stakeholders in the city – some of these are discussed below.

1.4 Key Stakeholders

Brighton & Hove City Council

Brighton & Hove City Council has several important roles relating to carbon reduction in the city. It has

[7] ONS, Census 2011, data released 24th September 2012.
[8] Brighton & Hove City Council, draft City Plan Part 1, May 2012
[9] Brighton & Hove City Council, *Business Retention and Inward Investment Strategy*, 2009
[10] Brighton & Hove Local Information Service (BHLIS), Households living in Fuel Poverty, Lower Super Output Area (LSOA), 2009

commissioned this study, recognising the role local government has in promoting and delivering sustainable energy generation and energy efficiency. The Council has assets of its own within the city which could provide opportunities for reducing carbon emissions – including offices, schools and land. Several schools already have microgeneration installed and some other Council buildings have PV installed or planned including Bartholomew House, Moulsecoomb campus and Hove Town Hall. The Council committed in its *Climate Change Strategy 2011-15* to installing solar PV on Council buildings and Council housing.[11]

Brighton & Hove City Council and city stakeholders' draft One Planet Living Plan is currently exploring targets for the city and council on renewable energy generation and carbon reduction, and recommends that targets be adopted to deliver 15% energy generation from renewables by 2020, reflecting national targets.[12]

The Council owns over 14,000 Council homes, providing good opportunities for applying measures at scale. Brighton and Hove's *Housing Strategy 2009-2014* includes the strategic goal (number 7) of reducing fuel poverty and minimising CO_2emissions. The Council has invested significantly in insulation and heating improvements in Council housing including over £3.5million in boiler and heating upgrades and replacements, and over-cladding of Wiltshire House and Somerset Point. At 2012 the average SAP (Standard Assessment Procedure for energy rating of dwellings) rating of Council housing stock was around 61 (an EPC rating of D). The average SAP rating for British homes is 51.6 and new homes have SAP ratings of around 80.[13]

The Council has other drivers related to carbon reduction such as reducing fuel poverty in the city and has recently been involved in delivering and promoting various grant schemes for private sector housing including CESP, Warm Homes, Warm Front, solar hot water and Affordable Warmth grants. In 2011-12 367 separate measures were installed through the Brighton and Hove Energy Action Partnership, saving an estimated 270 tonnes of carbon. The majority of these installations were heating or boiler replacements, followed by loft insulation and cavity wall insulation.[14] There are significant opportunities for Brighton & Hove City Council to set supportive mechanisms to drive the uptake of energy efficiency and low carbon energy generation. These include setting policies in the Local Development Framework (LDF) which will

[11] Brighton & Hove City Council, *Brighton and Hove Climate Change Strategy 2011-2015*, 2011.
[12] Bioregional, draft One Planet Living Plan for Brighton, in production.
[13] DECC, *Great Britain's housing energy fact file*, 2011.
[14] Brighton and Hove City Council, Brighton and Hove Energy Action Partnership Annual Review 2012.

influence new development, becoming directly involved in delivering carbon reduction schemes in the city, such as the Green Deal or district heat networks. The Council will also be looked to as a trusted source of information and support by public and commercial organisations.[15]

Those involved in the management of Council-owned buildings with significant emissions, such as the King Alfred Leisure Centre and Prince Regents Pool, and schools in Brighton and Hove, will also need to be involved in delivering carbon reduction measures. National government's drive to increase the independence of schools from local government control through schemes such as academies and free schools may however reduce the Council's ability to influence carbon reduction within the school estate, even though the emissions will continue to be attributable to the Council for CRC reporting purposes and represent around a third of the Council's own emissions.

A recent report by the Committee on Climate Change provides useful additional information on how Councils can reduce emissions in their area.[16] It emphasises the importance of Council action and identifies opportunities for intervention, but also recognises that in the absence of any requirement on Local and Unitary Authorities to take action, and limited funding available, there is a significant risk to the implementation of national climate change targets. The Committee has recommended that a statutory duty to develop and implement carbon reduction plans and/or additional funding (for example, to become Green Deal providers) is provided to support local government action. The Committee is also supportive of the type of approach being taken by Brighton and Hove Council in this study: developing an ambitious carbon plan which focuses on the emissions drivers over which the Council has some control. The main areas for action which the CCC identifies for Local and Unitary Authorities are:

- Energy efficiency in residential buildings – identified as the largest opportunity (through Green Deal and ECO);
- Some opportunities in non-residential buildings (and also transport, which is not covered by this study);
- Supporting power sector decarbonisation through granting planning approval for projects such as wind turbines;
- Reducing emissions from their own estates;
- Supporting development of energy networks.

[15] A survey undertaken by DECC showed that Local Authorities were chosen by SMEs as one of the top three advice sources they would be likely to access, along with energy suppliers and the internet. DECC, *Unconstrained sector research*, 2010.

[16] Committee on Climate Change, *How Local Authorities Can Reduce Emissions and Manage Climate Risks*, 2012.

Other Social Housing

There are various Registered Social Landlords in the city (including A2Dominion, Affinity Sutton, Guinness Trust, Home Group, Moat Homes, Orbit South, Sanctuary Housing, Southern Housing and Servite Houses) who will need to be engaged further around improvements to their stock. Registered Social Landlords own around 5% of Brighton and Hove's total housing stock.

Private Sector Housing

Around 85% of homes in Brighton and Hove are in private ownership. This compares to an average of around 78% in England and Wales. Of the private stock in Brighton and Hove, approximately 75% is owner occupied and 25% private rented. This compares to an average of around 89% and 11% in England and Wales.[17] The average EPC rating for private sector housing in Brighton and Hove is estimated to be an E rating (in 2012), with 5% of the private sector stock estimated to be below this standard.[18]

Private home owners are generally more difficult to engage, and private rented homes are particularly difficult as landlords also need to be engaged and to see incentives for acting. Studies on retrofit programmes have shown that Council backing and marketing and visible, proactive promotion of schemes such as door knocking are important for driving take-up.[19] The Green Deal may also provide a good mechanism for engaging private landlords as it can enable them to make improvements to their properties avoiding upfront costs. Domestic emissions in the city (including Council homes) account for around 57% of the borough's total emissions, making this sector vital to the delivery of carbon reduction targets.

The main government programme for delivering energy efficiency in this sector is the Green Deal, which is due to be launched fully in 2013 - its success is likely to be crucial for delivering carbon reductions in private sector housing. The Green Deal allows homeowners to take out loans for energy efficiency measures which they then pay back through savings on their energy bills, with the loan attached to the property rather than the individual. This mechanism also aims to overcome problems in the private rented sector where traditionally landlords are required to invest in energy efficiency measures, with the benefits going to the tenants in lower bills but not back to the landlord. Under the Green Deal landlords (or tenants with their landlord's consent) can take out loans attached to the property which the tenants then pay back through their energy bill savings.

[17] ONS, 2001 Census.
[18] Brighton & Hove City Council, ELASH 2012. An EPC rating of E is equivalent to a SAP rating of 39-54.
[19] For example, DECC, *Evaluation of the Delivery and uptake of the Carbon Emissions Reduction Target*, 2011.

Along with the Energy Bill which announced the Green Deal it was stated that from April 2016 the government also intends to introduce requirements meaning that domestic landlords should not be able to unreasonably refuse requests from their tenants for consent to energy efficiency improvements, where financial support is available. A minimum energy efficiency rating for private rented properties is also planned for 2018 (likely to be set at an EPC rating of E – and so unlikely to affect many houses in Brighton and Hove unless it is set at a higher level).

Brighton & Hove Strategic Partnership has committed in its Climate Change Strategy to exploring options for Green Deal projects – with the potential to generate significant investment in the local housing stock on energy efficiency measures; to provide continued advice and support to private householders; and to explore availability of funding for grants and to consider affordable loans options.

Other Public Sector

Other (non-Council) public sector organisations with assets in Brighton and Hove include the NHS, the University of Brighton, the University of Sussex, and Sussex Police.

The University of Brighton and Brighton and Sussex University Hospitals (BSUH) NHS Trust have both provided information on their buildings for this study. Both universities and BSUH have significant estate development programmes due to take place over the period to 2030. The two universities have existing heat networks and the BSUH NHS Trust are proposing a CCHP and heat network for their '3Ts' redevelopment programme at Royal Sussex County Hospital.

Industrial and Commercial Sector

Altogether the industrial, commercial and public sector accounts for around 43% of the city's emissions from buildings. Given the fairly low levels of industrial activity in Brighton and Hove, a significant proportion of this is likely to be due to SMEs and larger commercial organisations. There are around 7,300 commercial and industrial premises in Brighton and Hove, with a total floor area of over 1.6 million square metres. The majority of these are retail premises (around 53%), followed by offices (around 24%), then warehouses and factories (each around 10%).[20] This picture is fairly similar to that in England as a whole, but with a higher proportion of retail premises and lower proportion of factories and warehouses.

Where businesses are in rented properties, their landlords will also need to be engaged. The large number of organisations implies that a coordinating body and fairly significant resource will be needed

[20] ONS, Commercial and Industrial Floorspace and Rateable Value Statistics (2005 Revaluation), 2008. Note that data may have changed since 2008 but this is the latest available dataset.

to engage the businesses. Experience gained from programmes such as the Greater London Authority's 'Low Carbon Zones' initiative has demonstrated the difficulties of engaging with and influencing the private sector, particularly where these organisations are chain businesses with multiple sites and the decision-makers are not locally based. However, larger organisations in owned premises are more likely to feel they have the ability to take action, and the Council will already have links with many of the industrial and commercial organisations in the city.

Community Groups and Individuals

Community groups can play a significant role in facilitating carbon reduction initiatives through running projects, communicating information and campaigning for local action. Making significant interventions into the large proportion of the city's emissions that result from energy use from private domestic properties will require extensive communication networks and community groups could be a big component of this. Brighton and Hove is fortunate in having a large number of active local groups and environmental campaigners who will be important in helping to deliver carbon reduction measures in the city.

Individual residents will also need to be encouraged and supported to take steps to reduce their carbon emissions at home and at work through adopting more energy efficient habits.

National Government

National Government support will be vital in achieving carbon reduction targets - through providing financial incentives and sources of funding and setting a supportive framework for delivery. As discussed in Section 4, achieving carbon reduction targets at the local level relies significantly upon delivery of national government's plans to decarbonise the electricity grid as well as upon local action.

2 Policy Context

The following section sets out the key policies relating to energy use and carbon emissions which support carbon reduction initiatives in Brighton and Hove and inform this study.

2.1 National and International Policy

The key national policies relating to the reduction in energy use and CO2 emissions from buildings are summarised below:

- **The Kyoto Protocol** is an international treaty with the goal of achieving the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".
- **EU CO2 reduction targets** The UK is committed to meeting targets agreed between the European Commission and the Member States to reduce CO2 emissions by 20% on 1990 levels by 2020.
- **Climate Change Act (2008)** sets a legally binding target to reduce UK CO2 emissions by at least 26% on 1990 levels by 2020 and at least 80% by 2050. These targets have been translated into carbon budgets for the UK, currently covering the periods 2008-12, 2013-17, 2018-22, and 2023-27, as shown in the table below.

Carbon Budget Period	2008-2012	2013-2017	2018-2022	2023-2027
Reduction on 1990 CO_2 levels	23%	29%	35%	50%

Table 1: UK carbon budgets

- **UK Renewable Energy Strategy (2009)** describes how the UK will meet its legally binding target to supply 15% of all of the energy it uses from renewable sources by 2020. This target is anticipated to be achieved by using renewable energy technologies to supply over 30% of our electricity, 12% of the heat we use and 10% of energy for transport.
- **National Planning Policy Framework** replaced national Planning Policy Statements in March 2012. By reducing the detail of

national guidance and placing emphasis on Local Plans, it gives Local Authorities more responsibility in ensuring sustainable development. It includes a presumption in favour of sustainable development. It also states that housing should be provided on the basis of demand rather than supply, which may lead to increased levels of housing development. The Framework (paragraph 94) also provides an explicit link to the Climate Change Act: "Local planning authorities should adopt proactive strategies to mitigate and adapt to climate change…In line with the objectives and provisions of the Climate Change Act 2008".

- **Energy Act (2011)** updates energy legislation to provide support for energy efficiency measures to homes and businesses through the introduction of the Green Deal and Energy Company Obligation (see below), and to require energy efficiency improvements to be made in the private rented sector. From April 2016 private domestic landlords will be unable to refuse a tenant's reasonable request for consent to energy efficiency measures where a finance package is available, and a minimum energy efficiency standard will be required in domestic and non-domestic rented premises from April 2018.
- **UK Carbon Plan (2011)** The Carbon Plan was published in December 2011. It sets out the government's strategy for meeting the Climate Change Act and carbon budget targets, and the activity required in different sectors (buildings, transport, industry, low carbon electricity, agriculture forestry and land management, waste and resource efficiency).
- **UK Heat Strategy (2012)** The Heat Strategy builds upon the Carbon Plan and identifies pathways for the transition to a low carbon heat supply.
- **Feed In Tariff (FIT)** Launched in April 2010, FITs provide a financial incentive for the uptake for renewable electricity generating technologies.
- **Renewable Heat Incentive (RHI)** The RHI was launched in July 2011 and provides a financial incentive for the uptake of renewable heat generating technologies.
- **Green Deal** This is a government initiative, due to be launched fully in 2013, that will enable private firms to offer energy efficiency improvements to home and building-owners at no upfront cost, and to recoup payments through the savings in energy bills. For all Green Deal measures, the expected financial savings must be equal to or greater than the costs attached to the energy bill; this is known

as “the golden rule”. The government’s Green Deal consultation response, June 2012, suggests that the Home Energy Conservation Act (HECA) will be revitalised to encourage Local Authorities to plan for CO_2 emission reductions on a borough wide basis, recognising the importance of intermediaries in particular Local Authorities, social housing providers and communities in building local partnerships to deliver the Green Deal.

- **Energy Company Obligation** The 2011 Energy Bill, which made provision for the Green Deal, also provided for an Energy Company Obligation (ECO) to replace the current CERT and CESP schemes which oblige energy companies to contribute to the costs of installing energy efficiency measures in homes. The ECO is expected to focus on subsidising measures which do not meet the Green Deal’s golden rule - in particular solid wall insulation – and a proportion is expected to be targeted towards thermal energy efficiency measures in vulnerable homes.
- **CRC Energy Efficiency Scheme** The CRC scheme is a mandatory carbon trading system set up to encourage large energy consumers in the UK to manage and reduce CO2 emissions from their operations.
- **Building Regulations** The Building Regulations set the minimum standards for building performance and must be met for a building to be approved for construction. Part L of the Building Regulations focuses on the conservation of heat and power and sets specific requirements for the fabric performance, building services efficiency, overheating and the CO_2 emissions. Current and anticipated future requirements of Part L of the Building Regulations for both domestic and non-domestic buildings over the period of the City Plan have been taken into account when assessing the impact of new development on Brighton and Hove’s carbon emissions and when testing the feasibility of the carbon reduction targets proposed in the draft City Plan Part 1. Relevant Building Regulation requirements are discussed in more detail in Section 8.
- **Code for Sustainable Homes (CSH)** Sets out a national rating system to assess the sustainability of new residential development. There is currently no national minimum requirement for the rating new dwellings must achieve, however future Building Regulation targets are expected to reflect some of the energy requirements of some of the higher CSH levels and Brighton & Hove City Council is proposing to require developers to meet high

levels of the CSH. The potential for requiring different CSH levels is assessed in more detail in Section 8.

- **BREEAM** The Building Research Establishment Environmental Assessment Method (BREEAM) is a voluntary assessment scheme which aims to help developers to minimise the adverse effects of new non-residential buildings on the environment. Brighton & Hove City Council is proposing to require major new non-domestic developments to aim to achieve high BREEAM ratings. The potential for requiring different BREEAM levels is assessed in more detail in Section 8.

2.2 Local Policy

- **Brighton and Hove's Sustainable Community Strategy (2010)** sets "living within environmental limits and enhancing the environment" as an overarching priority for the city. The strategy sets challenging CO_2 target reductions of 42% by 2020 and 80% by 2050, based on per capita emissions, and further targets for the city's ecological footprint which takes into account a wider range of environmental impacts.
- **Brighton and Hove Climate Change Strategy (2011)** sets out an action plan to improve Brighton and Hove's environmental performance over the period 2011-15, created by the City Sustainability Partnership (the Council in conjunction with key organisations such as the NHS, University of Brighton, University of Sussex, local schools, Brighton & Hove Community and Voluntary Sector Forum, Brighton and Hove Chamber of Commerce and the South Downs National Park). Some of its key commitments and proposals for monitoring progress are set out below.

CLIMATE CHANGE STRATEGY TARGETTED OUTCOMES

Existing Buildings

Energy efficiency of homes and buildings: refurbishment (retrofit) of energy efficiency measures

- Maximise funding of measures through existing programmes
- Exploring options for Green Deal projects – with the potential to generate significant investment in the local housing stock on energy efficiency measures
- Delivery of Green Deal and Energy Company's Obligation (ECO) in the city to ensure choice and coverage to all residents in all tenures

Improved energy efficiency in the private rented sector

- Continued advice and support
- Explore availability of funding for grants and consider affordable loans option

Address fuel poverty, and impacts of excess cold and poor housing on health

- Continue to work with GP and Health professionals to improve health
- Provision of training to relevant groups of 'front-line' staff to increase awareness of fuel poverty and its impacts

Existing and new buildings

Increased use of renewable energy

- Procurement and installation of solar photovoltaics for council housing and corporate buildings
- Explore renewable heat technologies appropriate in housing linked to the Renewable Heat Incentive

New buildings

Planning policy and guidance

- Review SPD08 (2012), which sets specific standards by building size, type and use.
- Develop City Plan, which sets overall environmental performance standards for planned development
- Develop Site Allocations Development Plan Document (DPD), which sets performance standards for particular development sites in the city.

CLIMATE CHANGE STRATEGY MONITORING PROPOSALS

The climate change strategy states:

The NI 186 indicator incorporates the contribution of domestic buildings to the city's carbon footprint. This is a high-level indicator, and isn't sensitive enough to demonstrate immediate direct influence of any action taken.

Suggestions for further data development include:

- CO2 emissions per capita (former NI 186) and total emissions for domestic component
- Council Carbon Footprint (Carbon Management Programme/Carbon Reduction Commitment)
- Planning data:
  - Additional kW capacity renewable heat generating infrastructure installed in city (sustainability checklist data)
  - Additional kWh capacity of renewable electricity generating infrastructure installed.
  - New built homes delivered at Code for Sustainable Homes level 3, 4, 5 or 6
  - Number of new build non residential developments built to BREEAM Very Good/Excellent/Outstanding
  - Average $kgCO_2/m^2$/year (energy and carbon) performance of new built residential development
- Energy performance of council housing and the Council's corporate buildings PV project
- A reduction in the number of people living in fuel poverty (Indicator currently under review by

National Government) is included as a measure in the Council's Corporate Plan [2011].

- **Brighton and Hove draft City Plan Part 1 (2012)** Brighton & Hove City Council is seeking to embed sustainable development principles in their LDF. The Strategic Objectives set in the Draft City Plan Part 1 include contributing to a reduction in the ecological footprint of Brighton and Hove and championing the efficient use of natural resources and environmental sustainability, as well as ensuring design and construction excellence in new and existing buildings which responds positively to the challenges posed by local impacts of climate change. Through Policy CP8 it is proposed to require major new development to achieve CSH Level 5 or 6 (Greenfield) or BREEAM Outstanding. Additional policies on sustainable buildings, design requirements and developer contributions are also proposed in the City Plan. The City Plan policies are discussed further in Section 8.
- **Sustainable Building Design SPD08 (2008)** requires all residential planning applications involving new builds and conversions in the city to complete a Sustainability Checklist. The SPD also requires major developments to achieve zero net annual CO_2 from energy use and CSH Level 4 (Level 5 for Greenfield) for domestic development and BREEAM Excellent with minimum scores of 60% in the energy and water categories (70% for Greenfield). However, these requirements have been waived due to the recession.
- **Brighton and Hove's Housing Strategy 2009-2014 (2009)** includes the strategic goal (number 7) of reducing fuel poverty and minimising CO2 emissions and Strategic Goal 6: Work with home owners and landlords to maintain and improve the quality of their housing.
- **Brighton and Hove City Council Scrutiny Panel on Renewable Energy (2011)** made various recommendations on promoting renewable energy in the area, and including the following recommendations to which this study helps to respond: recommendation 6 (long term strategic planning): to undertake a study on renewable energy potential in the city including geographical, funding and partnership opportunities; recommendation 7, to undertake a heat mapping exercise; and recommendation 11, raising the profile of renewable energy.
- **Air Quality Management Area** - in 2008 an extended Air Quality Management Area was designated covering a significant area of the centre of the city.

3 Baseline Energy Use and CO2 emissions

The energy consumption and CO2 emissions from the existing and planned developments in Brighton and Hove over the period to 2030 have been calculated to set a baseline against which the effectiveness of potential measures can be assessed.

3.1 Current Energy Use and CO2 emissions from Buildings in Brighton and Hove

The baseline has been set as 2005, which is the first year in which Local Authority carbon emissions statistics were produced. The city's baseline annual CO2 emissions from buildings are **1,049ktCO2/yr**.

DECC Lower and Middle Level Super Output Area (LLSOA and MLSOA)[21] data on gas and electricity consumption has also been used in order to disaggregate the carbon emissions data into gas and electricity consumption. The latest energy use and emissions figures available for the city are from 2010. The headline statistics for the city for 2010 are presented in Table 2 below. It can be seen that electricity consumption is the most significant energy use for the industrial and commercial sector, whereas gas is more significant for domestic. The domestic sector accounts for the majority of the city's carbon emissions from buildings, 57%, compared to a national average of 47% and regional of 51% (2010 figures).

The change in CO2 emissions in Brighton and Hove between 2005 and 2010 is shown in Figure 2, and the split between sectors is shown in Figure 3. It can be seen that emissions have been recorded as falling over the period 2005-2009 and increasing slightly in 2010, reflecting a national increase in the same year. DECC have attributed this rise to particularly cold winter months at the start and end of the year causing an increase in gas use for heating, and greater use of fossil fuels (coal and gas, with a decrease in nuclear) to generate electricity.

It should be recognised that the baseline set for Brighton and Hove does not cover all of the CO2 emissions that result from direct and indirect activity within the city. Some of these other sources of emissions include:

- Emissions from waste and transport. These are not covered by this study, which focuses only on buildings.
- 'Scope 3' emissions - emissions which are a consequence of activity within Brighton and Hove but which occur at sources owned or controlled by other entities, for example

[21] Lower Layer and Middle Layer Super Output Areas – statistical geographies developed by ONS for the 2001 census to be as consistent in population size as possible – each LLSOA includes a population of around 1500, whereas other geographical units (e.g. wards) vary greatly in population numbers. MLSOAs are built from groups of LLSOAs and each include a population of around 7200.

emissions associated with the whole lifecycle of products or activities;

- Non- CO_2 greenhouse gas emissions – the study follows the reporting methodology used by DECC in their carbon emission statistics for local authorities, from which Brighton and Hove's baseline is derived, and only assesses CO_2. CO_2 accounts for around 85% of the UK's total greenhouse gas emissions (weighted by global warming potential - measured in CO_2eq).

A baseline for the Council's own emissions has also been set based on data provided by the Council on their electricity, gas and oil consumption in 2011-2012; a total of around **31.8ktCO2/yr**, with the majority of emissions from electricity use.

Sector	Gas Use (GWh/yr)	Electricity Use (GWh/yr)	Gas CO_2 (kt/yr)	Electricity CO_2 (kt/yr)	Other Fuels CO_2 (kt/yr)	Total CO_2 (kt/yr)	% Total CO_2	% Total CO_2 - SE average	% Total CO_2 - UK average
Domestic	1,456	477	300	244	8	553	57%	53%	48%
Industrial & Commercial	498	587	103	294	17	414	43%	47%	52%
Total ($ktCO_2$/yr)						967			

Table 2: Latest statistics on energy consumption and CO2 emissions from buildings (gas and electricity use) in Brighton and Hove 2010. Sources: DECC, Local and regional CO2 emissions estimates for 2005-2010 (released 23/08/12); DECC, MLSOA and LLSOA electricity and gas consumption data 2010 (released March 2012)

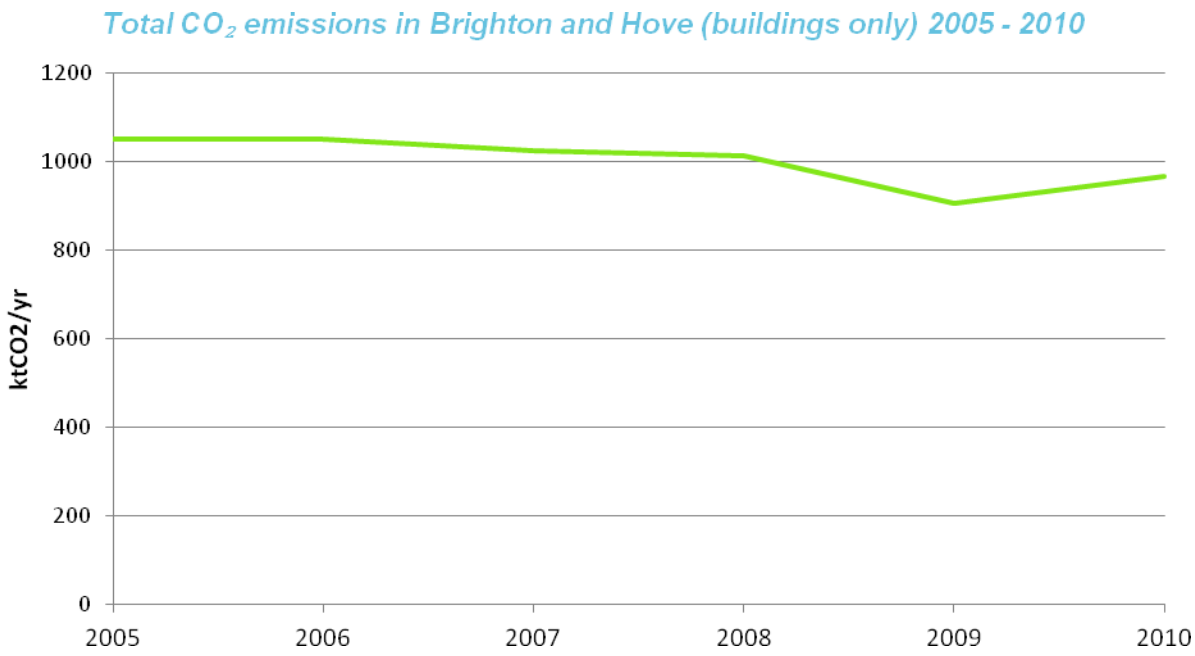


Figure 2: Brighton and Hove CO2 emissions from buildings 2005-2010

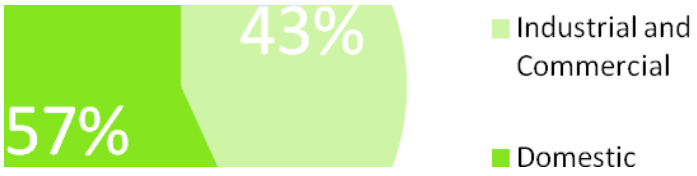


Figure 3: Brighton and Hove CO2 emissions from buildings by sector

3.2 Projecting Emissions to 2012

As there is around a two year time lag before energy consumption and carbon emissions data is produced, the latest data available is for the year 2010. To estimate progress to 2012, trends in energy consumption over the years 2005-2010 were assessed and extrapolated forward. Projected electricity and gas emission factors were also applied, as explained in Section 4. This resulted in a total emissions figure for 2012 of **877ktCO2** – a reduction of around **120ktCO2** compared to the 2005 baseline, representing a 16% reduction.

Energy consumption has reduced over 2005-10 and these trends are projected forwards to 2012, and projected emission factors are applied for 2011 and 2012. Should emissions statistics for the years 2010-2012 be significantly different from these projections this will need to be taken into account. There is a decrease in emissions due to the switch from one set of emission factors to another which may overestimate savings over the period 2010-12.

3.3 Emissions from New Development

In order to project the baseline forwards beyond 2012 it was necessary to take into account the additional impact of new development in the city. Other than this, the baseline emissions from buildings were assumed to remain constant to 2030.

The energy consumption and CO2 emissions from proposed development in Brighton and Hove have been based on strategic development area projections provided by Brighton & Hove City Council in the draft City Plan Part 1 and further assumptions made by AECOM on the timings and likely size of new development (where not indicated in the City Plan). AECOM has modelled the emissions from this new development using an in-house model which includes assumptions on future Building Regulations limits on CO2 which the developments will be expected to meet. Emissions factors were initially set to 2012 levels over the entire period, so that the impact of grid decarbonisation could be taken into account separately.

DEVELOPMENT TYPE	DEVELOPMENT AREA (sqm)				CARBON EMISSIONS (tCO_2/yr)	
	2013 - 2015	2016 - 2018	2019 - 2030	*Total*	Regulated by 2030	Unregulated by 2030
Flats	54,180	55,680	204,180	*314,040*	951	9,201
Mid-Terrace	34,560	31,600	127,920	*194,080*	573	4,651
Semi-Detached	41,200	38,000	152,800	*232,000*	754	5,560
Detached	25,560	33,120	102,240	*160,920*	447	3,139
Warehouse	0	0	10,000	*10,000*	0	46
Office	14,711	47,400	92,296	*154,407*	1,290	3,638
Hotel	0	1,800	1,200	*3,000*	113	59
General Retail	1,333	15,300	11,367	*28,000*	617	282
Multi-Residential	5545	9818	14636	*30,000*	70	1136
Hospital	36,000	31,000	7,000	*74,000*	1,803	2,589
Community/Leisure	7,070	31,604	31,625	*70,300*	657	682
Schools	364	5,945	4,691	*11,000*	106	107
TOTAL	**220,523**	**301,268**	**759,956**	***1,281,746***	**7,732**	**31,091**
Total CO_2 (tCO_2/yr)					**38,823**	

Table 3: Potential CO2 emissions from new developments in Brighton and Hove - based on data in the draft City Plan Part 1, 2012 and assumptions made by AECOM. CO□ figures are given at 2012 emission factors.

The results show that the total CO2 emissions from the potential new development emissions by 2030 are equivalent to just under 4% of the emissions from the existing buildings in the city – these figures are shown in Table 4. This impact is even less (under 3%) once grid decarbonisation is taken into account. The impact of new development on baseline CO2 emissions is shown in Figure 4.

	CO2 emissions (kt/yr)
Existing CO2 emissions from the existing building stock (2005)	1,049
Estimated CO2 emissions from new development in 2030 (at 2012 emission factors)	39

Table 4: Emissions from New Development Compared to Emissions from Existing Development

Brighton and Hove's Baseline Emissions from Existing Buildings and Impact of Emissions from New Development

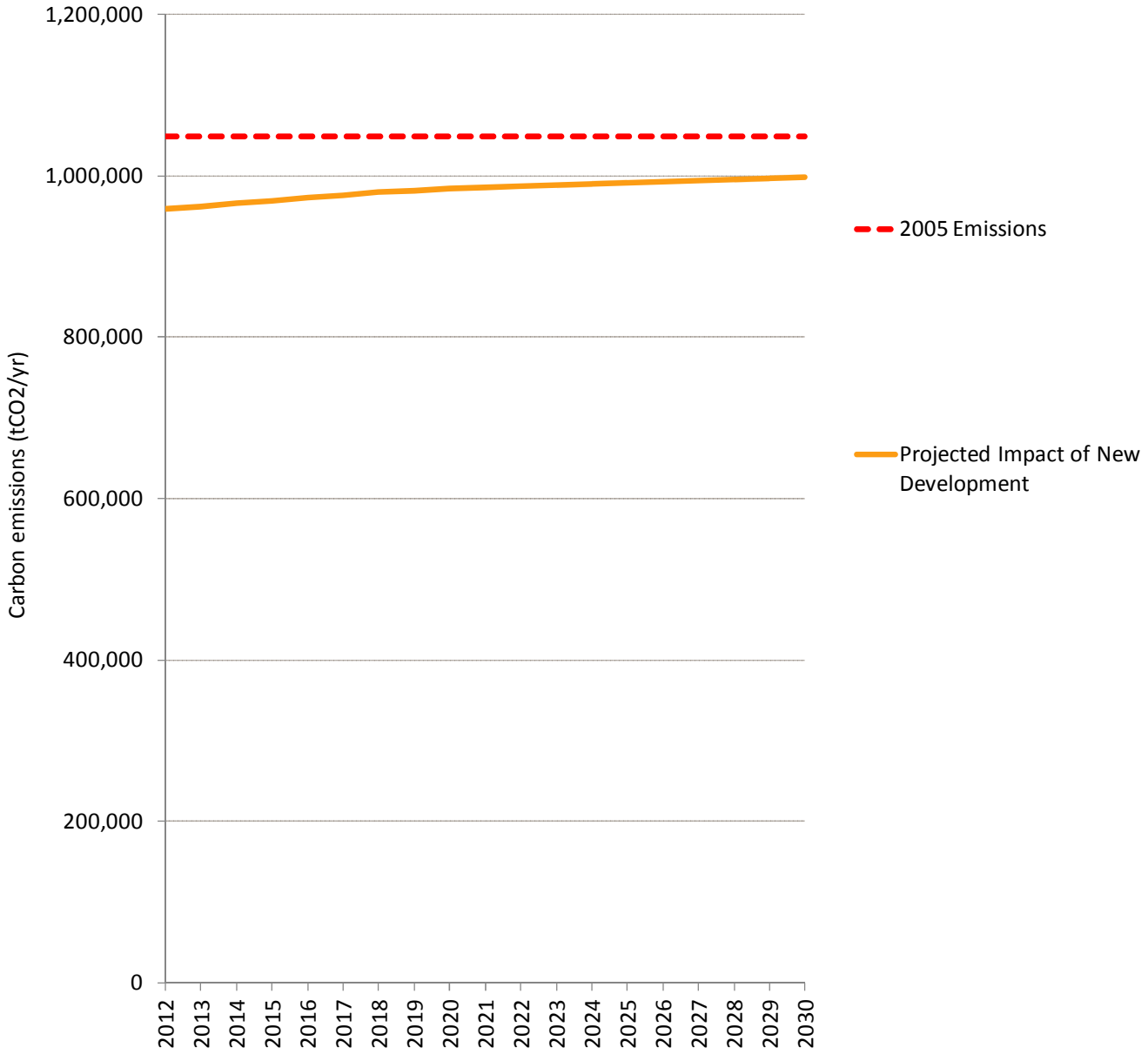


Figure 4: Projected impact of emissions from new development compared to baseline

3.4 Mapping Brighton and Hove's Energy Consumption and CO_2 Emissions

The figures on the following pages show Brighton and Hove's gas and electricity consumption and carbon emissions mapped across the city, using DECC LLSOA and MLSOA data for 2010, to give an indication of where energy use is concentrated in the city. Currently data is only available at a fairly high level with no breakdown below the LLSOA or MLSOA level.

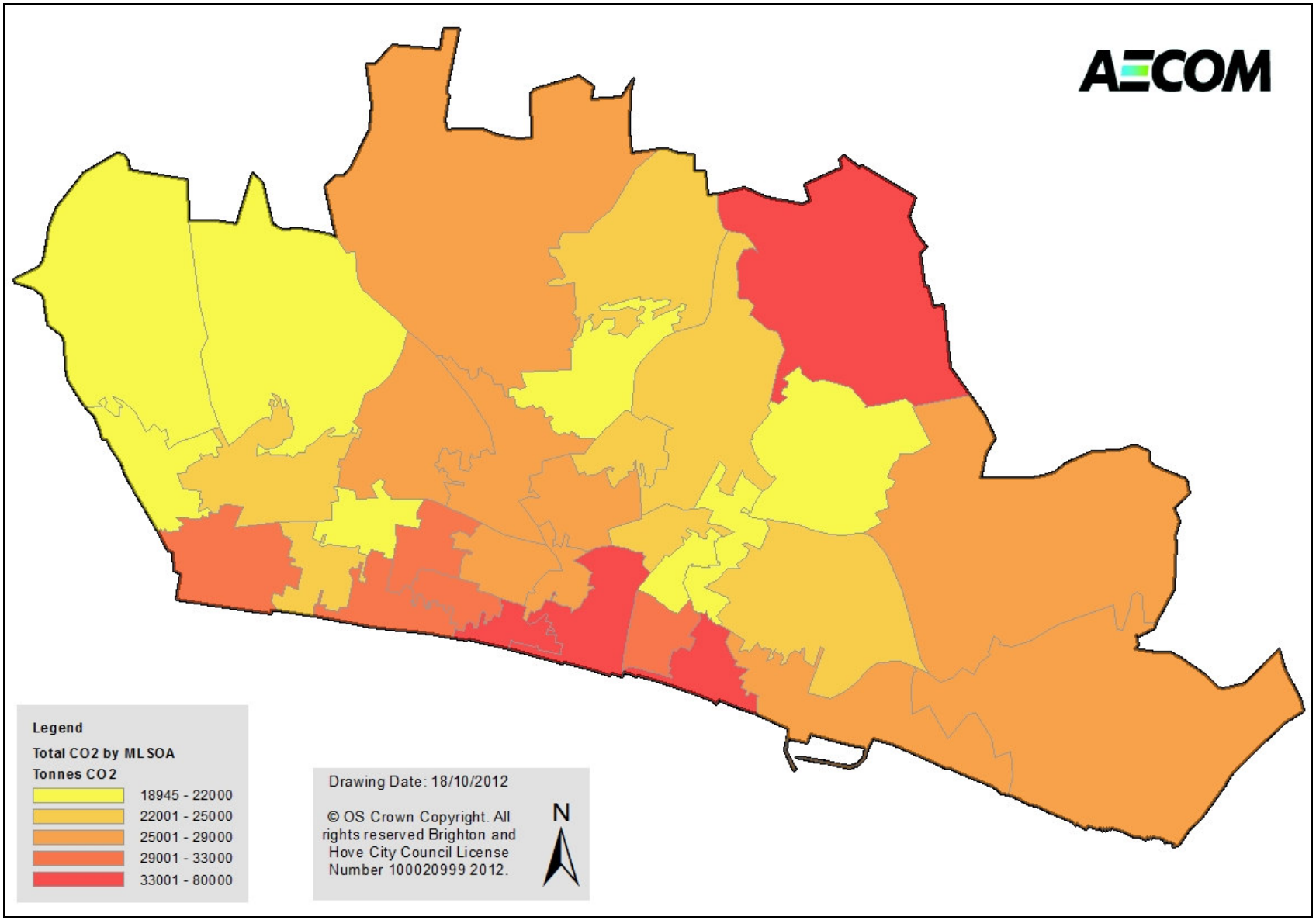


Figure 5: Brighton and Hove total gas and electricity CO2 emissions by SOA - based on DECC LLSOA and MLSOA statistics 2010

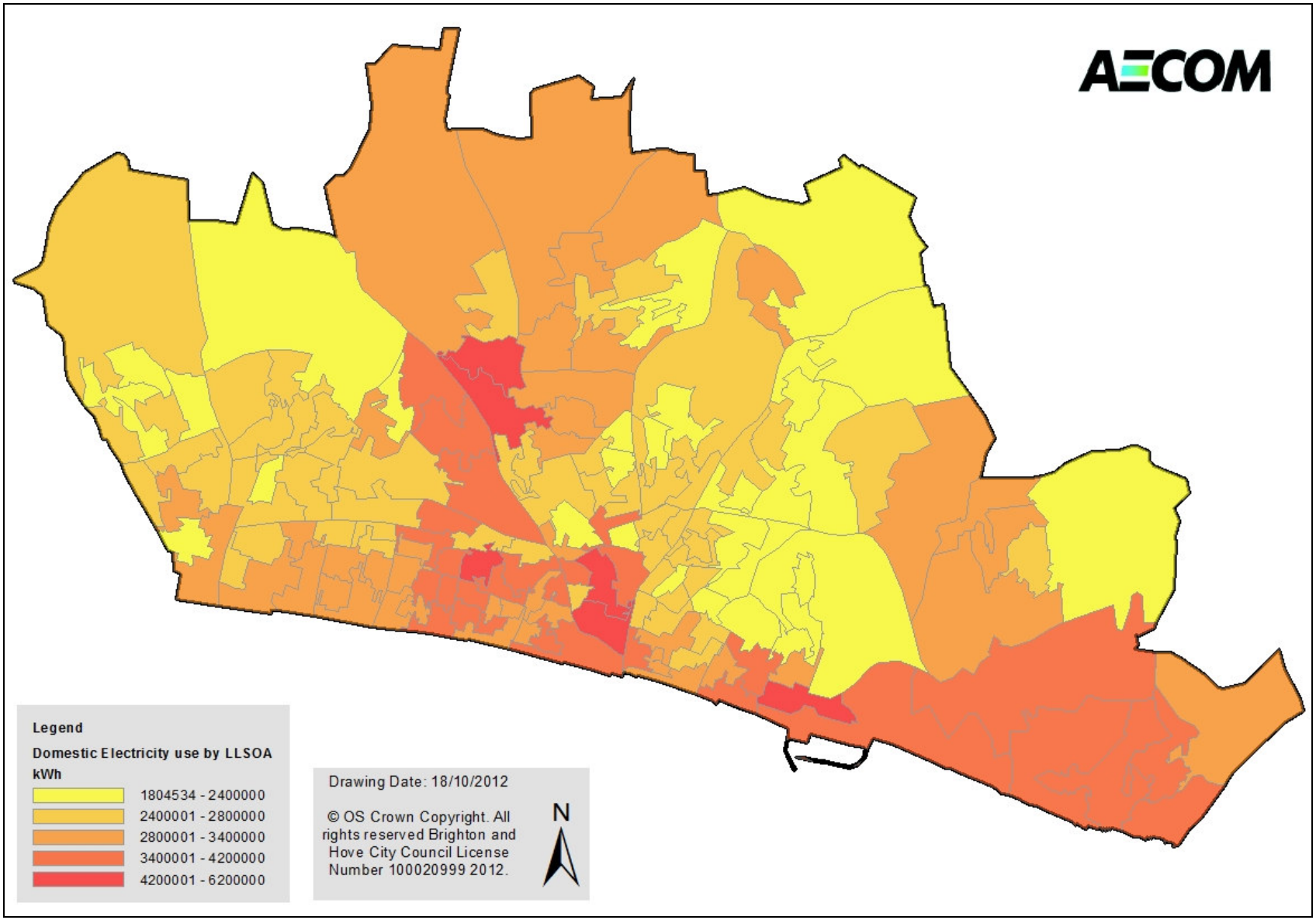


Figure 6: Brighton and Hove domestic electricity use by SOA - based on DECC LLSOA domestic electricity consumption statistics 2010

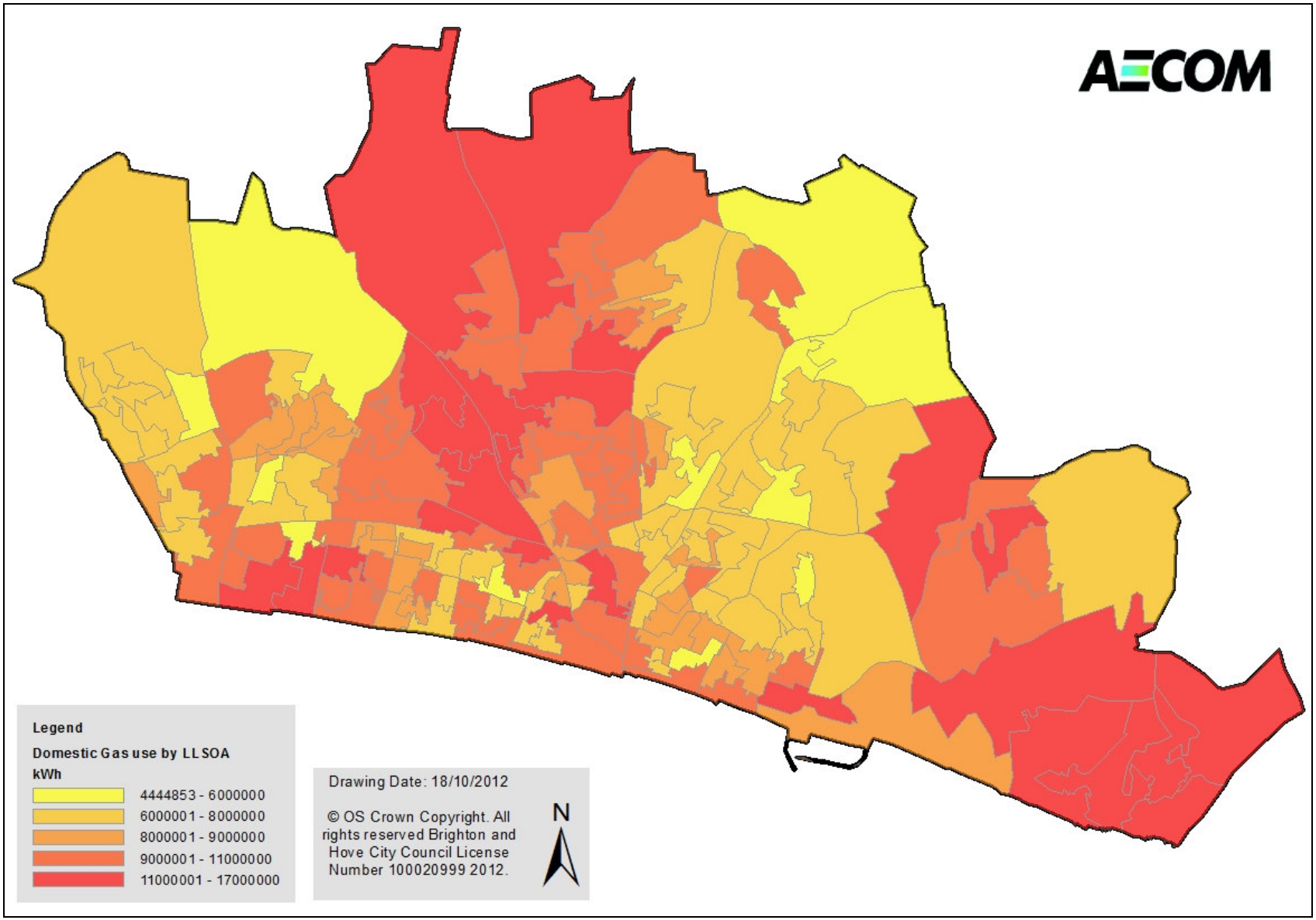


Figure 7: Brighton and Hove domestic gas use by SOA - based on DECC LLSOA domestic gas consumption statistics 2010

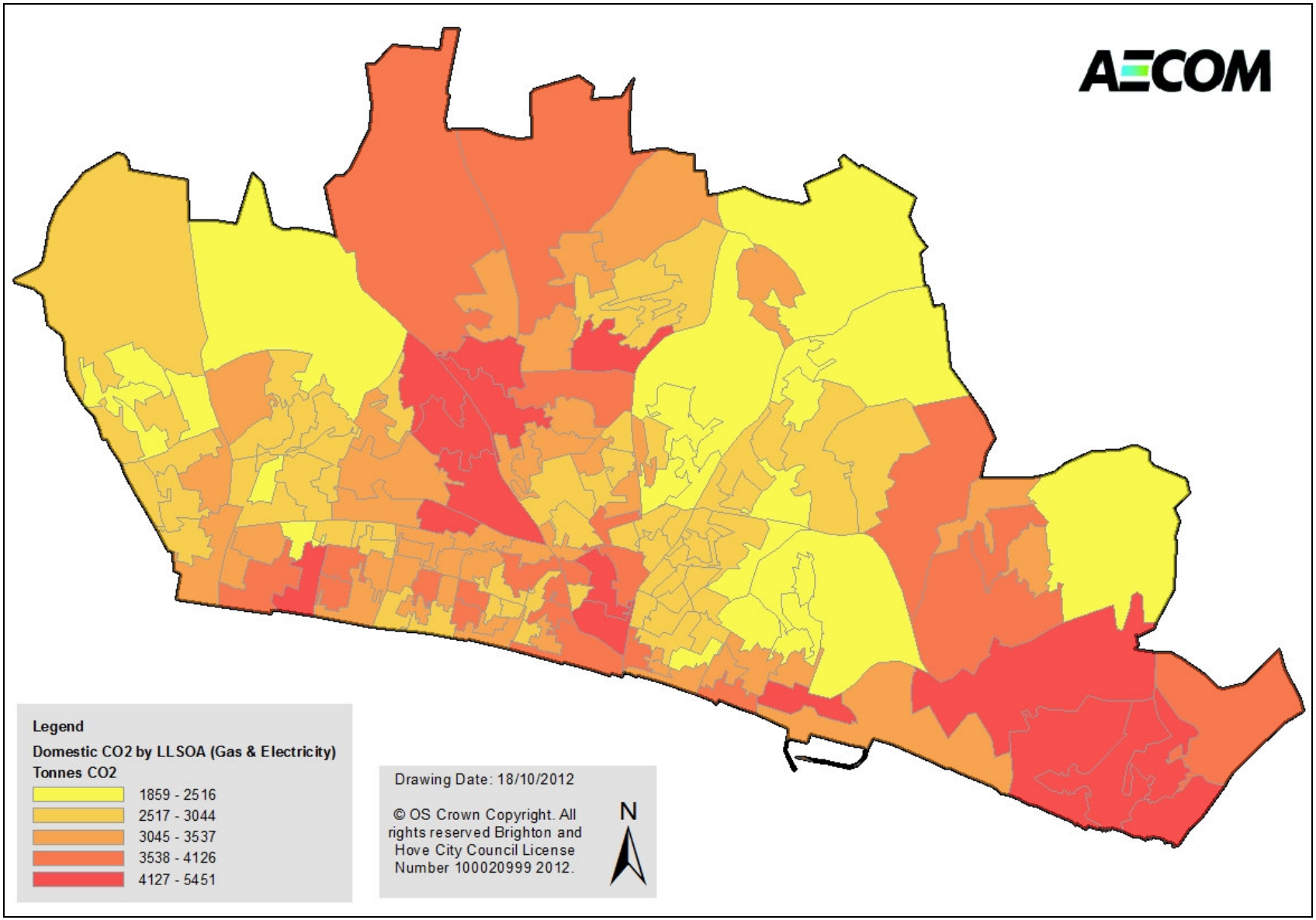


Figure 8: Brighton and Hove domestic CO2 emissions by SOA - based on DECC LLSOA domestic gas and electricity consumption statistics 2010

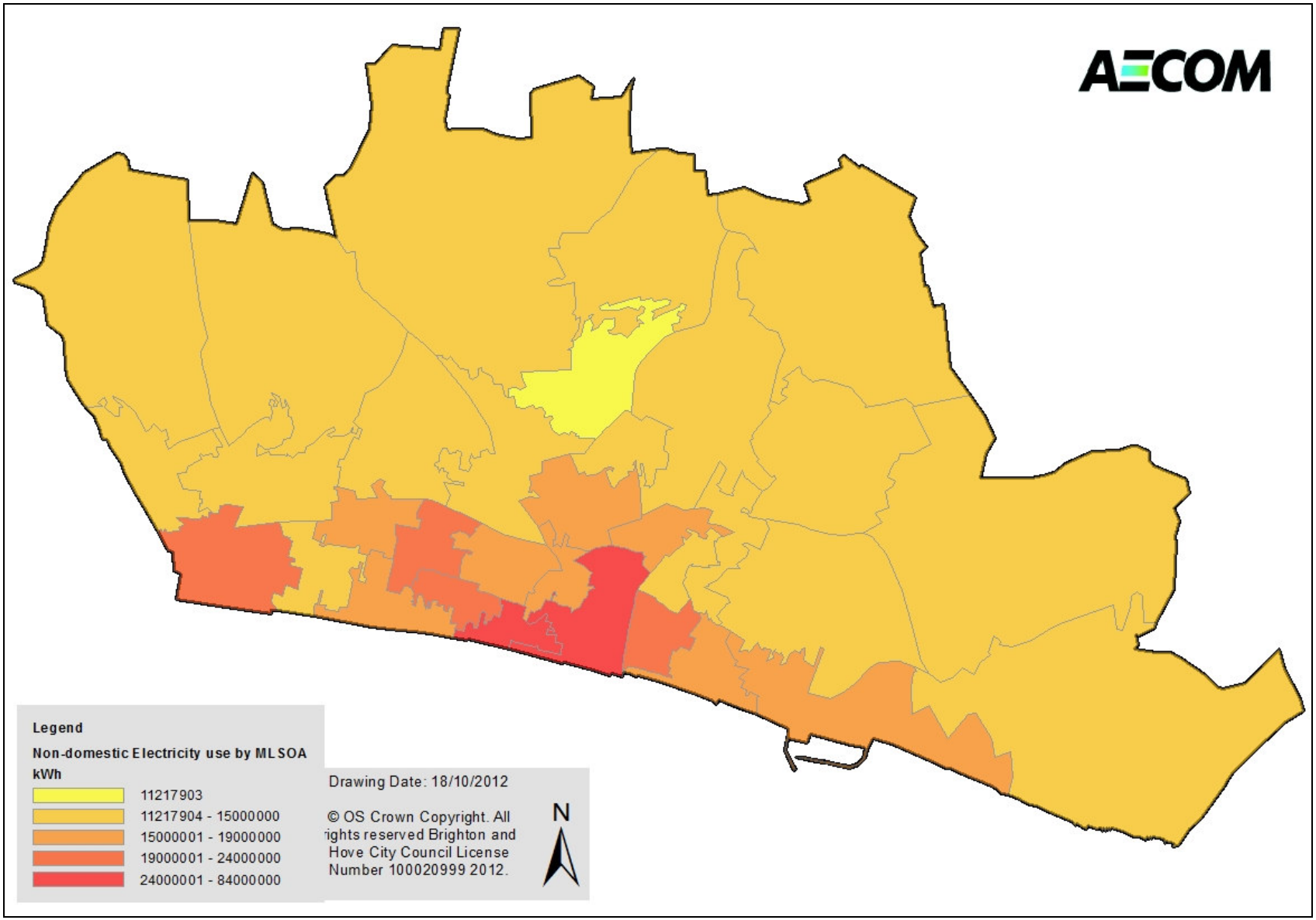


Figure 9: Brighton and Hove non-domestic electricity use by SOA - based on DECC LLSOA non-domestic electricity consumption statistics 2010

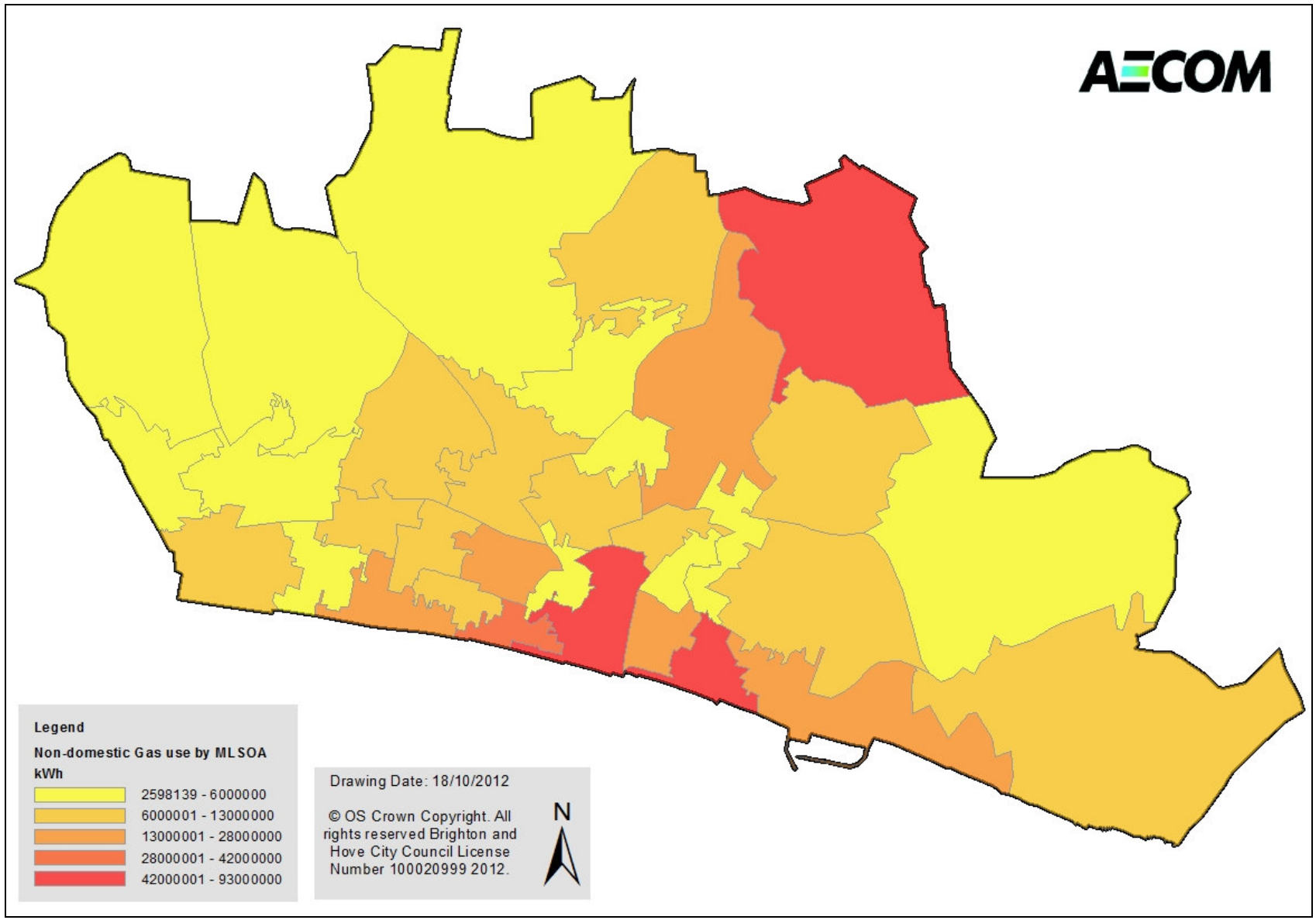


Figure 10: Brighton and Hove non-domestic gas use by SOA - based on DECC LLSOA non-domestic gas consumption statistics 2010

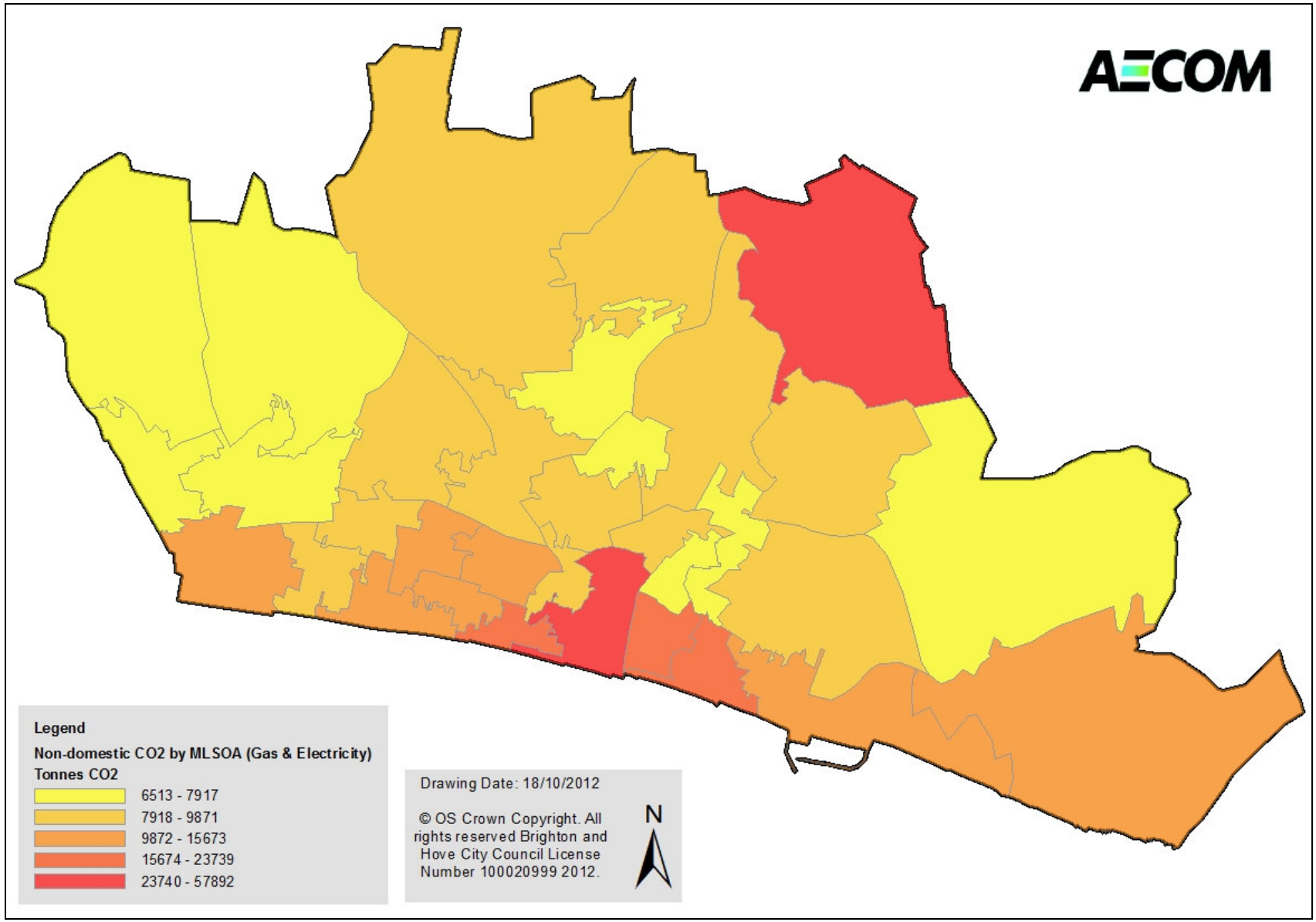


Figure 11: Brighton and Hove non-domestic CO2 emissions by SOA - based on DECC MLSOA gas and electricity consumption statistics 2010

4 Impact of National Action

The effect of national policies and strategies to decarbonise the supply of electricity from the national grid is projected to deliver a significant reduction in the local CO2 emissions for over the period to 2030. Various projections have been assessed in order to determine the likely impact for the future CO2 emissions in Brighton and Hove.

4.1 Introduction

The most significant and predictable CO2 emissions reductions from action taken at the national level will come from the decarbonisation of the electricity grid. Other national programmes such as the Green Deal, Feed in Tariff and Renewable Heat Incentive will be highly dependent upon local uptake and so cannot be completely separated from modelling of local action. The future electricity generation mix is expected to change, with a switch from existing fossil fuel power stations (particularly the planned closure of existing coal-fired power stations) to low and zero carbon energy generation (including renewables, new nuclear power plants and gas power plants with carbon capture and storage). This switch has implications for the use of certain technologies at the local level, such as heat pumps which rely on a decarbonised electricity grid to realise high carbon savings when compared to gas boilers – these will be discussed in following sections. The gas grid mix is assumed to remain relatively constant to 2030, though increased use of liquefied natural gas may slightly increase the carbon intensity associated with gas consumption.

This section of the report sets out the methodology and results for modelling the impact of the decarbonisation of the grid. It should be noted that all projections should be treated with some caution as they are highly dependent upon the delivery of specific amounts of different types of generation plant, all of which will be affected by political decisions and the markets, both of which are difficult to predict too far in advance with much confidence. It should be noted that national government have avoided setting a grid decarbonisation target in their 2012 Energy Bill, and have announced that no such target will be set until 2016.

4.2 Grid Decarbonisation – Emission Factor Calculation Methodology

Estimating the impact of the decarbonisation of the grid on Brighton and Hove's carbon reduction targets requires the use of projected electricity carbon emission factors. Over the period 2012-2030 the Department of Energy

and Climate Change (DECC) predict the carbon intensity of the grid to reduce, for the reasons previously described.

A series of future carbon emission factors were calculated by AECOM using the methodology set out below, based on the total expected UK power generating mix. This is possible in the near term where the generating mix is understood. In the document 'Updated energy and emissions projections 2011',[22] DECC provides predictions for a range of scenarios for the UK generating mix for the period to 2030. The main set of electricity emissions factors used has been based upon their 'Baseline' scenario which takes into account central price and growth assumptions but only policies that existed before the UK's Low Carbon Transition Plan, and assumes a certain generation mix (see Figure 12 below). It has been chosen as the scenario illustrated in this report as it provides a more conservative set of assumptions than the other scenarios tested.

Two key sources of data were used to calculate these emission factors:

1. DECC Updated energy and emission projections (baseline case projections), October 2011 – for years 2011-2030;
2. DEFRA / DECC's GHG Conversion Factors for Company Reporting, April 2012;
3. Emission factors used by AEA in the DECC Local and Regional CO2 emissions Estimates for 2005-2010, August 2012, for the years 2005-2010.[23]

To calculate emission factors from the DECC 'Updated energy and emissions projections 2011' the TWh of electricity generated were converted to fuel used using DUKES power station efficiency data (including 7% losses associated with transmission and distribution) and converted to carbon emissions equivalent using the DEFRA / DECC CO2 emission factors for coal, gas and oil. The average emissions factor was then calculated based on the weighted average emission factors of the fossil fuel all the plant predicted to be built. This included renewables as well as gas.

Gas emission factors have also been based on the DECC Local and Regional CO2 emissions Estimates factors.

Two alternative scenarios were also taken for electricity factors to provide some sensitivity analysis: DECC's 'Central' scenario which

[22] http://www.decc.gov.uk/assets/decc/11/about-us/economics-social-research/3134-updated-energy-and-emissions-projections-october.pdf

[23] http://www.decc.gov.uk/en/content/cms/statistics/climate_stats/gg_emissions/laco2/laco2.aspx

assumes that all carbon reduction policies which the government is committed to are implemented and assumes a different generation mix with greater use of nuclear and renewable energy generation (see Figure 13 below), and the Interdepartmental Analyst Group projections, 2011[24] which are based on the DECC Energy model which projects average electricity emissions based on a slightly different and more optimistic set of assumptions (based on a scenario to deliver the national target of an 80% reduction in CO2 emissions by 2050).

[24] http://www.decc.gov.uk/en/content/cms/about/ec_social_res/iag_guidance/iag_guidance.aspx

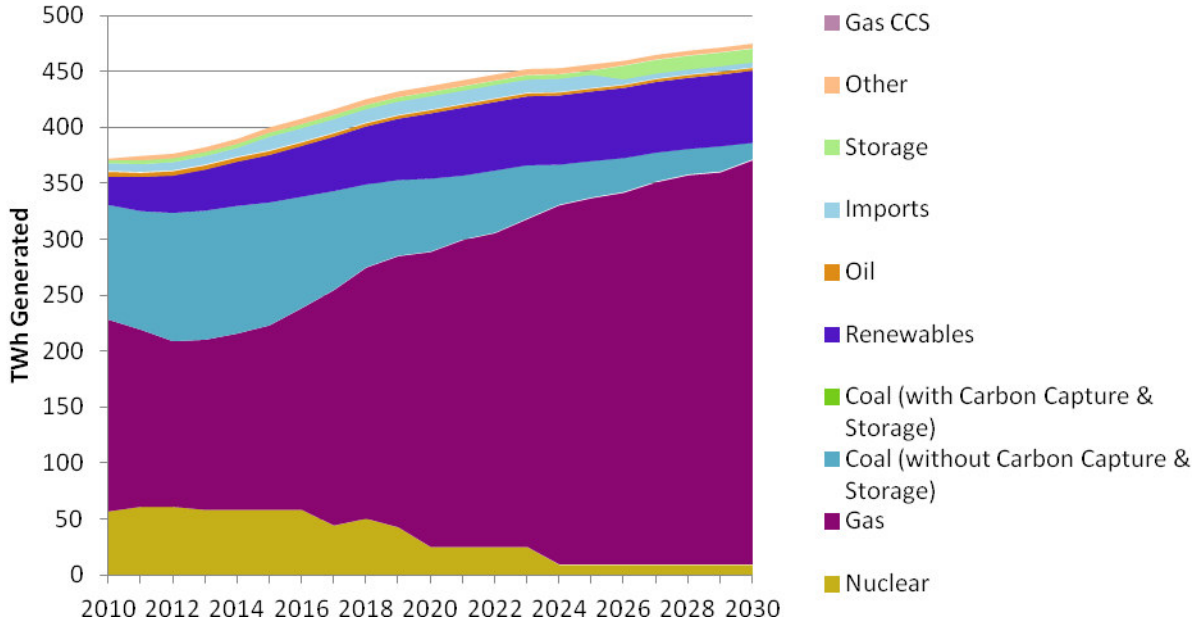


Figure 12: Electricity generation by plant type assumed under DECC Baseline scenario

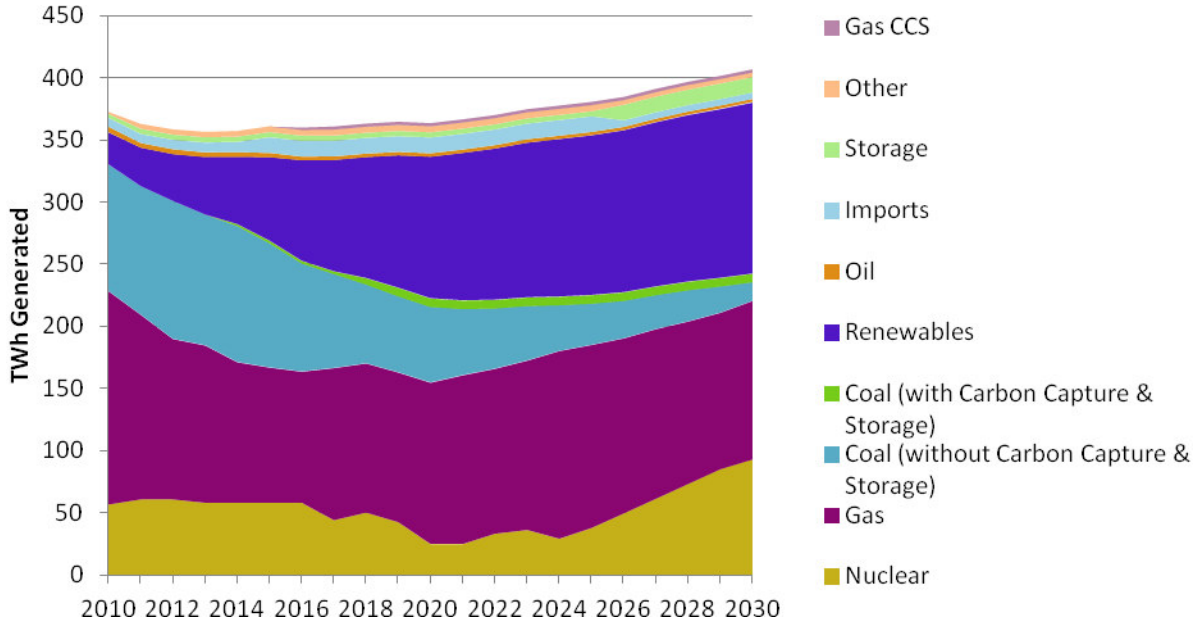


Figure 13: Electricity generation by plant type assumed under DECC Central scenario

4.3 Impact of Grid Decarbonisation in Brighton and Hove

The impact of grid decarbonisation on Brighton and Hove's baseline CO2 emissions (including new development) is shown below. The DECC Central Scenario electricity emissions factor has been selected for use in the rest of this study. This has been chosen as, according to DECC, it reflects projections that take account of climate change policies where government funding has been agreed and where decisions on policy design are sufficiently advanced to allow robust estimates of policy impacts to be made. The government currently has policies in place to reduce emissions to meet the first three carbon budgets to 2022.

Grid decarbonisation is projected to result in a very significant CO2 saving over the period 2012 to 2030, ranging from around 15% to 35% of Brighton and Hove's baseline emissions depending on the decarbonisation scenario applied. Projections for beyond 2030 anticipate that electricity emission factors will continue to drop as renewable energy, nuclear and carbon capture and storage play a greater role in the energy mix. The DECC Interdepartmental Analysts Group (IAG) data suggests an emission factor of 0.023 by 2050. As noted above, projections of future decarbonisation of the grid are very uncertain and dependent upon national government policy, so should be treated with caution and reviewed over the period covered by this study, particularly as the ability to achieve local carbon reduction targets is significantly influenced by grid decarbonisation.

Note: grid decarbonisation projections are based on the overall generation mix of all electricity on the grid. Given that a local project, such as construction of wind turbines in Brighton and Hove, would have on its own a tiny impact on the overall mix of the grid, double-counting of savings from such projects can be ignored and the savings from any local large-scale renewable energy generation have been included in Brighton and Hove's carbon reduction scenarios.

The Council can play its part in helping to decarbonise of the grid by supporting the delivery of large scale low carbon electricity generation schemes where appropriate and in line with other planning objectives.

Projected Impact of Grid Decarbonisation, Comparing DECC Scenarios

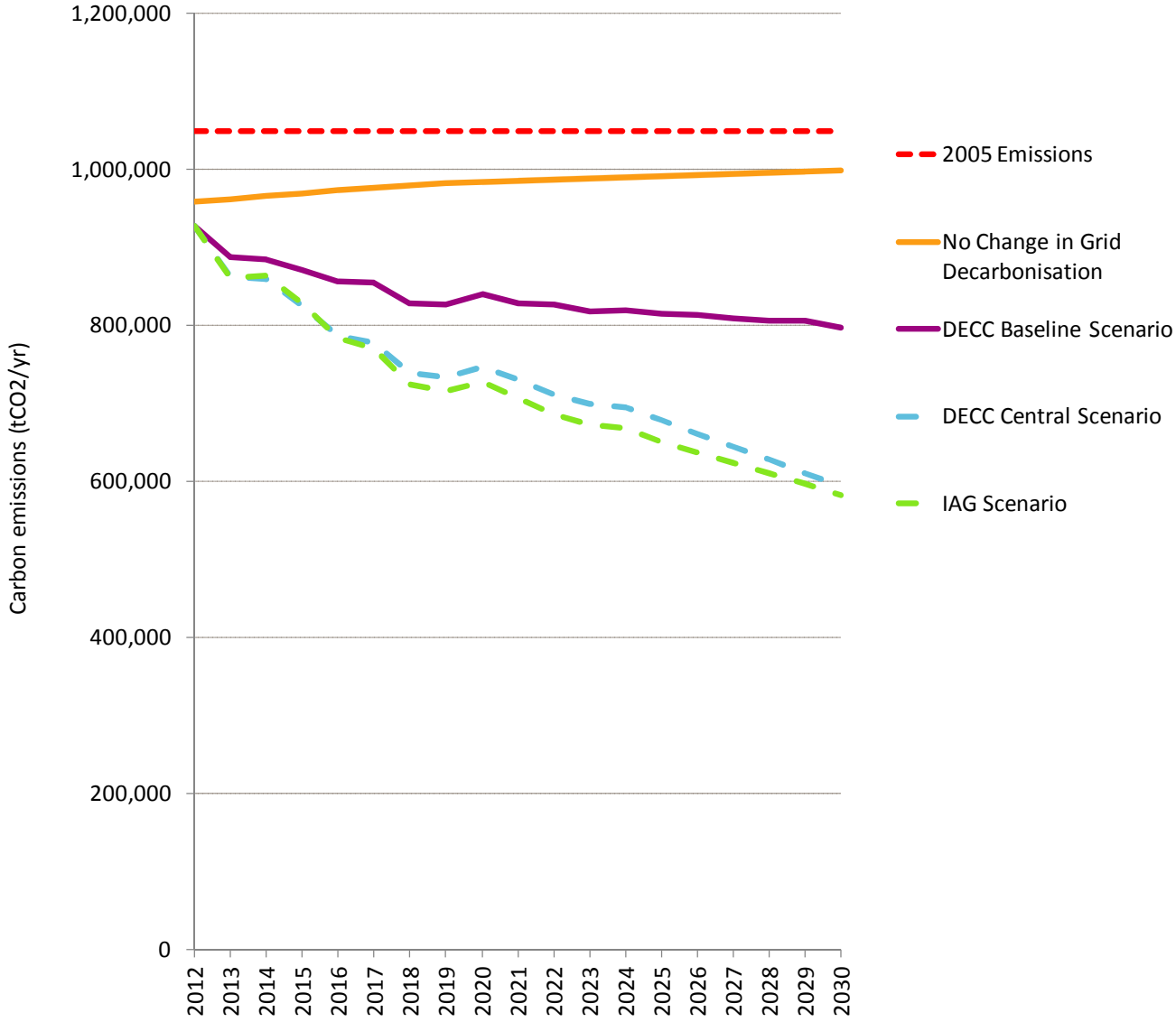


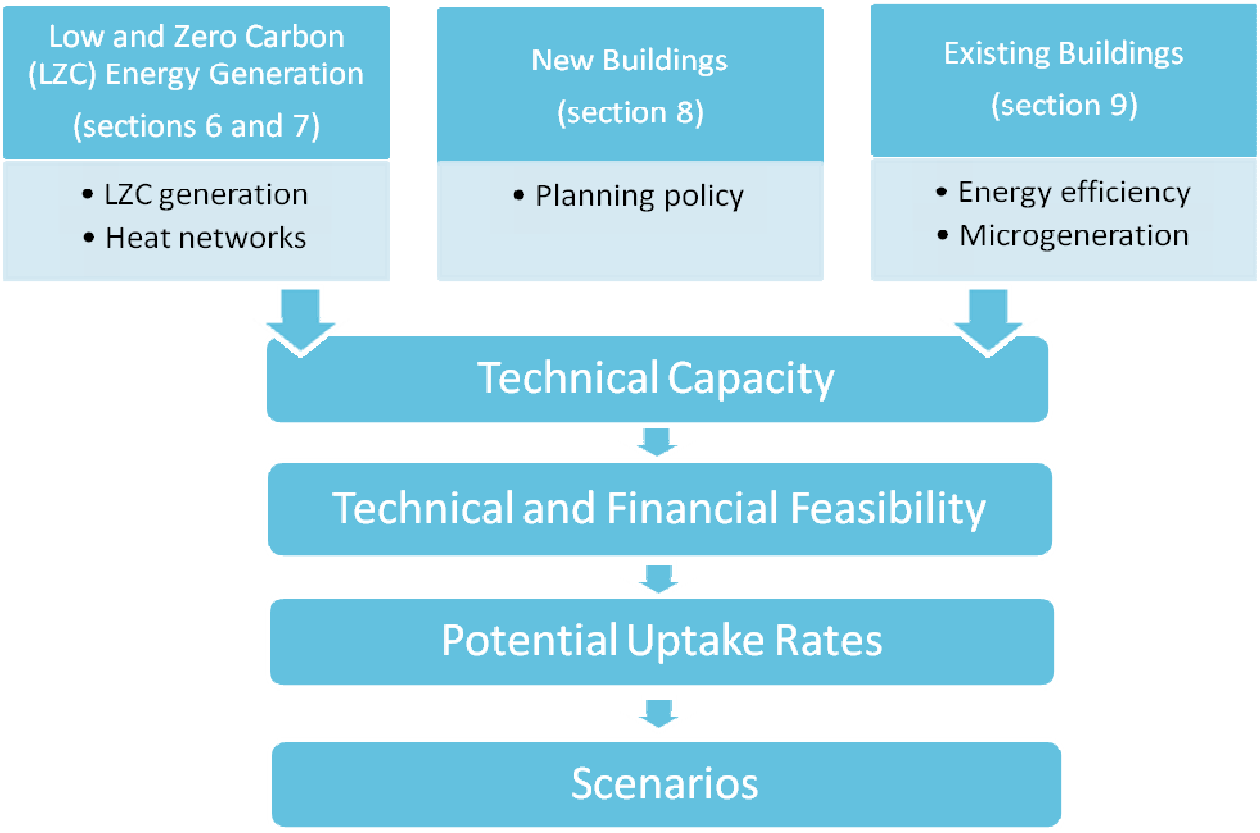
Figure 14: Projected impact of grid decarbonisation, DECC Baseline scenario and alternative scenarios. Impact is shown relative to baseline including new development

5 Introduction to Assessment of CO_2 Reduction Opportunities

Following the assessment of the impact of national and regional action on Brighton and Hove's carbon emissions, the remainder of the report focuses on the potential for action within Brighton and Hove itself. Local action is essential for national and local carbon targets to be attained. The analysis discussed in this section indicates that there is significant potential at the local level, although a significant amount of resource will also be required to deliver this potential. A wide range of possible measures have been identified and the following four sections (6 to 9) focus on their assessment, divided into the following themes:

- Low and Zero Carbon Energy Generation
- Heat Network Assessment
- New Buildings Planning Policy Assessment
- Existing Buildings Measures

The assessment covered in sections 6 to 9 all feeds into a scenario modelling tool created by AECOM to allow the generation and further assessment of overall carbon reduction scenarios for the city, presented in section 10. The methodology is shown on the following page.


Low and Zero Carbon (LZC) Energy Generation (sections 6 and 7)
• LZC generation
• Heat networks
New Buildings (section 8)
• Planning policy
Existing Buildings (section 9)
• Energy efficiency
• Microgeneration
Technical Capacity
Technical and Financial Feasibility
Potential Uptake Rates
Scenarios

6 Low and Zero Carbon Energy Generation

This section presents the results of a baseline assessment of existing and planned low and zero carbon energy generation in Brighton and Hove, as well as energy opportunities mapping undertaken for the area to identify areas of potential for various low and zero carbon energy technologies. It also discusses the results of the regional assessment of renewable energy potential undertaken for the South East by the South East Partnership Board in 2010.

5.1 Background

The UK Renewable Energy Strategy (2009), summarized in section 2, set out government proposals for achieving the national target agreed under the EU Renewable Energy Directive (2009). The overall target is for 15% of all energy used in the UK to be supplied from renewable energy sources by 2020.

In order to meet these targets, concerted action will be required to coordinate delivery of renewable and low carbon energy infrastructure and ensure that the planning system is geared up to deliver the capacity required at the rate needed.

DECC has encouraged the English regions to undertake resource assessments to understand how the regions could contribute to achieving national targets. Although spatial planning will no longer take place formally at the regional level, these assessments still have an important role to play in informing national policy. They are also an efficient and effective way of providing the evidence base for local authority spatial planning, informing practical plans for delivery of renewable and low carbon energy infrastructure, and identifying strategic energy opportunities. A study using the methodology suggested by DECC for these assessments was completed for the South East in 2010, which included analysis of the potential for renewable energy generation in Brighton and Hove over the period to 2031.

The methodology used for the energy opportunities mapping in this study follows the DECC methodology for the English regions.[25]

6.1 Existing and Planned Low and Zero Carbon Energy Generation in Brighton and Hove

A desktop-based assessment of the existing low and zero carbon energy generation installed in Brighton and Hove was undertaken based on a range of data sources. The results

[25] DECC, *Renewable and Low-carbon Energy Capacity Methodology: Methodology for the English Regions*, 2010

of this assessment are presented in Table 5 and the sources used are shown in Table 6. There are limited data sources recording the installation of microgeneration. In the absence of comprehensive data, figures from Ofgem's Feed In Tariff database have been presented, and some examples of microgeneration installations in Brighton and Hove are given separately in Table 7. It should be noted that the PV and wind examples are likely to overlap with the figures from Ofgem as these technologies are covered by the Feed in Tariff.

It can be seen that there are relatively few large scale low and zero carbon energy installations in Brighton and Hove. The largest existing identified installation is the gas CHP plant at the University of Sussex. Other than several medium-scale biomass and gas CHP plants, including some with district heating, installations are limited to the small scale, although a very large offshore wind farm is currently proposed by EON at Rampion c.13km off the coast.

Type	Name	Total Installed Generating Capacity (MWe)	Source
Larger Installations, CHP and Biomass			
Existing/On Site			
Biomass	One Brighton	0.500	BHCC Sustainability Achievements May 2012
Biomass	Brighton Aldridge Community Academy	0.550	BHCC Sustainability Achievements May 2012
Biomass	Stanmer Earthship	0.015	BHCC Sustainability Achievements May 2012
District Heating (DH)	Brighton General, Elm Grove	Unknown	BHCC
Gas boiler DH	Brighton University, Cockcroft Building	Unknown	BHCC
Gas CHP	Sainsburys Brighton	0.321	DECC CHP database
Gas CHP	Amex House	0.300	BHCC Sustainability Achievements May 2012
Gas CHP	Portslade Aldridge Community Academy, Chalky Road Portslade	Unknown	Planning Register BH2011/02824
Gas CHP	Brighton University, Falmer site	Unknown	BHCC
Gas CHP	Patching Lodge Park Street	Unknown	BH2006/03952 and BH2008/02769
Gas CHP	William Moon Lodge The Linkway Brighton	Unknown	BH2007/02692
Gas CHP and DH	University of Sussex	1.160	DECC CHP database
Gas CHP and DH	Varley Halls of Residence, University of Brighton	0.2	Planning Register BH2010/00235
Gas DH	Royal Alexandra Quarter (Former Royal Alexandra Hospital site, 57 Dyke Road)	Unknown	BH2010/03379
Gas micro CHP, communal heating	331 Kingsway, Hove	Unknown	Planning Register BH2011/00227
Planned			
Biomass	The Keep, Woollards Field	0.300	BHCC Sustainability Achievements May 2012
Biomass and Communal Heating	Maycroft & Parkside, London Road, Patcham	0.12	Planning register BH2011/03358

Gas CCHP and DH	Royal Sussex County Hospital 3T's	3	Planning register BH2011/02886
Offshore Wind	Rampion	665	Renewables Map UK
Microgeneration			
Existing			
Micro CHP	Range of existing buildings	0.002	Ofgem Feed in Tariff Installation report 30 June 2012
Micro Wind	Range of existing buildings	0.010	Ofgem Feed in Tariff Installation report 30 June 2012
PV	Range of existing buildings	1.502	Ofgem Feed in Tariff Installation report 30 June 2012

Table 5: Existing and planned low and zero carbon energy generation in Brighton and Hove (October 2012)

Type	Name	Total Installed Generating Capacity (MWe)	Source
Microgeneration Examples			
Existing/On Site - examples (note PV and Wind figures may be double counted with FIT figures)			
Biomass	Stanmer Earthship	0.015	BHCC Sustainability Achievements May 2012
Biomass	Lloyd Close Hove	0.01	Eco Open Houses
Biomass	Falmer Academy	Unknown	Brighton and Hove City Council Energy Team
GSHP	BHASVIC College 205 Dyke Road Hove	Unknown	BH2008/01113
GSHP	Wellsbourne Centre Whitehawk Road Brighton	Unknown	BH2009/03156
GSHP	Balfour School	Unknown	BHCC Sustainability Achievements May 2012
GSHP	Longhill School	0.08	BH2009/00737
GSHP	West Hove Infants School	Unknown	Brighton and Hove City Council Energy Team
GSHP	Westergate House Westergate Road Brighton	Unknown	BH2004/00895/FP
GSHP	Balfour Junior School	Unknown	Brighton and Hove City Council Energy Team
ASHP	Goldstone Primary School	Unknown	Brighton and Hove City Council Energy Team
ASHP	Queens Park Primary School	Unknown	Brighton and Hove City Council Energy Team
ASHP	Whitehawk Primary School	Unknown	Brighton and Hove City Council Energy Team
ASHP	Whitehawk Library and Social Services	Unknown	Brighton and Hove City Council Energy Team
ASHP	Somerhill Junior School	Unknown	Brighton and Hove City Council Energy Team
PV	Mile Oak Primary School	Unknown	Brighton and Hove City Council Energy Team
PV	Portslade Infant School	Unknown	Brighton and Hove City Council Energy Team
PV	Cardinal Newman School	Unknown	Brighton and Hove City Council Energy Team
PV	331 Kingsway, Hove	0.013	Planning Register BH2011/00227

PV	Fairway Trading Estate	0.061	BH2009/03155
PV	Pioneer House, Bustead Close	0.010	BH2009/02911
PV	Former Nurses Accommodation Brighton General Hospital Pankhurst Avenue Brighton	0.014	Planning Register BH2010/01054
PV	Brighton University, Cockroft Building	0.044	Carbon Management Plan
PV	Amex House	0.036	BHCC Sustainability Achievements May 2012
PV	One Brighton	0.009	BHCC Sustainability Achievements May 2012
PV	Stroudely Road, NEQ	0.011	BH2010/00523
PV	Stanmer Earthship	0.001	Brighton & Hove Eco Open Houses
PV	Lloyd Close Hove	0.004	Eco Open Houses
PV	City Park Hove	0.033	Planning Register BH2012/00114
PV	Queen's Road	0.005	BH2005/051542
PV	Hollingdean Materials Recovery Facility	0.003	BH2006/00900
PV	Shoreham Port, St George's Church Kemptown, City Coast Church Portslade	0.12MW total	Brighton Energy Cooperative website
PV	Dorothy Stringer School	Unknown	Brighton and Hove City Council Energy Team
SHW	Cardinal Newman School	Unknown	Brighton and Hove City Council Energy Team
SHW	Whitehawk Library and Social Services	Unknown	Brighton and Hove City Council Energy Team
SHW	Whitehawk Primary School	Unknown	Brighton and Hove City Council Energy Team
SHW	Goldstone Primary School	Unknown	Brighton and Hove City Council Energy Team
SHW	Gala Bingo Hall & Adjacent Car Park 193 Portland Road Hove	119sqm	BH2011/02263
SHW	County Oak Medical Centre, County Oak Avenue	144sqm (est)	BH2005/06811
SHW	Brighton Aldridge Community Academy	17sqm	BHCC Sustainability Achievements May 2012
SHW	Gladstone Row, Stroudley Road, NEQ (21 Townhouses)	42sqm?	Eco Open Houses
SHW	Stanmer Earthship	3sqm	Brighton & Hove Eco Open Houses
SHW	Lloyd Close Hove	0.006	Eco Open Houses
SHW	Davigdor School	20sqm (est)	BH2008/02655

SHW	Jurys Inn	Unknown	BHCC Sustainability Achievements May 2012
SHW	Longhill School	Unknown	BH2009/00737
SHW	Dorothy Stringer School	Unknown	Brighton and Hove City Council Energy Team
SHW	Somerhill Junior School	Unknown	Brighton and Hove City Council Energy Team
SHW	50 Brunswick Place	Unknown	BH2006/02390
SHW	Balfour Junior School	Unknown	BH2008/02641
Wind	Stanmer Earthship	0.001	Brighton & Hove Eco Open Houses
Wind	Westergate House Westergate Road Brighton	0.006	BH2005/00073/CD/FP
Wind	Varndean Link College	0.006	BHCC
Wind	Woodingdean Business Park	0.01	BHCC
Wind	Hollingdean Materials Recovery Facility	0.002	BH2006/00900
Wind	West Hove First And Middle School Portland Road Hove, BH2006/03814	0.002	BHCC Planning Register BH2006/03814
Planned			
ASHP	Range of planned developments July 2011-July 2012	0.529	BHCC Sustainability Checklist
ASHP	The Level Café, Brighton	Unknown	BHCC Sustainability Achievements May 2012
ASHP	NEQ Block J, New England Square Office development	0.160	BH2010/03999
Biomass	Planned development July 2011-July 2012	Unknown	BHCC Sustainability Checklist
Earth Ducts	The Astoria	Unknown	BHCC Sustainability Achievements May 2012
Gas CHP	Range of planned developments July 2011-July 2012	0.03	BHCC Sustainability Checklist
GSHP	Planned development July 2011-July 2012	Unknown	BHCC Sustainability Checklist
PV	Range of planned developments July 2011-July 2012	0.090	BHCC Sustainability Checklist
PV	Royal Sussex County Hospital 3T's	0.039	BH2011/02886
PV	NEQ Block J, New England Square Housing	0.103	BH2010/03999
PV	The Engineerium, The Droveway, Hove	0.008	BH2011/00228
PV	Ainsworth House Wellington Road Brighton	0.017	BH2010/03994

PV	Hove Town Hall (BHCC)	Unknown	Brighton and Hove City Council Energy Team
PV	Moulescoomb Campus (BHCC)	Unknown	Brighton and Hove City Council Energy Team
PV	Bartholomew House (BHCC)	Unknown	Brighton and Hove City Council Energy Team
SHW	Range of planned developments July 2011-July 2012	43sqm	BHCC Sustainability Checklist
SHW	The Keep, Woollards Field	17sqm	BHCC Sustainability Achievements May 2012
SHW	The Level Café, Brighton	Unknown	BHCC Sustainability Achievements May 2012
SHW	The Astoria	36sqm	Planning Register BH2010/03759
SHW	Ainsworth House Wellington Road Brighton	0.002	BH2010/03994

Table 6: Examples of microgeneration installations in Brighton and Hove

Data Sources Used
DECC CHP database
BHCC Sustainability Achievements May 2012
Renewables Map UK - http://www.renewables-map.co.uk/
Ofgem Feed in Tariff Installation report 30 June 2012
BHCC Sustainability Checklist
DUKES Table 5.11 - Power Stations in the UK
DUKES Table 5.12 - Large Scale CHP in the UK
UK Wind Energy Database
DECC Renewable Energy Planning Database August 2012
Ofgem ROCS Accredited Stations Public Report September 2012
UK Renewables Wind Database
UK Heat Map
REA Biogas AD plants database
Biogas map - http://www.biogas-info.co.uk
Google searches for references to renewable energy installations
BHCC officer input
BHCC Planning Register

Table 7: Data sources used for low and zero carbon energy generation tables

6.2 Energy Opportunities Mapping

Potential opportunities and constraints have been mapped for a range of renewable and low carbon energy technologies. This assessment has followed the DECC methodology for regional resource assessments, supplemented by additional data and assumptions where required.[26]

The DECC methodology assesses what it describes as the "physically accessible and practically viable" resource in a region. A series of assumptions are applied to understand the extent of the natural resource and take into the account some of the major technical, physical, planning and regulatory constraints which limit the potential capacity for each technology. A separate study was undertaken by the South East Partnership Board in 2010 which followed the DECC methodology to estimate the resource capacity for the South East, including Brighton and Hove.[27] The current study does not try to reproduce those calculations but produces local energy opportunity maps based on certain stages of the same methodology.

[26] DECC, *Renewable and Low-carbon Energy Capacity Methodology: Methodology for the English Regions*, 2010

[27] SEPB, *Review of Renewable and Decentralised Energy Potential in South East England*, June 2010

The DECC methodology does not assess in depth what portion of the potential capacity identified by the mapping undertaken in this study or the resource calculations in the South East study is likely to be deliverable over this period, taking into account economic viability and practical constraints on deployment of each technology. Regardless of the 'physically available' land resource, it is likely that potential (i.e. installed capacity) will be still further reduced by non-physical constraints such as land ownership, ambition, funding, and commercial attractiveness, and may be further constrained by designations such as Air Quality Management Areas (AQMAs), Conservation Areas, and the South Downs National Park. Bottom-up assessments of potential capacity are therefore included in section 10 of this study (carbon reduction scenario development).

Technologies where the deliverable potential is particularly likely to be significantly less than the technical potential include onshore commercial scale wind power, where the impacts of the technology will need to be further explored with the South Downs National Park Authority. It is also the case for small scale wind and microgeneration, where the

uptake will largely be determined by economic viability and consumer choice rather than resource availability.

The potential for energy generation from the following sources has been mapped:

- On-shore wind (commercial and small-scale);
- Biomass (energy crops and managed woodland);
- Microgeneration and areas of potential for improvements to existing buildings;
- Low carbon heat distributed via heat networks (not covered by the DECC methodology).

Offshore technologies are excluded from this assessment, as they are outside the scope of local government responsibility. Small-scale hydro power was also investigated but no opportunity areas were identified in the area.[28]

The maps indicate the distribution of the renewable and low carbon energy resources to the extent that it is possible to map this with the available information. It should be noted that the assessment described in this report refers to the "physically accessible and practically viable resource", as defined in the DECC methodology. There are other factors not taken into account in the DECC methodology which will also constrain the resource that may be delivered by 2030. This is also true of the heat network opportunity assessment. Some of these factors are outlined below and are considered in more detail in sections 7 and 9 of this report.

There are large areas which in principle could have the potential for commercial wind power which are within the South Downs National Park. The majority of this land is owned and leased by the City Council. In practice, the suitability of commercial scale wind turbines in protected landscape areas will need to be assessed with reference to the landscape character, to identify any locations where some development may be appropriate and what form this may take. The South Downs National Park Authority (SDNPA) is the local planning authority for the whole of the South Downs National Park and is in the process of undertaking its own energy opportunities assessment. Distance from the electricity grid may also be an issue.

[28] The potential for small scale hydro power generation was assessed using a recent Environment Agency study into the potential across England and Wales: EA, *Mapping Hydropower Opportunities and Sensitivities in England and Wales: Technical Report*, 2010

There are also opportunities for energy from biomass within the South Downs National Park, including energy crops grown on land which is less productive and may not be needed for food production, animal waste and straw, and areas of woodland which may provide some wood fuel. Again these opportunities would need further investigation in cooperation with the South Downs National Park Authority. The need to explore opportunities with the SDNPA is further discussed in section 0 below. Opportunities to use the biomass for heating in Brighton and Hove may also be constrained by the city's Air Quality Management Area.

Several opportunity areas with potential for district heating have been identified. The basis for their identification and further assessment of their potential is presented in section 7. Urban areas also offer potential for building-integrated solar energy and heat pumps, while there is some potential for small scale wind linked to buildings in rural areas.

The draft energy opportunities plan for Brighton and Hove is shown in Figure 15.

Brighton and Hove Energy Opportunities Map

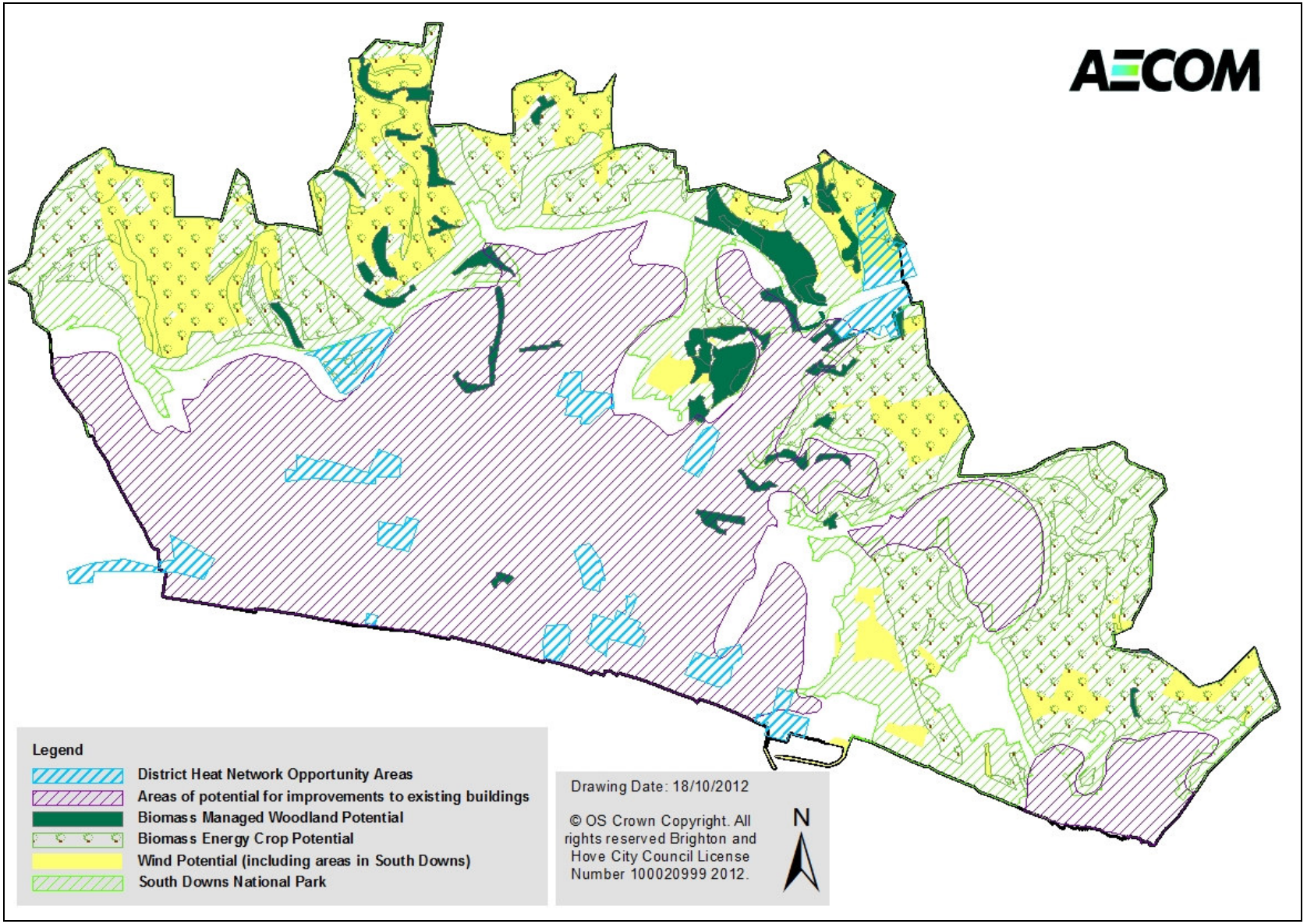


Figure 15: Energy opportunities map for Brighton and Hove

Map of Wind Speeds in Brighton and Hove at 45m

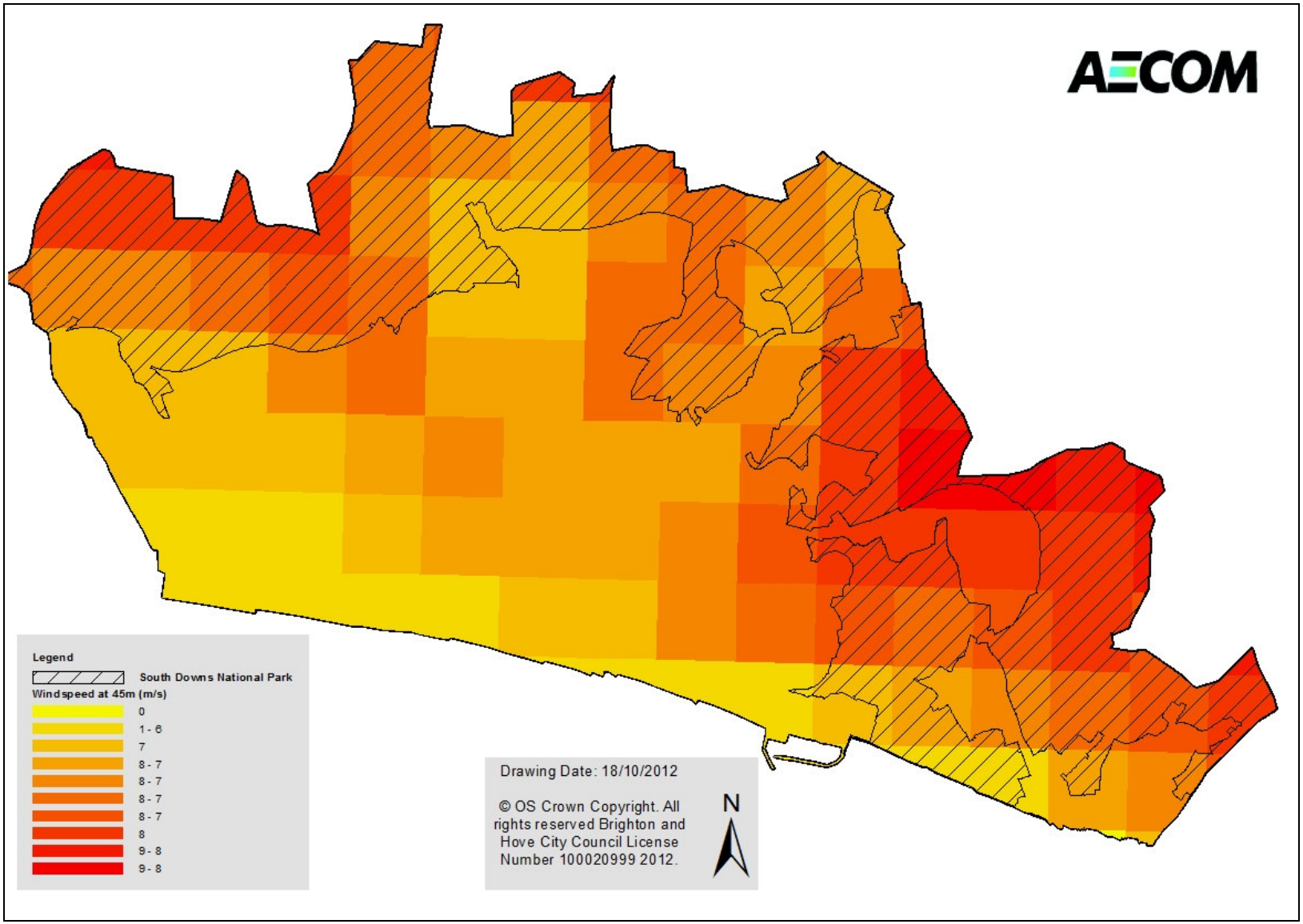


Figure 16: Wind speeds at 45m

Map of Wind Speeds in Brighton and Hove at 10m

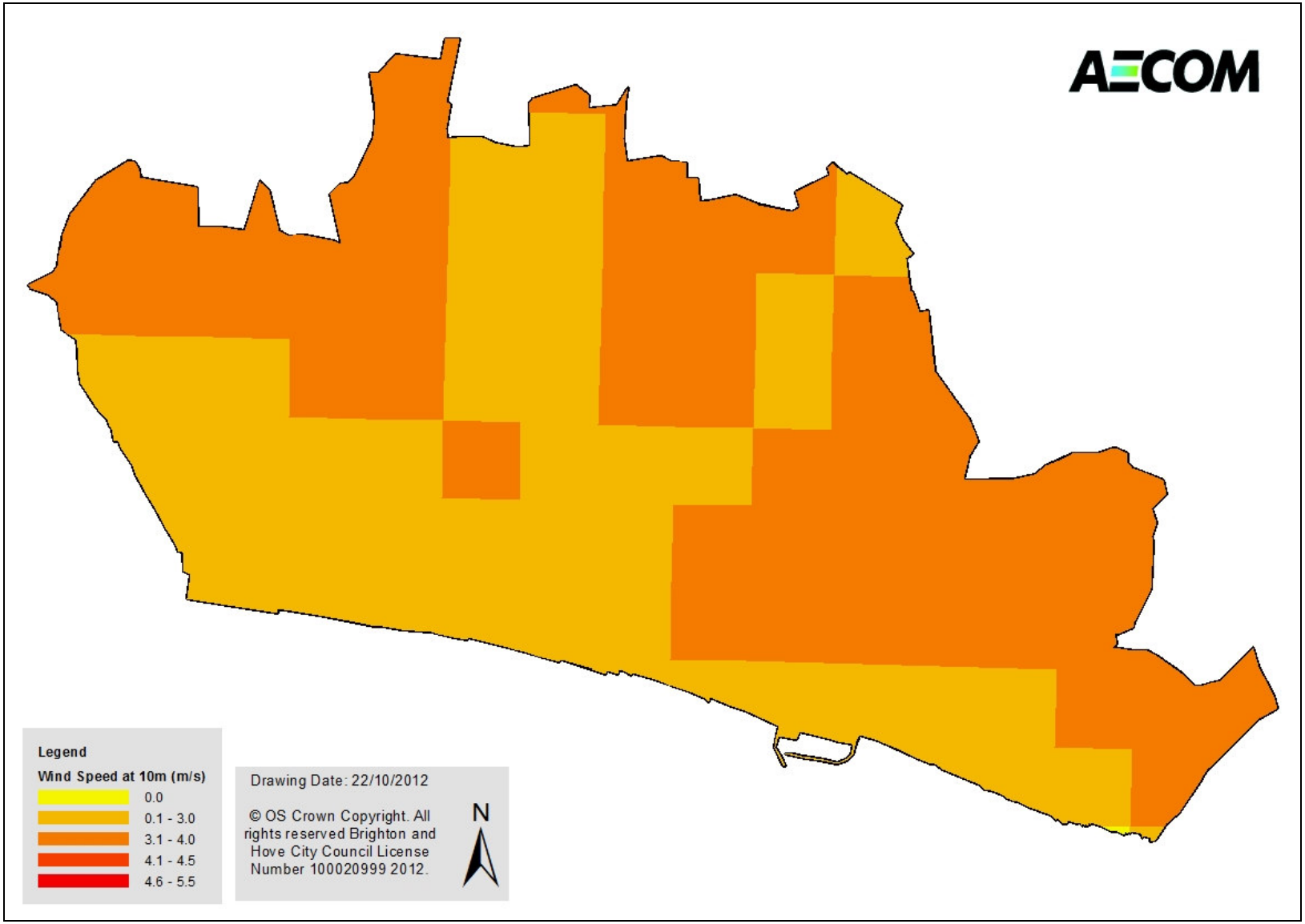


Figure 17: Wind speeds at 10m, scaled - showing no potential over 4.5m/s

Map of Key Potential Constraints in Brighton and Hove

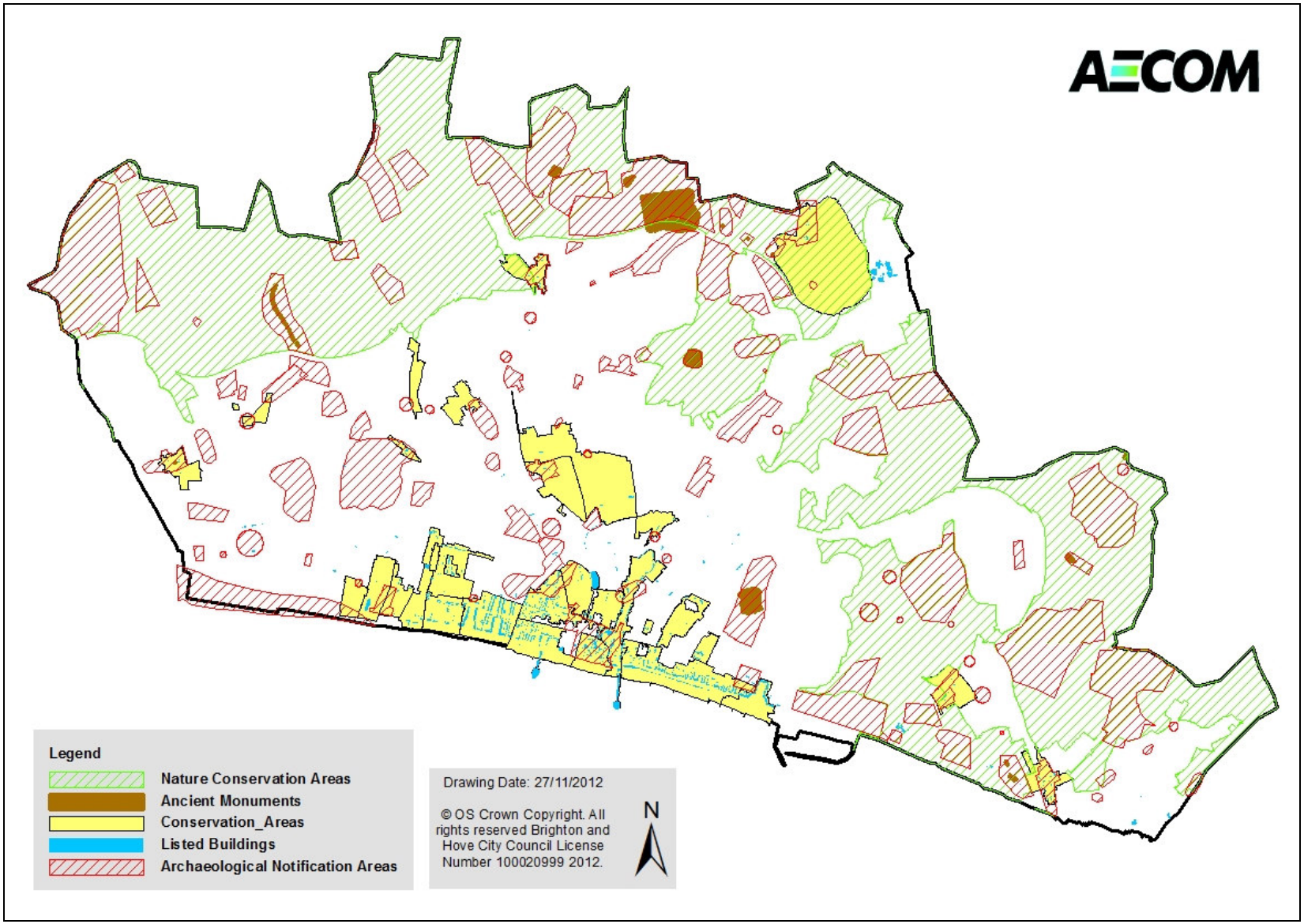


Figure 18: Map showing key potential constraints in Brighton in Hove

6.3 Energy Opportunities Mapping Methodology

6.3.1 Wind: Commercial Scale

A range of information has been mapped in order to identify locations which may be suitable for commercial scale wind energy, as set out in Table 8. The DECC methodology assumes an average turbine size for commercial wind of 2.5MW, which would stand 135m tall (blade tip height).

The map provided at Figure 15 shows the areas across the region which may be suitable for commercial scale wind energy, once the information in Table 8 has been taken into account. This analysis distinguishes the areas within this with international or national landscape or nature conservation designations, where wind energy development should not necessarily be ruled out, but which would need to be considered on a case by case basis, which is outside the scope of this study but is further discussed in section 0 below.

Based on the DECC methodology assumption that a maximum of 9MW could potentially be installed per square km of suitable land, the maximum theoretical potential for the land identified as potentially suitable in Brighton and Hove would be just under 90MW. Nearly all this potential falls within the South Downs National Park. Clearly the DECC assumptions are an estimate of maximum potential only and to realise any of this potential consultation will be needed with the South Downs National Park Authority, which is currently undertaking its own renewable energy study.

Location of resource	
The following areas are assumed to have sufficient wind resource to potentially justify investment in commercial scale wind energy.	
GIS dataset	**Source**
Areas where wind speed exceeds 4.5m/s at 45m above ground level.	NOABL wind speed database
Non-Accessible Areas and Exclusion Areas	
The following areas are assumed not to be able to accommodate commercial scale wind energy.	
GIS dataset	**Source**
Built-up areas plus 400m buffer	DEFRA Agricultural Land Classification
Roads (motorway, A roads, B roads) plus 150m exclusion area either side	OS OpenData
Railways plus 150m exclusion area either side	OS OpenData
Inland waters	OS OpenData
Airports plus 5km exclusion area	Already excluded
Civil air traffic control constraints	CAA VFR charts
MoD training areas	n/a – BHCC confirmed none in area
Ancient woodland	www.magic.gov.uk
Sites of historical interest	www.magic.gov.uk / BHCC
Designated Landscape and nature conservation areas	
The following areas may be able to accommodate some energy development without compromising the purpose and integrity of their designation. Suitability of large scale wind for these sites would need to be assessed further, in particular in cooperation with the South Downs National Park Authority.	
GIS dataset	**Source**
Landscape Areas	www.magic.gov.uk / BHCC
Nature Conservation Areas	www.magic.gov.uk / BHCC

Table 8: Information mapped to identify locations which may be suitable for commercial scale wind energy

6.3.2 Wind: Small Scale

It is useful to consider wind in terms of the turbine scale because different actors have potential to deliver different scales of turbines. Medium scale wind turbines can be delivered in rural areas by farmers, land owners and communities. Small scale turbines are likely to come forward for school and community buildings and for business centre developments. Micro turbines could be fitted by a private individual. Turbines of this scale are (or have been) marketed by DIY chain stores and are eligible for the Feed in Tariff. Energy Saving Trust guidance should be followed to help ensure they are installed appropriately.[29] The balance between smaller scale wind and large commercial wind turbines is important. It is true that medium and small scale turbines are less efficient and proportionally to energy output are more expensive; however they have fewer barriers for deployment and can help raise awareness of the importance of low carbon energy; although if installed inappropriately they can give a negative message.

The DECC methodology assumes a typical installed capacity per turbine of 6kW for small scale wind. This size of turbine would typically be building integrated or installed on a mast within the grounds of a property.

These wind turbines are assumed in the DECC methodology to be potentially suitable in locations where wind speeds exceed 4.5m/s. Following the DECC methodology, average wind speeds have been adjusted to account for the effect of the built environment. The Defra Rural Definition Dataset has been used to identify urban, suburban and rural areas, and wind speed scaling factors for these locations have been taken from Microgeneration Installation Standard (MIS) 3003.

Other than a broad assumption about the impact of the built environment on average wind speeds, no constraints have been taken into account in identifying potentially suitable locations for small scale wind. This is because the constraints are site specific, depending on factors such as the proximity to buildings and other tall structures, roof space and structural suitability of a building in the case of building-integrated installations, and availability of space for ground-mounted masts. However applying the constraint of requiring a wind

[29] http://www.energysavingtrust.org.uk/Generate-your-own-energy/Wind-turbines

speed of 4.5m/s (scaled) at 10m indicates no potential within the area.

The datasets available for use in this analysis are not precise (the wind speed dataset is based on an estimated average wind speed at 10m across areas of 1km^2 and scaling factors are applied fairly broadly) so local site-specific assessment may show that small scale wind is appropriate in some locations, for example along the coast where turbines are less obstructed. Wind speeds are generally lower at reduced heights (where small turbines might be placed) and it is suggested that small turbines should only be promoted where wind speeds are good and the site is not obstructed by trees and other buildings. The map at Figure 17 shows wind speeds for Brighton and Hove at 10m hub height and shows that no wind speeds above 4.5m/s were identified. The methodology used is summarised in Table 9.

Location of resource	
The following areas are assumed to have sufficient wind resource to potentially justify investment in small scale wind energy.	
GIS dataset	**Source**
Areas where wind speed exceeds 4.5m/s at 10m above ground level, after speeds have been adjusted for urban, suburban and rural environment. (Scaling factors - urban: 56%; suburban: 67%; rural: 100%)	NOABL wind speed database DEFRA Agricultural Land Classification MIS 3003

Table 9: Information mapped to identify locations which may be suitable for small scale wind energy

6.3.3 Biomass

The DECC methodology biomass resource assessment covers a variety of sources:

- Plant biomass, comprising managed woodland, energy crops, waste wood and straw;
- Animal biomass and food waste, including wet organic waste and poultry litter;
- Municipal solid waste and commercial and industrial waste;
- Biogas from landfill sites and sewage treatment works.

The DECC methodology also requires an assessment of the potential capacity for co-firing biomass with coal or oil in power stations.

However there are no large power stations within Brighton and Hove.

The DECC methodology focuses on the resource available within an area, and does not set out an approach to quantifying the potential to make use of imported biomass and setting targets for this. In practice, there is significant potential for biomass to be imported, particularly given Brighton's coastal location. Whilst importation of biomass involves carbon emissions from transport, these are generally fairly low and are easily offset by the carbon savings made through the use of a low carbon fuel.

Not all of these biomass sources can be usefully mapped, but the DECC methodology has been followed for those which can: managed woodland and energy crops. Section 6.5 presents the results of the South East renewable energy capacity study which calculates the potential resource from other biomass sources.

6.3.4 Biomass: Managed Woodland

Forestry arisings from managed woodland which have the potential for use as fuel include brash (foliage, branches and stems usually <7cm diameter), thinnings, or poor quality final crops in both conifer and hardwood crops, according to information from the Forestry Commission.[30] The map at in Figure 15 shows the distribution of woodland in Brighton and Hove. Table 10 lists the information used to produce this map.

Location of resource	
The following areas are assumed to be a potential resource.	
GIS dataset	**Source**
Areas of woodland	www.magic.gov.uk / BHCC

Table 10: Information mapped to identify locations which may be suitable for managed woodland

The Forestry Commission estimates that there is potential for harvesting nearly 114,000 cubic metres of wood per year in the whole of East Sussex if 75% of all non-Forestry Commission woodland and 100% of Forestry Commission woodland were to be actively managed. Based on an estimate that 60% of conifer and mixed crops, and 10% of broadleaf growing resource would be used as sawlogs, the Forestry Commission estimates a useable total of just over 80,000 cubic metres of woodfuel per year – with a potential for generating around 180,000MWh of energy per year.[31]

[30] www.forestresearch.gov.uk/fr/infd-6w9gju
[31] Forestry Commission woodfuel calculator, May 2012.

Brighton & Hove City Council estimates that their arboricultural and parks works produce around 300-350 cubic metres of wood chip per year which is used as mulch throughout the city; however this use enables the Council to avoid glyphosate weedkiller so is not an approach that would easily be altered. The Council additionally made use of 120 cubic metres of elm disease timber in 2011 for biomass fuel. Future extreme events such as hurricanes or ash die back may provide other sources of surplus biomass, depending on guidance from DEFRA on the use of diseased wood which may have transport restrictions applied.

6.3.5 Biomass: Energy Crops

The DECC methodology defines high, medium and low scenarios have been defined for the amount of land which is potentially available for energy crop production, as follows:

- High: All grade 1-4 agricultural land, excluding constrained areas;
- Medium: Land where use for biocrops is less likely to compete with use for food production;
- Low: land already subject to applications submitted to the Energy Crop Scheme (ECS).

The low scenario gives no results in Brighton and Hove as there were no current energy crop schemes identified in the area.[32] The high scenario is an overestimate, however the medium scenario as defined by DECC has elements which cannot be mapped, so for illustrative purposes a hybrid medium/high scenario has been mapped. This is defined in Table 11 and shown in Figure 15.

A number of exclusion areas have been defined, where growing energy crops may not physically be possible, or may not be desirable. These are also described in Table 11.

There are other potential constraints which DECC recommends for further consideration. One of these is water stressed areas where the DECC methodology advises consultation with the Environment Agency. The Environment Agency has not specifically been consulted for this study; however it has been consulted by AECOM for previous energy opportunity studies about the implications of planting energy crops in water stressed areas. Their response stated that water stress classification is not necessarily relevant to crop production, as it is defined by water companies on the basis of household demand. They advised that the regional Catchment Abstraction

[32] Based on data from www.magic.gov.uk

Management Strategy can be used as a guide to the availability of water in major aquifers and rivers for irrigation purposes and has referred to the 'Optimum Use of Water for Industry and Agriculture' report as a source of data on water required for irrigation of these and other crops – these documents could be referred to if the Council wishes to investigate this issue further.[33] The DECC methodology states that other potential adverse environmental impacts include biodiversity impacts, such as where farmland bird species of conservation concern have been identified. This is highlighted as an area where Natural England should be consulted. Natural England's 'Nature on the Map' tool has been used and shows that there are some areas within Brighton and Hove where birds of conservation concern have been identified in the vicinity (the map shows circles with a 2km radius from the centre of a 1km OS square where any of 14 species of conservation concern have been recorded in the last 5 years, based on a range of sources).[34] This map is shown in Figure 19. Another potential constraint is protected landscapes where the DECC methodology advises that no blanket exclusion should be applied, however a maximum block limit may be applied, subject to consultation with Natural England. We have highlighted designated landscape areas on our resource map to show areas where consultation will be required. As nearly all the identified areas of potential fall within the South Downs National Park it will clearly be necessary to cooperate with the SDNPA to investigate opportunities further.

[33] http://www.environment-agency.gov.uk/business/topics/water/119927.aspx ; WS Atkins Ltd in association with Cranfield University for Environment Agency, *Optimum Use of Water for Industry and Agriculture Dependent on Direct Abstraction Best Practice Manual*, 2002

[34] http://www.natureonthemap.naturalengland.org.uk/

Location of resource	
The following areas are assumed to be a potentially suitable location for energy crops.	
GIS dataset	**Source**
Grades 3 and 4 land[35]	DEFRA Agricultural Land Classification
Exclusion Areas	
The following areas are assumed not to be able to accommodate energy crops.	
GIS dataset	**Source**
Permanent pasture and grassland[36]	www.magic.gov.uk – BAP priority habitat datasets
Public rights of way with 3m buffer	www.magic.gov.uk
SPS Cross-compliance buffer	Not mapped as spatial dataset not available
Roads	OS OpenData
Rivers and lakes	www.magic.gov.uk
Woodland	www.magic.gov.uk / BHCC
Common land	www.magic.gov.uk
Nature conservation areas	www.magic.gov.uk / BHCC
Historic Designations	www.magic.gov.uk / BHCC
Areas where adverse environmental impacts are possible due to energy crops	
The following areas may be able to accommodate some energy crops but there may be potential for adverse environmental impacts and consultation will be needed with various responsible agencies.	
Area	**Agency**
Water stressed areas (not mapped, but Brighton and Hove is within a water	Environment Agency

[35] The approach used here is a hybrid scenario, between DECC's medium and high scenarios.

[36] Not available as a spatial dataset. Approximated for illustrative purposes based on a range of BAP Priority Habitat datasets (Coastal and Floodplain Grazing, Fen, Lowland and Upland Calcareous Grassland, Lowland and Upland Meadows, Undetermined Grassland, Dry Acid Grassland, Lowland Meadows, Purple Moor Grass and Rush Pastures and Upland Heathland. However these datasets are likely to underestimate the total. The South Downs National Park Authority is also aiming to increase the level of permanent pasture and grassland within the national park.

stressed area)	
Biodiversity impact areas (not mapped, but there are farmland bird species of conservation concern identified within the South Downs National Park)	Natural England
Protected landscapes	Natural England / South Downs National Park Authority

Table 11: Information mapped to identify locations which may be suitable for energy crops

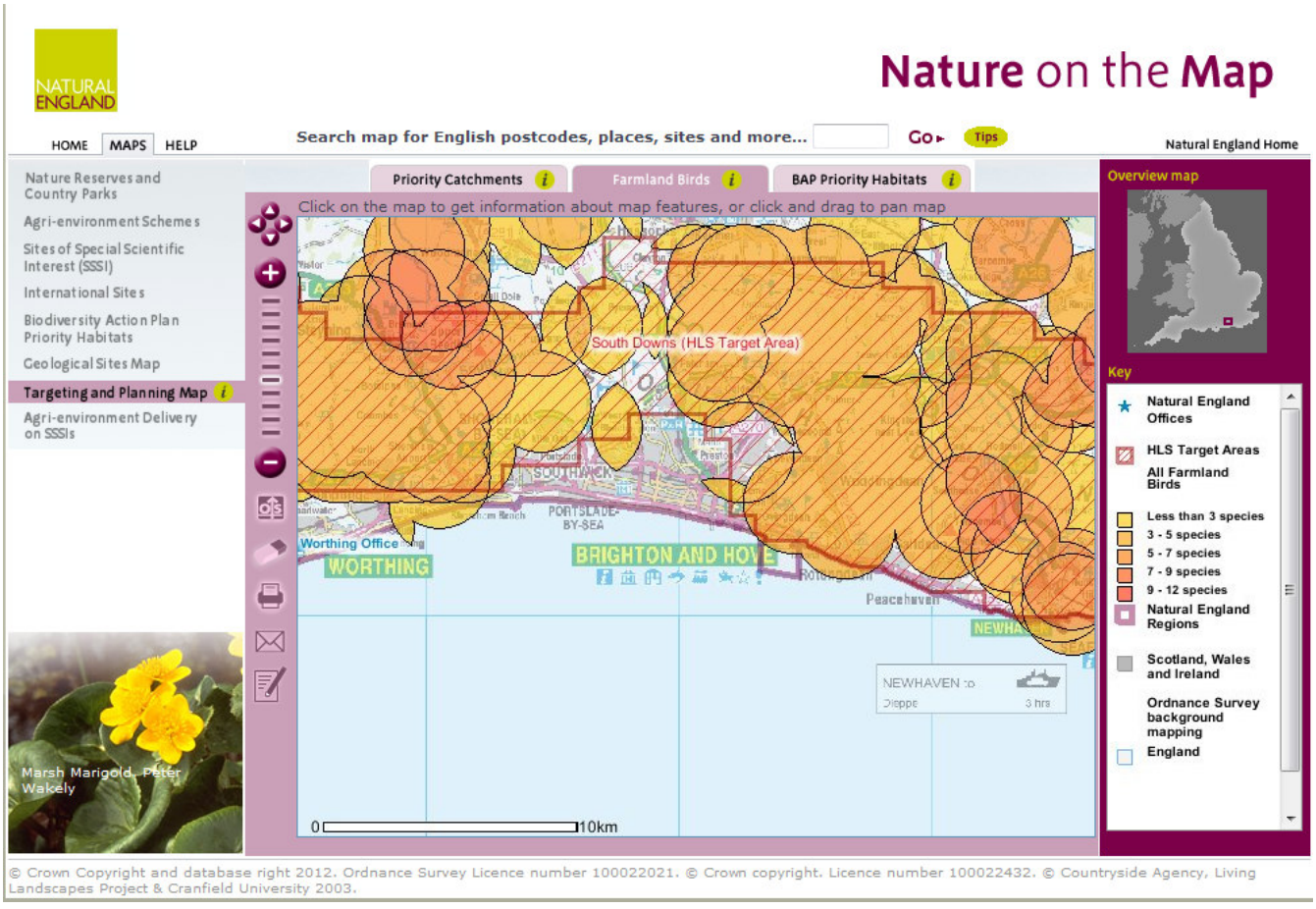


Figure 19: Natural England Nature on the Map showing farmland bird species of conservation concern

6.3.6 Microgeneration and Energy Efficiency

Areas with potential for microgeneration other than micro wind and for energy efficiency measures have been mapped based on the built-up areas in Brighton and Hove; these are shown on the main energy opportunities map in Figure 15. The deliverability of these measures is assessed in detail in section 9. Additional constraints such as Conservation Areas or the presence of listed buildings may restrict the application of certain technologies. Some general constraints which may apply to different technologies are shown in the constraints map at Figure 18.

6.3.7 Heat Networks

The methodology for identifying heat network opportunity areas is covered separately in section 7. 14 opportunity areas were identified; these are shown on the main energy opportunities map at Figure 15 and in section 7.

6.4 Note on the South Downs National Park

Nearly all the potential wind, biomass managed woodland and biomass energy crop opportunities identified by the energy study within the Brighton and Hove local authority area are within the South Downs National Park, and a significant proportion of these are within Brighton and Hove City Council freehold land. Taking forward any of these opportunities would require further investigation with the South Downs National Park Authority (SDNPA) and consideration of issues such as landscape sensitivity.

Significant development areas which border the SDNPA are Toads Hole Valley and the university campuses at the top of Lewes Road. Heat network opportunity areas have also been identified on the borders of the National Park: at Toads Hole Valley, University of Brighton (Paddock Field) and Sussex University (Falmer campus).

The National Park designation is a material consideration in the making of any planning decision that may significantly affect the Park. The SDNPA is in the process of developing its Local Plan and an energy opportunities study is also currently being undertaken by AECOM for the SDNPA, investigating the potential opportunities and constraints for low and zero carbon energy generation and energy efficiency within the park.

Some renewable energy technologies are likely to have additional constraints within the

SDNPA. Findings on best practice from the Renewable and Low Carbon Energy Scoping Study undertaken by AECOM for the South Downs National Park[37] suggest that while many areas of National Parks will not be appropriate for large scale low carbon and renewable energy projects, experience in Wales suggests that appropriate landscapes might exist, even in National Parks and that National Park authorities should not reject these applications without consideration. The study suggests that smaller scale technologies and energy efficiency schemes can also capitalise on a National Park's renewable resource without compromising the quality of the landscape.

Energy efficiency improvements to existing buildings are vital to meeting carbon reduction targets and tackling climate change, however there are likely to be aesthetic impacts which will require consideration within the context of the South Downs National Park. There are relatively few buildings in Brighton and Hove within the National Park boundaries but a significant amount of development along the city's northern and eastern boundaries borders the National Park.

The SDNPA has interests in developing local markets for woodfuel, supporting active woodland management and establishing new woods. Around 23% of the South Downs is woodland, c.38,000ha., of which a significant proportion has not been actively managed for many years. The Forestry Commission has identified a potential annual increment of > 130,000 m^3 of wood per year within the national park, and suggests that of this > 60,000m^3 per year of lower quality wood could be used as woodfuel providing 140,000,000kWh/year, enough to heat more than 9,000 homes.[38] Although the majority of this resource is outside the Brighton and Hove administrative area (in the central areas of the South Downs), developments or existing buildings within Brighton and Hove may be interested in sourcing some of this woodfuel resource from within the South Downs.

It is suggested that Brighton and Hove City Council and the South Downs National Park Authority should:

- Jointly recognize the importance of tackling climate change, in particular in relation to protecting the future of the National Park area and the city.

[37] AECOM for South Downs National Park Authority, *South Downs National Park Renewable and Low Carbon Energy Study – Scoping Report*, 2012

[38] Forestry Commission, *Trees, Woods and Forests in the South Downs National Park*, July 2012.

- Share information on the emerging energy opportunities work currently being undertaken for Brighton and Hove City Council and for the South Downs National Park Authority.
- Work together to investigate opportunities for the development of sustainable energy resources within and around the National Park area where appropriate, including:
    - Biomass resource
    - Wind generation opportunities
    - Anaerobic digestion
    - CHP and district heating (likely to be outside the National Park, on its border)
    - Energy efficiency improvements to existing buildings.

  These may include opportunities where the Council owns the freehold on land within the National Park.
- Where proposals for low and zero carbon energy generation come forward within or on the boundaries of the National Park Authority it is likely to be appropriate for either party to consult with the other and to take into account their carbon reduction drivers as well as other relevant factors.
- Work together and share information to better promote and monitor the implementation of low and zero carbon energy generation and energy efficiency measures within the National Park.
- Investigate opportunities for cross-boundary cooperation with other local authorities, such as Green Deal provision or local carbon offset funds which may be set up to use allowable solutions funding.

6.5 Renewable Energy Capacity Assessment: South East Study

The renewable energy resources identified in the maps above have already been quantified in a study carried out in 2010 by the South East Partnership Board, which followed the DECC methodology for the English regions: the *Review of Renewable & Decentralised Energy Potential in South East England*. The results of this study are shown in Table 12 and Figure 20 below. The study covers the period to 2031 as it was related to the implementation programme of Regional Strategies, which no longer exist, however the timescales link well with the current study which extends to 2030.

There are numerous assumptions behind this data, which are summarised at Appendix C and are set out in detail in the SEPB report. It is AECOM's opinion that some of these assumptions in the DECC methodology may result in under or overestimates. In particular:

- The assumed uptake of heat pumps appears high. This is due to an optimistic assumed viability of installing heat pumps in 100% of off-grid existing homes and 75%, 50% and 25% for detached/semi detached, terrace homes and flats respectively and assuming 10% uptake for existing commercial/business properties and 50% for new domestic development.
- The study appears to have ruled out commercial scale wind in the area; this is likely to be due to assuming that no wind can be developed within the South Downs National Park. AECOM has followed the DECC methodology to investigate the potential for commercial scale wind should it be possible within the National Park.
- The South East study highlights all land holdings that in theory could be used to grow biocrops based on soil conditions. In reality bio-crops are unlikely to be delivered on such a large scale at any one time, as land-owners will ultimately respond to market demands, and will change crops as such. There is some concern that growth of biocrops could endanger local food production capability, and hence lower grades of land should be favoured for biocrop farming. The Council is currently undertaking work on local food and this may include further mapping to assess potential capacity of land for food growing.
- The agricultural arisings figures appear high.
- Biomass results exclude the potential for importing biomass fuel; they are based on the available resource within the area only.
- Energy from waste figures are related to Brighton and Hove's waste production. However as Brighton and Hove's municipal solid waste is sent to the energy recovery facility at Newhaven, and as there are no existing or planned energy from waste plants within the authority it is not expected that significant energy from waste generation will take place in Brighton and Hove over the period to 2030.
- Wet organic waste figures, which cover food and animal waste, are also related to the city's waste production. The SE study gives figures on technical potential, but there is currently no collection of municipal food waste in the city and discussions with the Council on the potential for use of animal waste did not result in any suitable sites being identified. Should food waste collection be introduced this is a potential source of carbon savings. There may also

be potential for use of commercial food waste. Anaerobic digestion is discussed further in section 9.4.3 of this report.

- The estimates for solar PV are building-based only and assume a 2kWp typical domestic installation.
- Solar Farms were not considered in the South East study but bottom-up estimates of their potential have been included in the scenarios created as part of this study and they are discussed at section 9.3.2.
- Offshore technologies such as wind, tidal and marine energy are not covered in the South East study (nor in this study) as they are outside the scope of local government.

AECOM has undertaken a bottom-up assessment of the potential for renewable energy generation, with uptake rates which take into account additional factors not covered by the DECC methodology, such as consideration of historic uptake rates, costs, and other practical non-physical constraints. This analysis is presented in section 9 and factored into the scenarios modelled for Brighton and Hove which are presented at section 10.

Renewable Electricity Potential for Brighton (2031)			
Technology	**Technology Sub-Type**	**Installed capacity (MW)**	**Generated capacity (GWh/yr)**
Wind	Onshore, commercial scale[39]	0	0
	Onshore, small scale: less than 100kW	0	0
Biomass	Managed Woodland	unknown	unknown
	Energy Crops (medium scenario chosen) - Elec	0.08	0.58
	Waste Wood	unknown	unknown
	Agricultural Arisings	35.1	264.3
	Poultry Litter	0	0
	Co-Firing (Biomass with Coal)	0	0
Waste	Municipal Solid Waste	126	485
	Commercial and Industrial Waste	unknown	unknown
Biogas	Wet Organic Waste (e.g. food, animal manure)	5.8	29.9
	Landfill Gas	0	0
	Sewage Gas	1.7	6.5
Hydro	Small scale	0	0
Solar	PV	87.1	68.7
TOTAL	**All renewable electricity (where known)**	**255.78**	**854.98**
Renewable Heat Potential for Brighton (2031)			
Technology	**Technology Sub-Type**	**Installed capacity (MW)**	**Generated capacity (GWh)**
Biomass	Managed Woodland	unknown	unknown
	Energy Crops (medium scenario chosen) - Heat	1	1.7
	Waste Wood	unknown	unknown
Solar	Solar Thermal	75.7	33.1
Heat Pumps	Heat Pumps	379	863
TOTAL	**All renewable heat (where known)**	**455.7**	**897.8**

Table 12: Renewable resource potential in Brighton and Hove in 2031, as estimated in the SEPB Review of Renewable & Decentralised Energy Potential in South East England

[39] AECOM has revised this estimate – the SE study appears to have applied a blanket exclusion for all areas within the South Downs National Park. Should it be possible to include areas within the National Park, a maximum potential (theoretical) estimate of 90MW has been made – a significant additional resource although further work will be needed to determine how much, if any, of this resource could be realised in practice..

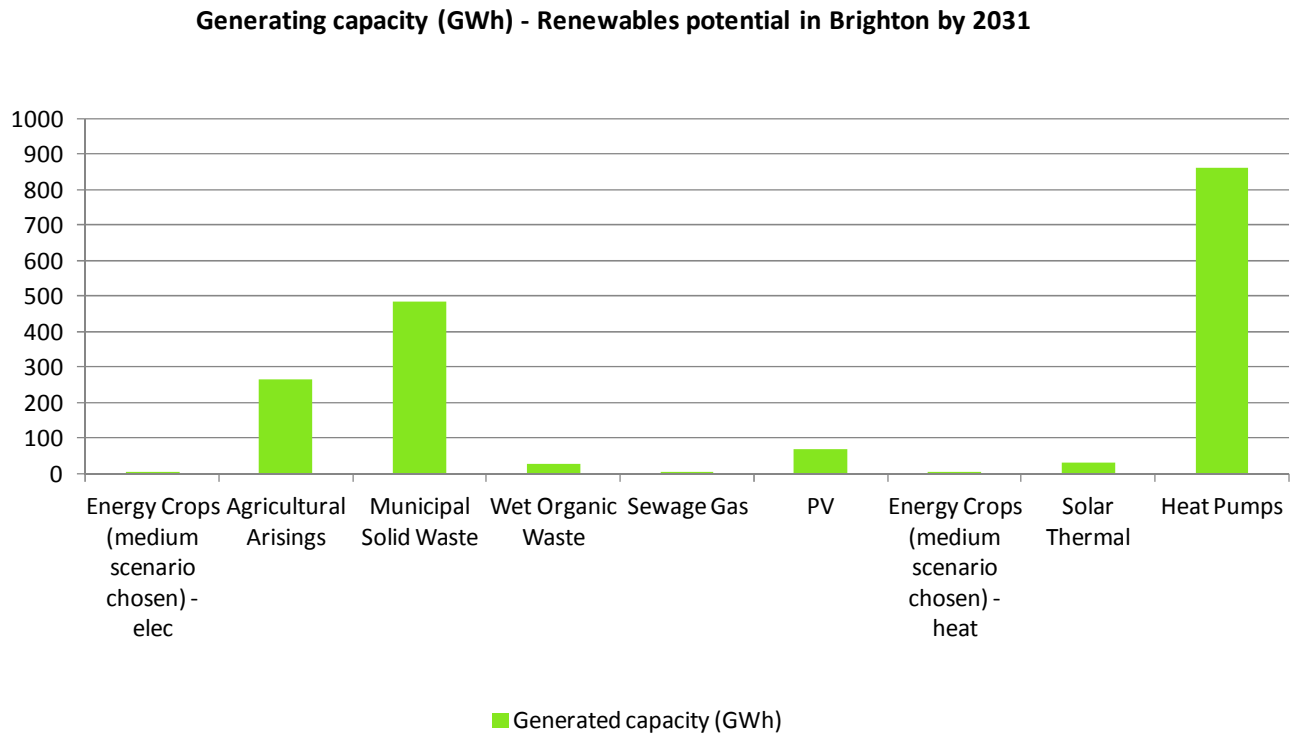


Figure 20: Renewable energy generation potential in Brighton and Hove in 2031, as estimated in the SEPB Review of Renewable & Decentralised Energy Potential in South East England

6.6 Recommendations for Further Work

Advice on next steps resulting from this study is given at section 11. This energy study provides a high-level analysis of major carbon saving opportunities in the city. However all projects which the Council decides to take forward or to promote in Brighton and Hove will need to undergo detailed feasibility assessments and stakeholder engagement, and business plans will need to be undertaken on an individual project or programme basis. Initial steps the Council could take include providing clear guidance to residents and potential developers on where particular technologies are likely to be appropriate and what the considerations are likely to be for determining their suitability. The energy opportunities maps produced as part of this study can help to inform this.

7 Heat Network Assessment

This section describes the process and presents the results of our analysis of the opportunities for district heating within Brighton and Hove. It presents the district heating opportunity maps created by AECOM and provides details of the 'long-list' of fourteen district heating clusters within the Local Authority area that have been assessed and the relative priorities that have been assigned to each. Three heat network clusters were shortlisted in consultation with Brighton and Hove City Council for further assessment, and the results of this analysis are also presented.

7.1 Identifying district heating opportunities

In reviewing the potential for heat networks in Brighton and Hove we sought to identify locations with the most potential taking into account the following criteria:

Total heat demand

We have assessed the total heat demand within each of the clusters based on energy consumption data from DECC and supplemented with metered or benchmarked data from other sources where available. The total heat demand provides an indication of the potential environmental and financial benefits that could be derived from the creation of a heat network served by a low carbon energy technology.

Heat density

Using energy consumption data and the national heat map available from DECC we have been able to locate areas within Brighton and Hove with the highest levels of heat density. Using GIS information from Brighton and Hove City Council and additional information from Google maps we were then able interrogate these to determine which buildings were contributing most to the heat density. The heat density is a good indication of the financial viability of a district heating network (DHN) as it indicates the potential to supply a large amount of heat with minimal infrastructure.

Presence of Key Anchor Loads

Using the Council and other public sector building energy consumption data, GIS information on the location of public sector buildings and details of the top 30 private sector employers as well as desktop surveys we have identified locations where there are a number of buildings with high and stable heat demands in close proximity. A cluster of anchor loads can provide the initial load in the creation of a wider network. Other existing buildings of potential interest have also been listed.

We have also reviewed building ownership to gain an understanding of the likely ease with which a network might be created. It is easier to secure customers for a DHN if there is one point of contact to coordinate with, rather than many individual customers. For example, a block of 50 social housing dwellings could be connected more easily under one agreement with the Housing Association, rather than 50 individual private homeowners. Local Authorities are also usually more able to enter into long term energy supply contracts than private customers. Key stakeholders in each cluster area have been identified and will need to be contacted for those clusters where more detailed technical and financial assessment is being undertaken. Potential anchor loads and heat density across the area are shown in Figure 21.

Building energy profiles

We have looked for locations with building types which result in a good balance of heat demand profiles. To deliver the best environmental and financial performance systems need to be operational for as long as possible and this requires year-round constant heat requirements. For example a residential area will require heat in mornings, evenings and weekends, but there is less demand for heat in the daytime. If commercial buildings are also present which have a daytime heat demand, the overall demand profile is more consistent and will enable the system to operate more efficiently.

Existing Infrastructure

We have also identified where existing infrastructure, such as the presence of existing district or communal heat networks or low carbon technologies such as CHP engines or Biomass boilers, is already in place in the clusters. Such infrastructure could potentially make the creation of a wider district heating network more deliverable and viable.

Proximity to key opportunities and constraints

We have mapped opportunities such as existing district heating schemes, CHP engines, biomass boilers and communal boilers in Council owned properties. Potential areas around these existing opportunities have a higher potential. Equally there are a number of constraints that could adversely impact on the potential for establishing district heating in a particular location, such as air quality restrictions, listed buildings/roads or physical barriers such as railway tracks.

Development Sites

As well as reviewing the existing heat demands and densities we have looked at the future development plans within the area and assessed the potential for using these to help to trigger the delivery of district heating networks by providing further heat loads and potentially areas for energy centres and pipe installations.

Potential for Expansion

Clusters that are close to one another provide the opportunity for future expansion of a scheme to deliver future increases in the environmental benefits and financial viability.

Other Potential Benefits

Potential social benefits such as reducing fuel poverty, and potential direct benefits to the Council, through connection of their own buildings to heat networks, have also been reviewed.

Financial and Practical Viability

Although no detailed assessment of technical design or financial viability has been undertaken for the long-list of clusters the potential financial viability and deliverability has been assessed based upon AECOM's previous experience of undertaking feasibility studies, design and delivery of heat networks.

7.2 Initial identification of clusters

By reviewing the maps and looking for the best opportunities in each of the areas listed above and through discussion with Brighton & Hove City Council we identified a long-list of 14 clusters for further analysis. A map showing the identified clusters is presented on the following page. The clusters are centred around:

1. Brighton Marina
2. Eastern Rd
3. Edward St
4. Brighton Centre
5. New England Quarter and London Rd
6. Sussex University
7. University of Brighton (Paddock Field)
8. University of Brighton (Moulsecoomb)
9. Toads Hole
10. Hove Park
11. Hove Station
12. Schools Cluster
13. Hove Beachfront
14. Shoreham Harbour

Following this initial identification, three high priority clusters were selected for further analysis of technical and financial feasibility (clusters 2, 3 and 5), as explained at section 7.4.

Map of Heat Network Anchor Loads in Brighton and Hove

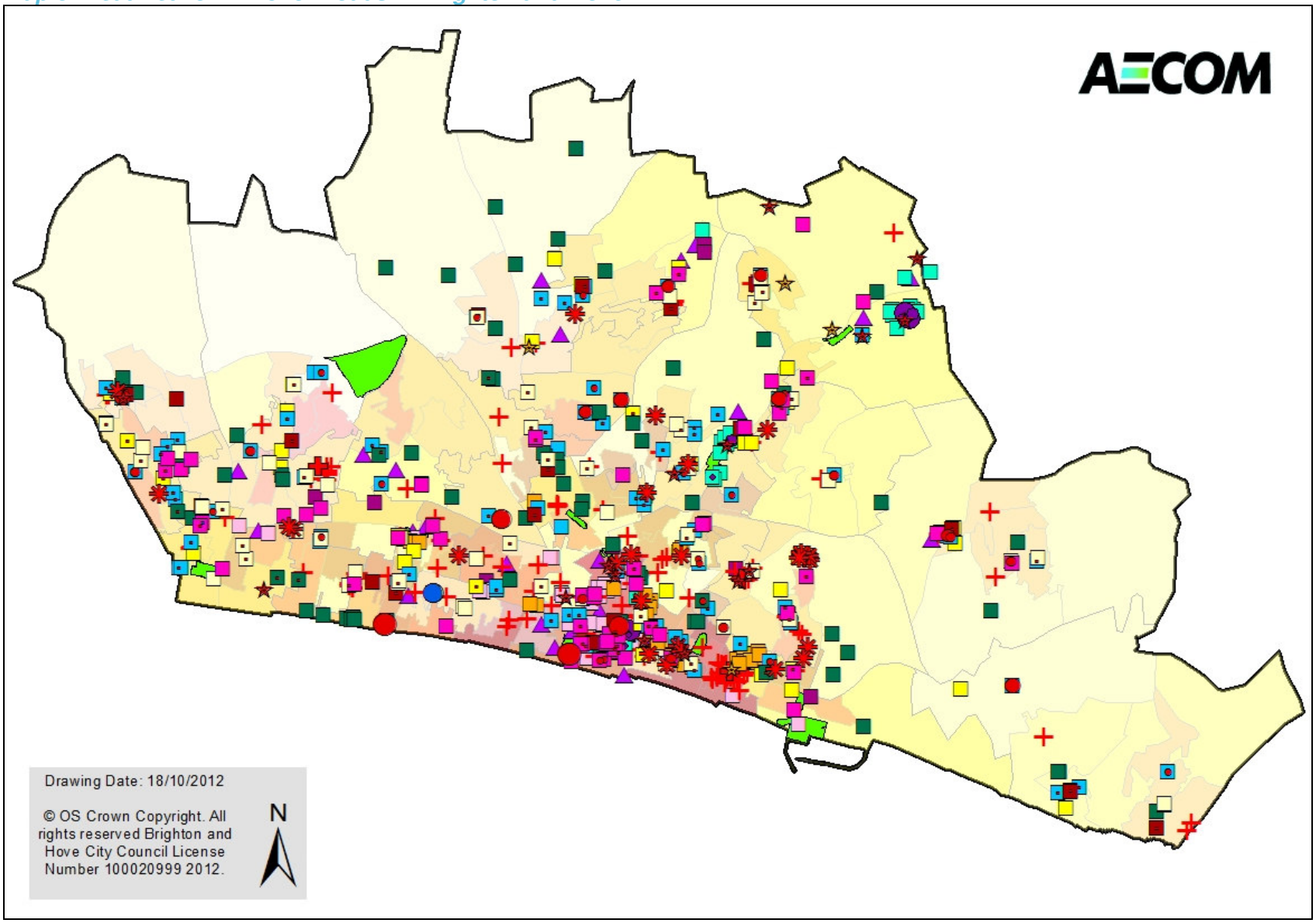


Figure 21: Map showing anchor loads and heat density in Brighton and Hove (See section 7.3 for a key to the symbols shown)

Map of Existing and Planned Gas CHP & Biomass and Council-owned Communal Boiler Installations

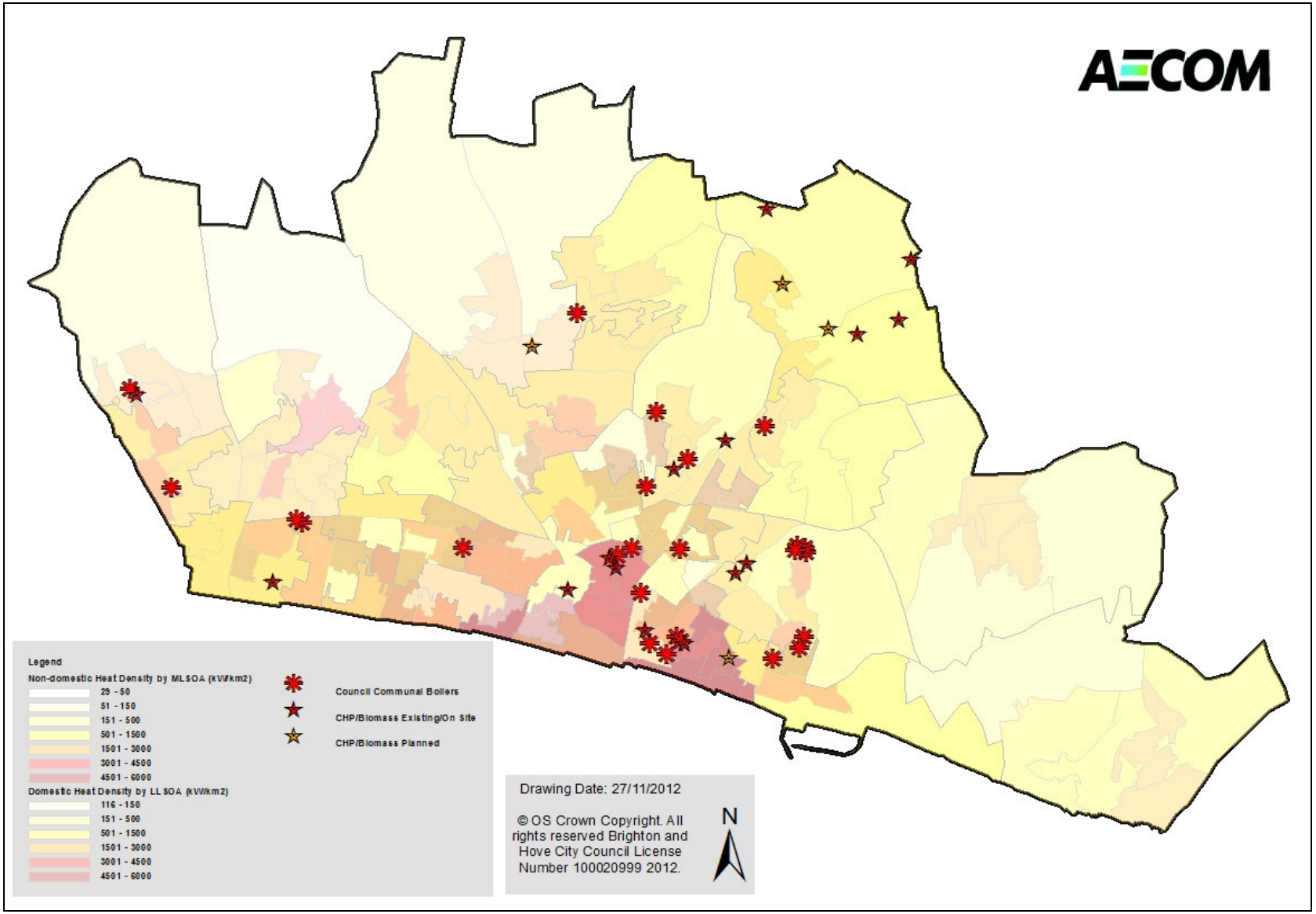


Figure 22: Existing and planned gas CHP and biomass installations and Council-owned communal boiler installations in Brighton and Hove

Map of Heat Network Opportunity Areas in Brighton and Hove

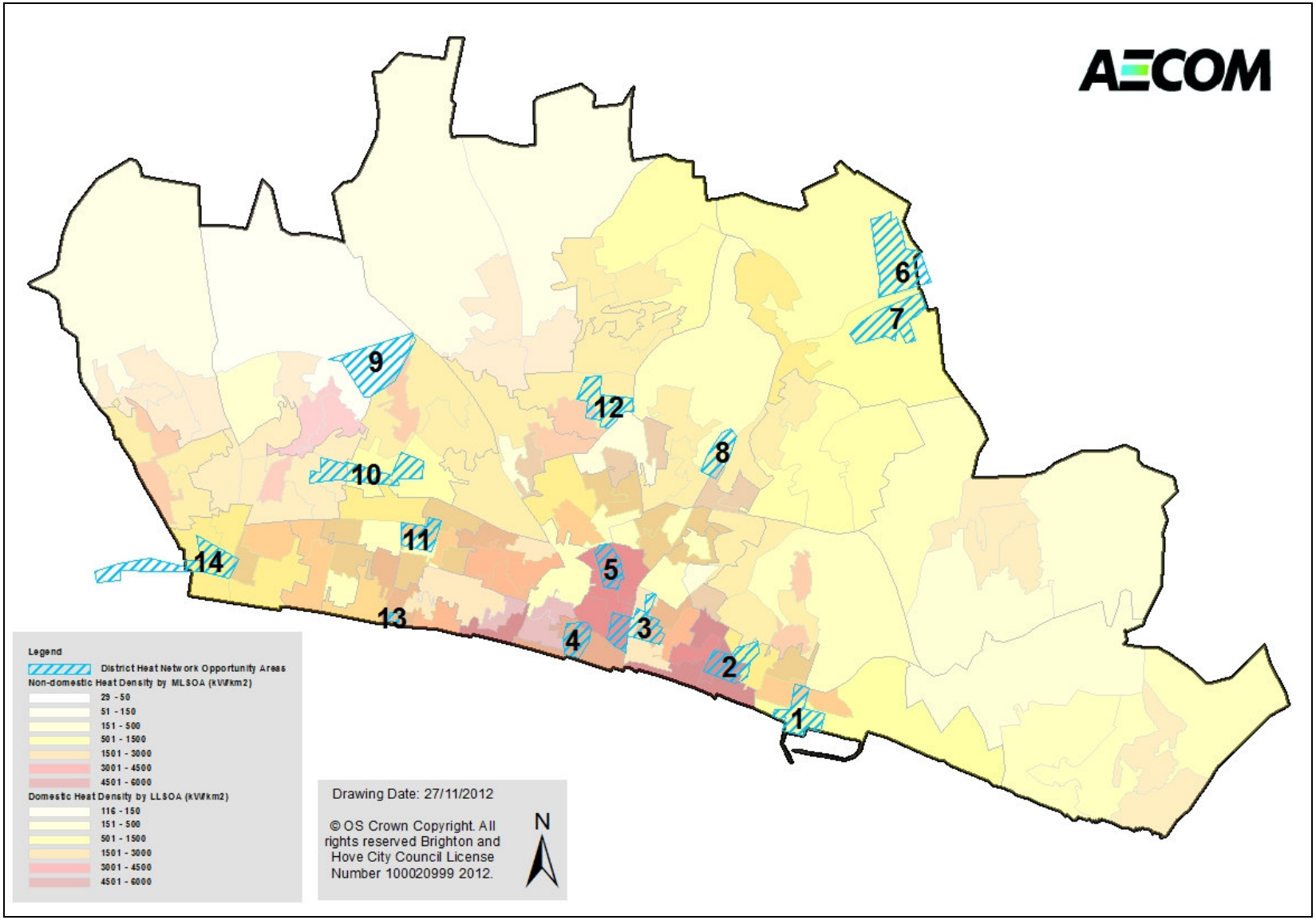


Figure 23: District Heat Network Opportunity Clusters in Brighton and Hove (with approximate cluster boundaries)

7.3 Analysing the clusters

The long-listed clusters have been analysed in more detail to assess their potential. The results of this analysis have been presented in separate datasheets, which provide the following information:

Map excerpts

An excerpt of the National Heat Map and the Brighton and Hove District Heating Opportunity Map are presented showing the overall heat demands of the cluster as well as the location of the key buildings within the cluster. The latter are all shown at the same scale to give an indication of the relative sizes of the cluster areas.

Cluster review

Introduction to the cluster outlining the building typology and any specific details relating to any existing features that are of interest. This includes a review of the existing and proposed buildings as well as details of the key opportunities and constraints within the cluster that could have an impact on the technical or commercial viability or the practical delivery of a network.

Key existing buildings

We have identified existing buildings within the cluster and gathered data on their heat demands where possible. The names attributed to each of the sites have been taken from a variety of databases and therefore may not always match the current occupier or use. Buildings identified are indicative only – their willingness to connect has not been explored, and any further assessment of the clusters would need to consider the optimum network design which might involve the exclusion of some buildings listed here, or inclusion of other buildings not identified.

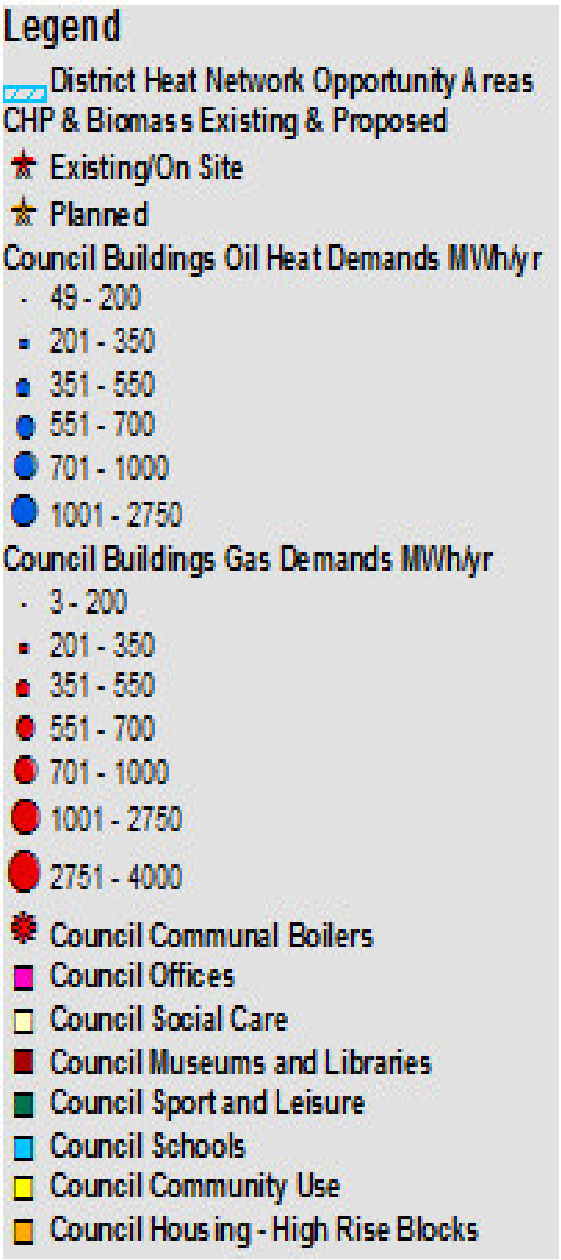
Proposed buildings

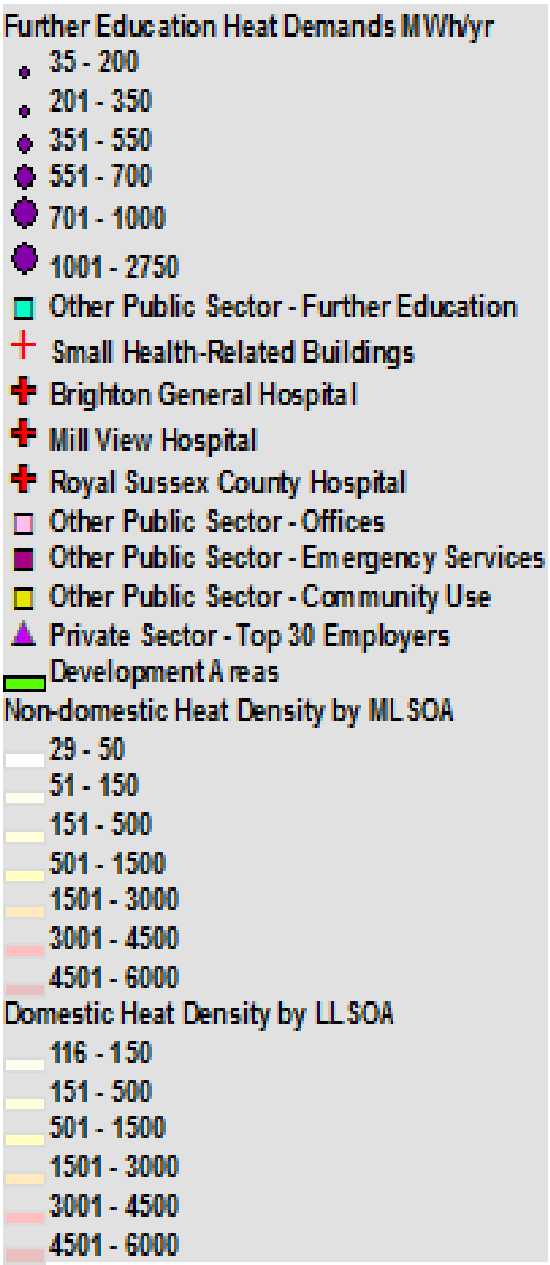
The proposed buildings within the cluster are also listed and the estimated size and delivery date is given based on information from the City Plan Part 1 and AECOM assumptions.

Cluster assessment summary

The relative potential of the cluster with regards to technical, financial and deliverability factors has been assessed for each site. For each of the criteria assessed, the relative potential has been identified on a scale from low to high using 5-scale ‘traffic-light’ scoring mechanism from red, through orange, yellow, light green and dark green.

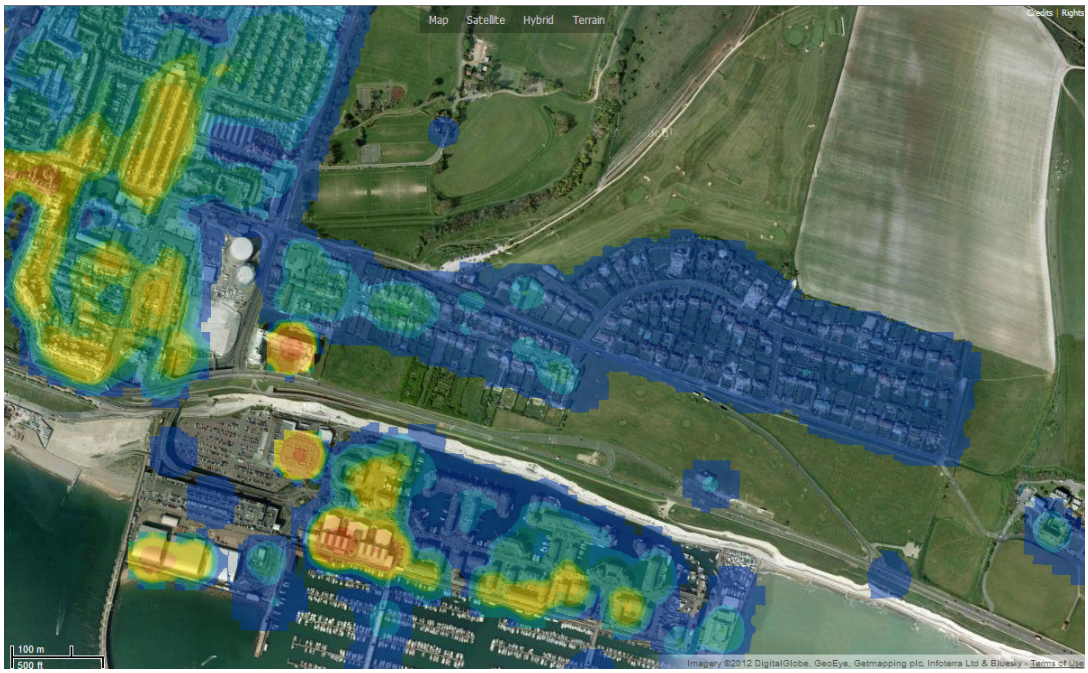
The datasheets for each of the 14 clusters are presented over the following pages. The following legend should be used to understand the maps.


Legend
District Heat Network Opportunity Areas
CHP & Biomass Existing & Proposed
Existing/On Site
Planned
Council Buildings Oil Heat Demands MWh/yr
49 - 200
201 - 350
351 - 550
551 - 700
701 - 1000
1001 - 2750
Council Buildings Gas Demands MWh/yr
3 - 200
201 - 350
351 - 550
551 - 700
701 - 1000
1001 - 2750
2751 - 4000
Council Communal Boilers
Council Offices
Council Social Care
Council Museums and Libraries
Council Sport and Leisure
Council Schools
Council Community Use
Council Housing - High Rise Blocks

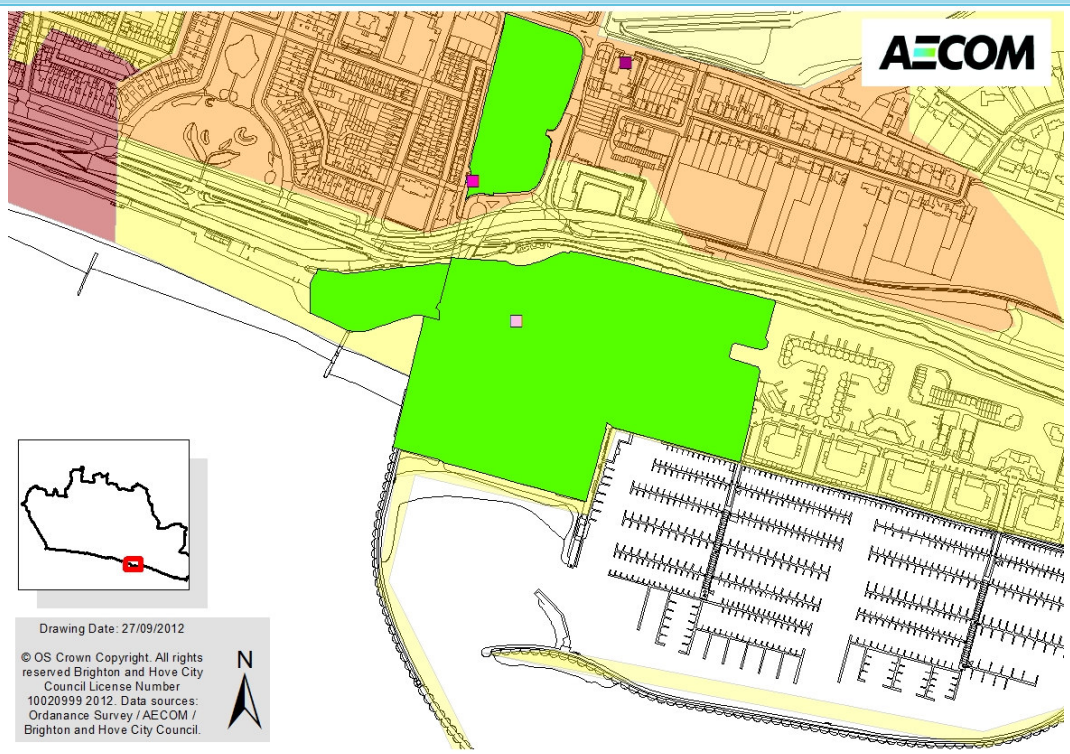

Further Education Heat Demands MWh/yr
35 - 200
201 - 350
351 - 550
551 - 700
701 - 1000
1001 - 2750
Other Public Sector - Further Education
Small Health-Related Buildings
Brighton General Hospital
Mill View Hospital
Royal Sussex County Hospital
Other Public Sector - Offices
Other Public Sector - Emergency Services
Other Public Sector - Community Use
Private Sector - Top 30 Employers
Development Areas
Non-domestic Heat Density by MLSOA
29 - 50
51 - 150
151 - 500
501 - 1500
1501 - 3000
3001 - 4500
4501 - 6000
Domestic Heat Density by LLSOA
116 - 150
151 - 500
501 - 1500
1501 - 3000
3001 - 4500
4501 - 6000

1 Brighton Marina

National Heat Map



Local District Heating Opportunity Map



Site Review	
Existing buildings	The key existing buildings are within the Marina, which includes a large Asda supermarket, offices, leisure, retail and residential buildings.
Proposed buildings/ development sites	Key buildings in this cluster are the development sites at the Marina Inner Harbour, Black Rock and the former Gas Works site, A total of approximately 23,500sqm of new non-domestic development and 1940 new homes are expected over the period to 2030.
Potential constraints	The Marina is located below the cliffs which rise around 30 meters and are also bounded by the A259 and the sea. The site is located adjacent to the Brighton Air Quality Management Area.
Potential opportunities	The development areas could enable sites for an energy centre.
Links to other clusters	Potential link to Cluster 2 (Eastern Road) approximately 1km away.
Policy and Strategies	Brighton Marina masterplan (2008) - an SPD is being developed which will supercede this document. Draft City Plan Part 1, forthcoming draft City Plan Part 2. Development Area 2: Brighton Marina.
Key stakeholders	Marina Developer

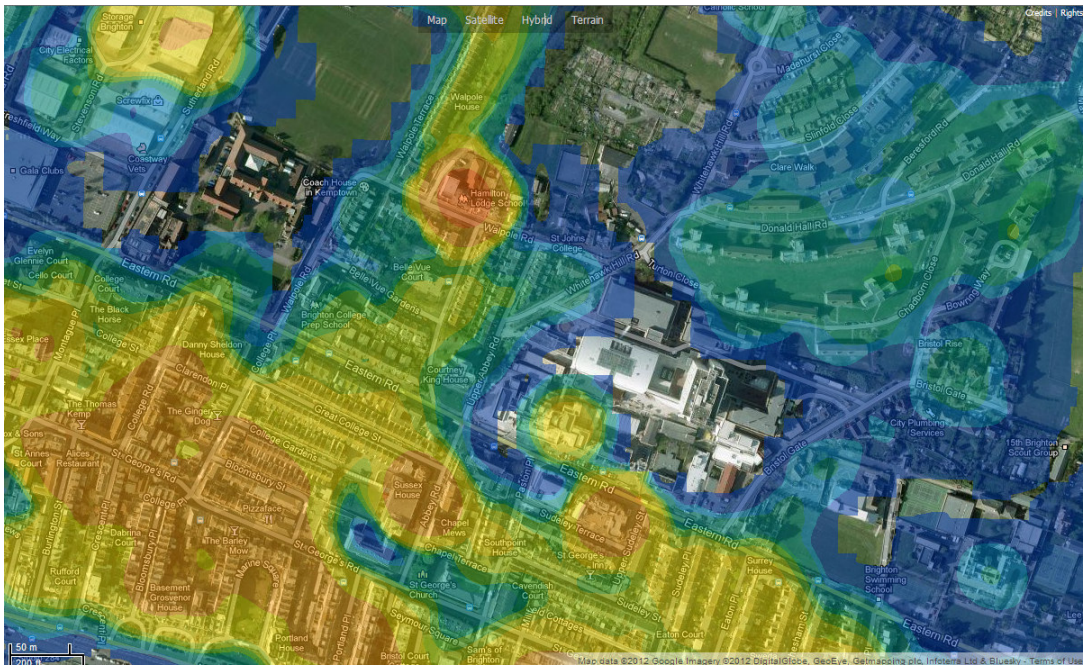
Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	Brighton Steiner School		School	Brighton Steiner School Charity	
2	Marine Drive		Housing	Various private	
3	Roedean Fire Station			East Sussex Fire and Rescue	

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building Type**	**Status / Timing Assumed**	**Notes**
A	Brighton Marina Inner Harbour		Community 1,500sqm Leisure 3,500sqm Retail 5,000sqm 1,000 residential units	2014-24 (housing to 2030)	853 residential units already granted planning permission for the outer harbour
B	Black Rock Development		Leisure 7,000sqm		
C	Gas Works Development		Office 4,000sqm Retail 500sqm 85 residential units		
D	Primary School		Primary School 2,000sqm		Not in a Strategic Allocation

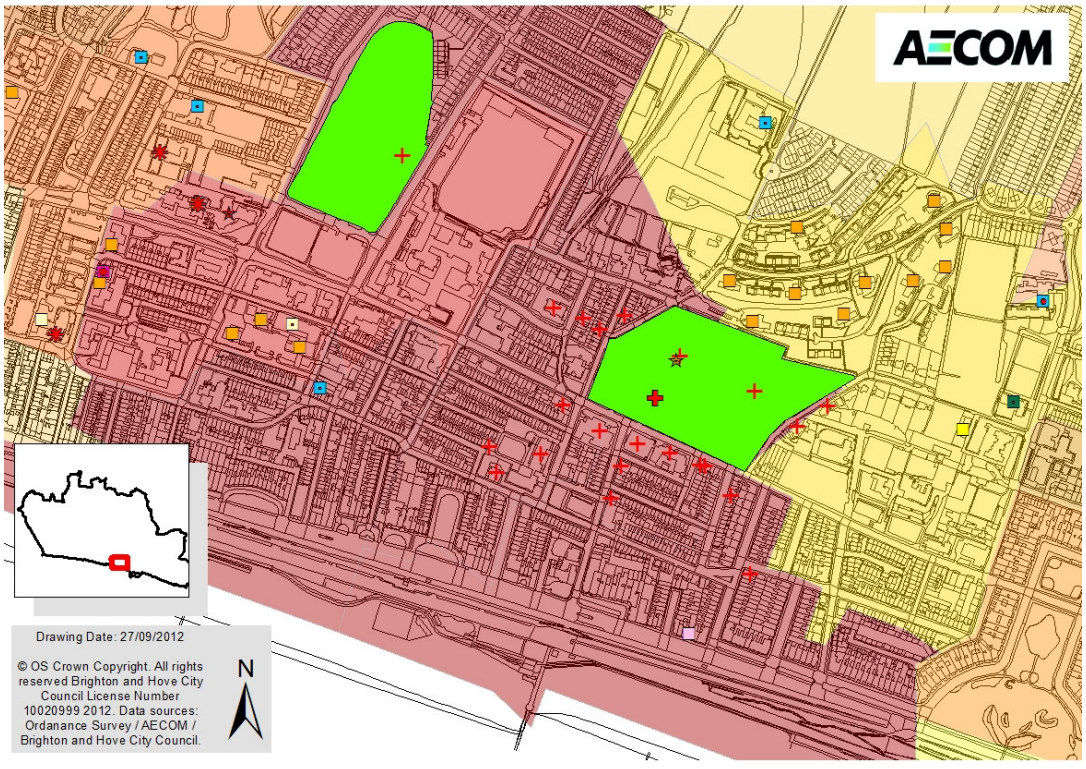
Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

2 Eastern Road

National Heat Map



Local District Heating Opportunity Map



Site Review	
Existing buildings	Key buildings in this cluster are the Royal Sussex County Hospital, the Swimming Pool, former St Marys School, Brighton College and numerous residential and care homes – notably several Council-owned high rise residential blocks.
Proposed buildings/ development sites	There are two key development sites in the cluster. The Royal Sussex County Hospital site is undergoing significant hospital redevelopment (their 3Ts programme) with the majority to complete by 2017. The Freshfield Road site nearby is currently light industrial but has the potential to be developed to provide offices, warehousing and a significant amount of residential development.
Potential constraints	Eastern Road is a major road and narrow in parts, so installing infrastructure could be disruptive. The cluster is located within the Brighton AQMA, which could have an impact on the choice of technology or design of the system.
Potential opportunities	Planned 3MW gas CCHP and communal heat network in the Hospital. Existing communal systems also located in some of the residential buildings. The Council are also investigating the potential to install communal heating facilities as part of renewal programmes at some of the other residential buildings/estates within the cluster.
Links to other clusters	Potential link to clusters 1 (Brighton Marina) and 3 (Edward Street)
Policy and Strategies	Draft City Plan Part 1, forthcoming draft City Plan Part 2. Development Area 5: Eastern Rd and Edward St

Building Ownership/Key stakeholders	There are a number of Council owned buildings in the cluster however many of the buildings are owned by other public sector bodies including Brighton and Sussex University Hospitals NHS Trust, Social Housing Providers, a care home operator and Brighton College.

Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	Royal Sussex County Hospital		Hospital	NHS	
2	Royal Alexandra Childrens Hospital		Hospital	NHS	
3	Sussex Eye Hospital		Hospital	NHS	
4	NHS Trust Buildings		Hospital	NHS	
5	Audrey Emerton Building		Hospital	NHS	
6	Sussex House		Hospital	NHS	
7	Roedean Prep School		School	Private	
8	Brighton College Prep School		School	Private	
9	Brighton College		School	Private	Includes swimming pool
10	Swimming Pool (St Mary's)		Leisure	Private	
11	Former St Mary's College		Offices	? (in use by NHS)	
12	Hereford Court		Residential	Council	
13	Wiltshire House		Residential	Council	
14	St Josephs Rest Home		Care Home	?	
15	Patching Lodge		Residential	RSL? (Hanover)	Existing gas CHP
16	Donald Sheldon House		Care Home	RSL	
17	College Court		Care Home	RSL	
18	Cecil Court		Care Home	RSL	
19	Evelyn Glennie Court		Care Home	RSL	
20	Jaqueline Du Pre Court		Care Home	RSL	
21	Martlet Court		Care Home	RSL	
22	Courtney King House		Care Home	RSL	

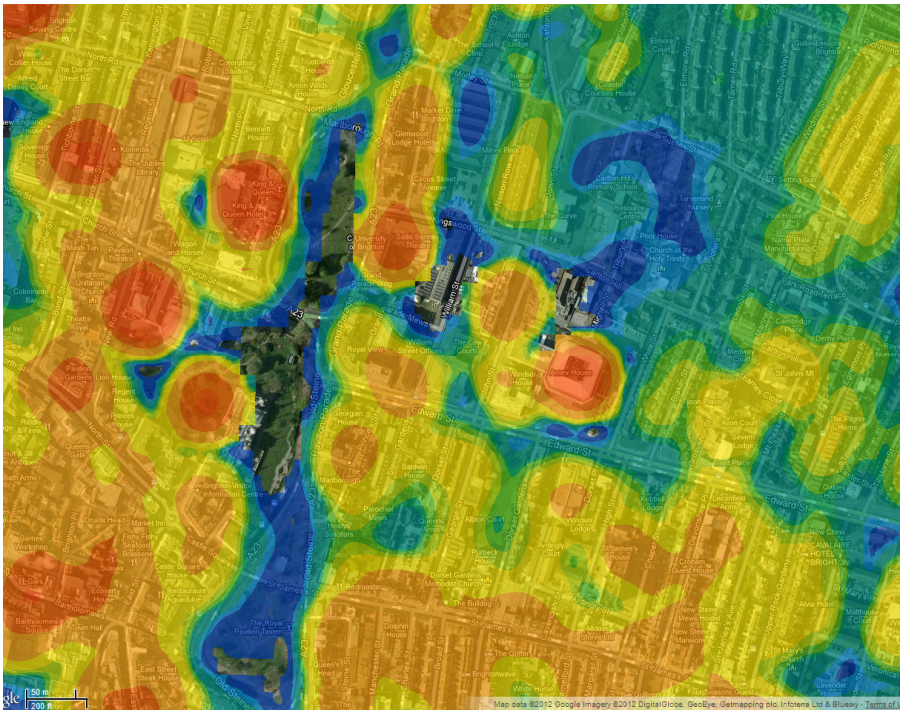
23	Leach Court	1800 MWh/yr	Residential	Council	Communal boilers (replacement due 2021). 108 properties.
24	Sloane Court	510 MWh/yr	Residential	Council	Communal boilers (replacement due 2021). 40 properties.
25	Lavender House	90 MWh/yr	Residential	Council	Communal boilers (replacement due 2021). 25 properties.
26	Donald Hall Road Flats		Residential	Council	Considering conversion into communal heating
27	Essex Place		Residential	Council	
28	Somerset Point		Residential	Council	
29	Turton Court		Residential	Council	
30	Chadborn Close		Residential	Council	
31	Bowring Way		Residential	Council	
32	Warwick Mount		Residential	Council	
33	Lavender St Housing Office	355 MWh/yr	Office	Council	
34	Somerset Day Centre		Day Centre	Council	
35	Craven Vale Resource Centre	365 MWh/yr	Care Home	Council	Slightly distanced from other buildings
36	Montague House Day Centre	165 MWh/yr	Day Centre	Council	
37	Hamilton Lodge School		School	Private	
38	Montague Place	15 MWh/yr	School	Council	
39	St Marks CE Primary School	210 MWh/yr	School	Council (voluntary aided)	
40	St John the Baptist RC Primary	155 MWh/yr	School	Council (voluntary aided)	
41	Royal Spa Nursery School	20 MWh/yr	School	Council	Close to Edward St cluster
42	Queens Park Primary School	160 MWh/yr	School	Council	Close to Edward St cluster

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building Type**	**Status / Timing**	**Notes**
A	Development on Hospital site	Hospital	Hospital 74,000sqm	2013-20, majority by 2017	
B	Freshfield Road Site	Mixed Use	Office 10000sqm Warehouse 10,000sqm 215 residential units	2025-30	c.500m from hospital

Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

3 Edward Street

National Heat Map



Local District Heating Opportunity Map

Site Review	
Existing buildings	Key buildings in this cluster are the Prince Regent swimming pool, Royal Pavilion and a collection of other public buildings at the bottom of Edward Street.
Proposed buildings/ development sites	The new Amex building is being constructed on the carpark to the north of the existing site. A 300kW gas CHP system is included. There is another development site in this cluster located on the old Market site on Circus Street. The scheme is being developed by Cathedral and proposals include for a new public piazza, teaching and research facilities for the University of Brighton, a new dance studio and creative workspaces, up to 200 residential homes, office space, restaurants and a 400 bed student accommodation.
Potential constraints	Topography and major roads may be constraints. The cluster is located within the Brighton AQMA, which could have an impact on the choice of technology or design of the system.
Potential opportunities	CHP in the new Amex building.
Links to other clusters	Potential link to clusters 2 (Eastern Road), 4 (Brighton Centre) and 5 (Brighton Station).
Policy and Strategies	SPD04 - Edward Street Quarter (2006) SPD05 - Circus Street Municipal Market Site (2006) Draft City Plan Part 1, forthcoming draft City Plan Part 2. Development Area 5: Eastern Rd and Edward St.
Key stakeholders	Amex, Police, Courts, Cathedral Group (Circus St site), University of Brighton, Council.

Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	Amex Building		Office	Private	Future occupier?
2	Myhotel Brighton		Hotel	Private	
3	Premier Inn		Hotel	Private	
4	Law Courts and Family Centre		Court	Public other	
5	Sussex County Court		Court	Public other	
6	Brighton Police Station		Offices	Public other	
7	Windsor House Job Centre		Offices	Public other (DWP)	
8	47 Grand Parade		Office	Public other	
9	Main Building Grand Parade	2120 MWh/yr	University	University of Brighton	
10	Circus St	165 MWh/yr	University	University of Brighton	
11	68 Grand Parade	35 MWh/yr	University	University of Brighton	
12	Pavilion Parade	85 MWh/yr	University	University of Brighton	
13	St Peter's House	65 MWh/yr	University	University of Brighton	
14	Morley St School Clinic, Globe House		Health	NHS	
15	Prince Regent Pool	1835 MWh/yr	Leisure	Council	
16	Slipper Baths Fitness Centre		Leisure	Council	
17	Slipper Baths Nursery		Community	Council	
18	Jubilee Library		Cultural	Council (PFI)	
19	Royal Pavilion	190 MWh/yr	Cultural	Council	
20	Brighton Dome		Cultural	Brighton Festival Trust	
21	Brighton Museum and Art Gallery		Cultural	Council	
22	Corn Exchange		Cultural	Brighton Festival Trust	

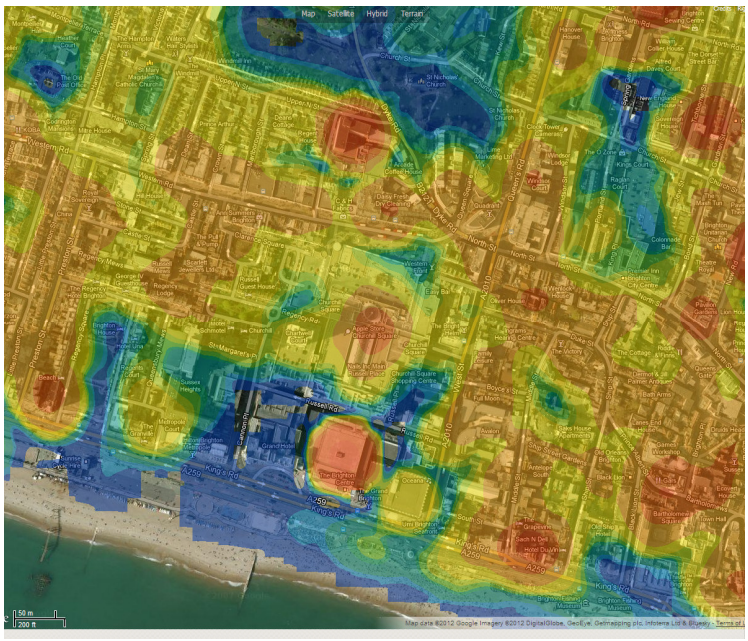
23	Pavilion Theatre		Cultural	Brighton Festival Trust	
24	Old Court House	60 MWh/yr	Cultural	Council	
25	Carlton Hill Primary School	150 MWh/yr	School	Council	
26	Tarnerland Nursery School	50 MWh/yr	School	Council	
27	Mantell House		Care Home	Council	
28	St James' House	2010 MWh/yr	Residential	Council	Communal Heating (boiler replacement due 2021). 119 properties.
29	St John's Mount		Residential	Council	
30	Tyson Place		Residential	Council	
31	Courtlands, Ashton Rise		Residential	Council	
32	Saxonbury, Ashton Rise		Residential	Council	
33	Richmond Heights, John St		Residential	Council	
34	Normanhurst, Grove Hill		Residential	Council	
35	Ecclesden, Grove Hill		Residential	Council	
36	Highleigh, Grove Hill		Residential	Council	
37	Thornsdale, Albion Hill		Residential	Council	
38	Sovereign House		Office	Public other	
39	Tourist Information Office		Office	Council	
40	Princes House		Office	?	
41	Regent House		Office	?	
42	Prior House		Office	Council	
43	Northgate House		Office	Council	
44	62 and 63 Old Steine	70 MWh/yr	Office	Council	
45	3 Palace Place		Office	Council	
46	30 New Road		Office	Council	
47	162 North St		Office	? (leased by Council)	
48	4-7 Pavilion Buildings	105 MWh/yr	Office	Council	
49	12a Pavilion Buildings		Office	Council	
50	St James Mansions		Office	Council	
51	Brighton Town Hall	295 MWh/yr	Office	Council	Further away.

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building Type**	**Status / Timing**	**Notes**
A	New Amex Building		Office	2012	Gas CHP 300kW
B	Edward Street		Office 30000sqm 165 residential units	2014-24	
C	Circus Street		Student Accommodation 6000sqm Dance studio 500sqm University Library 3800sqm Office 3200sqm Retail 1000sqm 160 residential units	2014-19	
D	Community Centre		Community including GP 1500sqm	2014-24	Referenced in City Plan Part 1, not in a Strategic Allocation
E	Additional New Homes		60 residential units		Referenced in City Plan Part 1, not in a Strategic Allocation

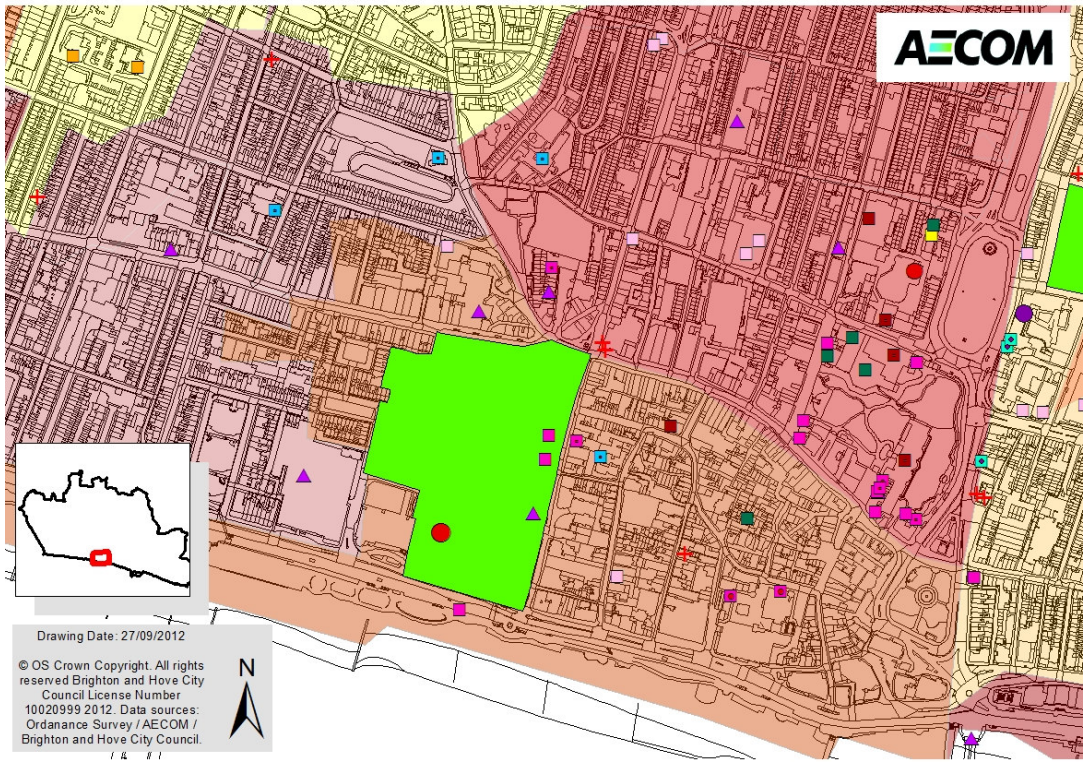
Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

4 Brighton Centre

National Heat Map



Local District Heating Opportunity Map



Site Review	
Existing buildings	The key existing buildings are the Brighton Centre, Churchill shopping centre, several hotels and residential tower blocks.
Proposed buildings/ development sites	Redevelopment of the Brighton Centre and Churchill Square.
Potential constraints	Listed Buildings including the Grand Hotel, St Paul's Church and Regency Square. The cluster is located within the Brighton AQMA, which could have an impact on the choice of technology or design of the system.
Potential opportunities	Redevelopment of the Brighton Centre could provide a potential energy centre location, subject to overall scheme viability and agreement with Standard Life, the key private sector funding and delivery partner. A new primary sub-station was indicated at the time of the SPD (2005) as likely to be required if development goes ahead (SPD01).
Links to other clusters and extensions	Link to cluster 3 (Edward Street). Potential extension to connect to the Town Hall, Register Office, Thistle Hotel (with swimming pool) and Queens Hotel.
Policy and Strategies	SPD01 - Brighton Centre: Area Planning and Urban Design Framework (2005) Draft City Plan Part 1, forthcoming draft City Plan Part 2. Development Area 1: Brighton Centre and Churchill Square.
Key stakeholders	Major neighbouring hotels, operators of Churchill Shopping Centre, Council.

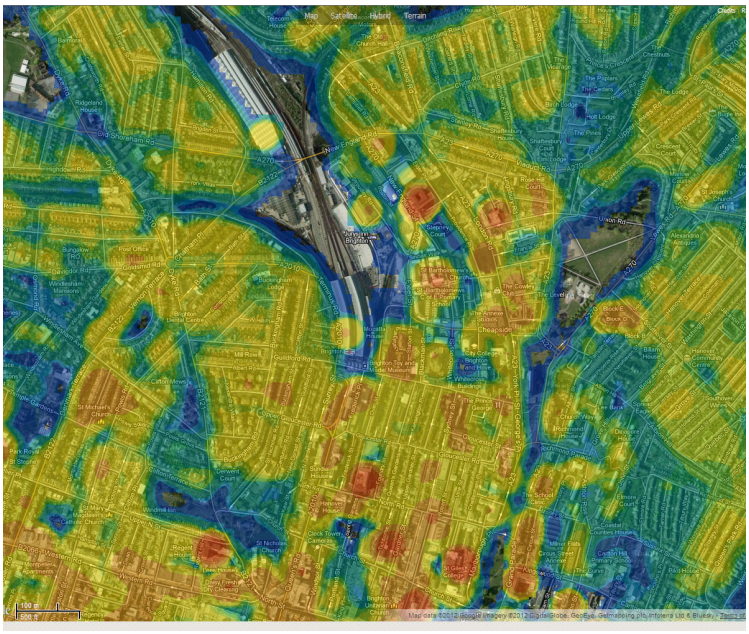
Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	Churchill Square – M&S etc		Retail	Private	To be redeveloped
2	Odeon Grand		Leisure	Private	
3	Grand Hotel		Hotel	Private	
4	Hilton Metropole		Hotel	Private	
5	Travelodge		Hotel	Private	
6	Family Co UK Ltd, 16 West St		Office	Private	
7	Queen Square House		Office	Private	
8	Medical Centre, North St		Health	PCT	
9	Sussex Heights		Residential	Private	
10	Chartwell Court		Residential	?	
11	69-70 Middle St		Office	Other public	
12	Crown House		Office	Other public	
13	Brighton Centre	2930 MWh/yr	Conference	Council	To be redeveloped
14	Middle St Primary School	85 MWh/yr	School	Council	
15	National House		Office	Council	
16	Phoenix House		Office	Council (part leased in only)	
17	Ovest House	25 MWh/yr	Office	Private (leased in by Council)	Council's lease soon to be terminated
18	11 Queen Square		Office	Council	May not be retained
19	Bartholomew House	255 MWh/yr	Office	Council	Further away from main cluster area
20	Brighton Town Hall	295 MWh/yr	Office	Council	Further away from main cluster area

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building Type**	**Status / Timing**	**Notes**
A	Brighton Centre and Churchill Square		Retail 20,000sqm Cinema 4,500sqm Hotel 3,000sqm Conference Centre 25,000sqm	2016-20	
B	New Residential		20 new homes	2013-14 2024-25	

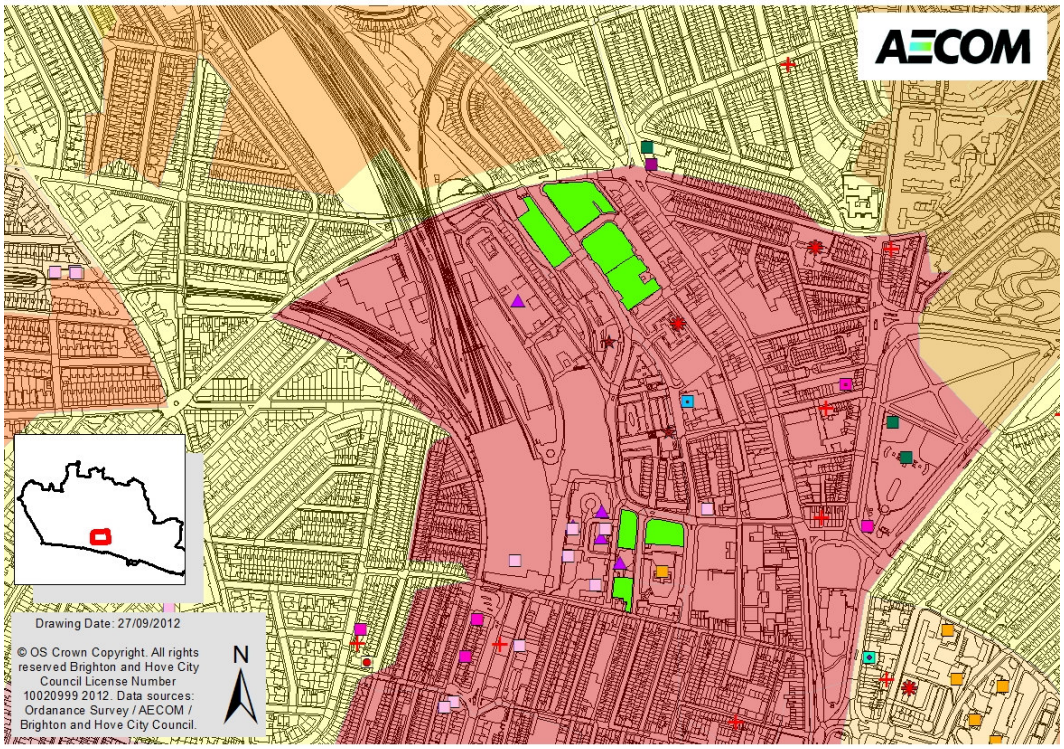
Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

5 New England Quarter and London Road

National Heat Map



Local District Heating Opportunity Map



Site Review	
Existing buildings	The New England Quarter includes residential and commercial buildings including a hotel and a college.
Proposed buildings/ development sites	A total of 20,000sqm of B1 office use is allocated in the City Plan Part 1 at London Road. A further 14,000sqm of B1 is expected at Preston Road. Ancillary retail uses and student accommodation is also referenced in the City Plan. 1,140 new homes are expected.
Potential constraints	The cluster is located within the Brighton AQMA, which could have an impact on the choice of technology or design of the system. This has impacted upon previous proposals for CHP and a heat network in the area.
Potential opportunities	Remaining sites still to be developed.
Links to other clusters	The southern edge of this cluster is located c.300m to the north of the edge of Cluster 3 (Edward Street).
Policy and Strategies	London Road SPD (2009) Draft City Plan Part 1, forthcoming draft City Plan Part 2. Development Area 4: New England Quarter and London Rd.
Building Ownership/Key stakeholders	City College and development partners, One Brighton owners, Bellerby College, Developers.

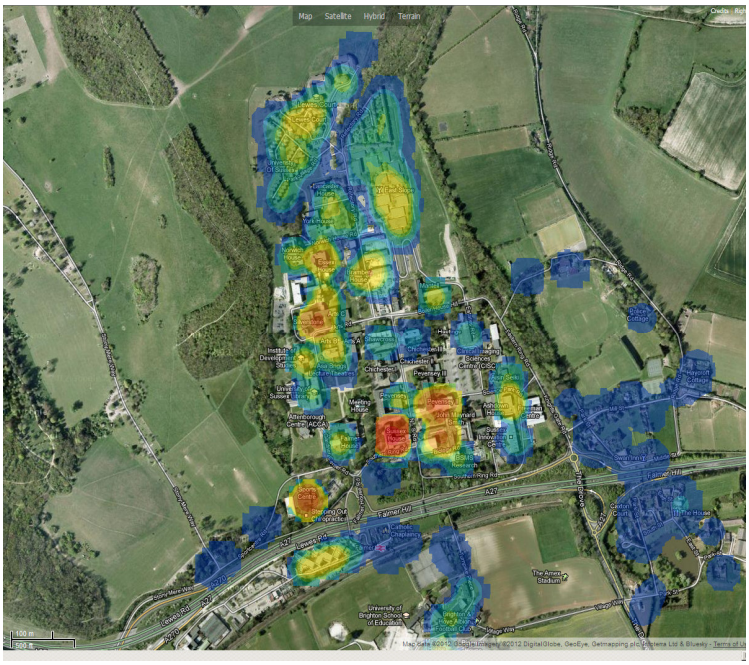
Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	One Brighton		Residential	Private	Existing communal heating
2	Jury's Inn		Hotel	Private	
3	City College		Education	Public other	
4	Bellerby College		Education	Bellerbys Educational Services Ltd	
5	St Bartholomew's Primary School	155 MWh/yr	School	School Trustees (Voluntary aided)	
6	Rose Hill Court	405 MWh/yr	Residential	Council	Communal boiler (potential for replacement 2013/14). 27 properties.
7	Theobold House		Residential	Council	
8	Napier House		Office	Pensions Regulator	
9	Lanchester House		Office	Brighton and Hove PCT	
10	Invicta House and Mocatta House		Office	Central Government	
11	Belmont St		Office	Central Government	
12	Britannia House		Office	Home, Leisure and Motoring Association	
13	Victory House		Office	Mott Macdonald	
14	New England House		Office	BHCC	

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building Type**	**Status / Timing**	**Notes**
A	New England Quarter and London Road Sites		Office 20,000sqm Ancillary Retail 1000sqm	2016-24	Block J and Block K Brighton Station Site and GB Liners site, Blackman Street have extant planning permissions.
B	Preston Road		Office 14,000sqm	2016-24	
C	Student Accommodation		Student Accommodation 4500sqm	2016-24	Referenced in City Plan
D	Residential		1,140 new homes	2013-30	165 units in strategic allocation for London Rd a-e, 460 units at Preston Rd
E	London Road Former Co-op (under consideration)		Student Accommodation 7165sqm Residential/Retail 2052sqm Retail 4086sqm	2012-15	Application under consideration 2012 – 351 units of student accommodation and 3 retail units. ASHP communal heating proposed.

Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

6 Sussex University

National Heat Map



Local District Heating Opportunity Map

Site Review	
Existing buildings	The existing buildings are those comprising the University of Sussex campus.
Proposed buildings/ development sites	There are plans to redevelop existing student accommodation at the East Slope Residences and adjoining land, with a net increase in room numbers.
Physical constraints	The motorway and railway to the South of the site makes a potential connection across to Cluster 7 difficult.
Potential opportunities	Potential use of alternative technologies, particularly biomass given the location.
Links to other clusters	Cluster 7 – University of Brighton Paddock Field
Policy and Strategies	Draft City Plan Part 1, forthcoming draft City Plan Part 2.Development Area 3: Lewes Rd.
Building Ownership/Key stakeholders	Sussex University, University of Brighton (to explore connection)

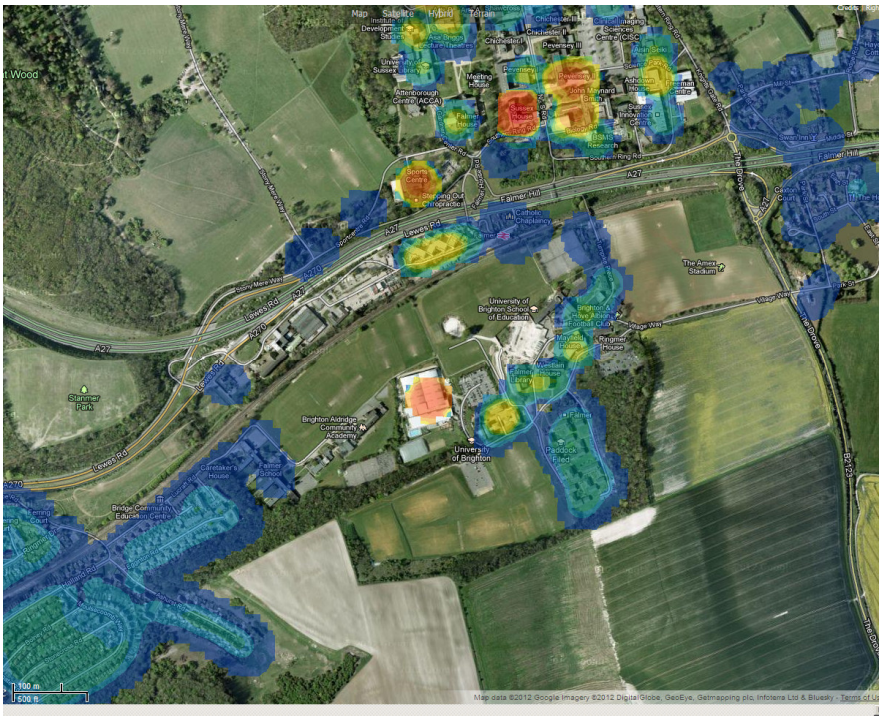
Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	University of Sussex campus		Mixed	University of Sussex	Existing 1.16MW gas CHP and DH system

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building Type**	**Status / Timing**	**Notes**
A	Student Accommodation		Student Accommodation 8,250sqm	2014-24	

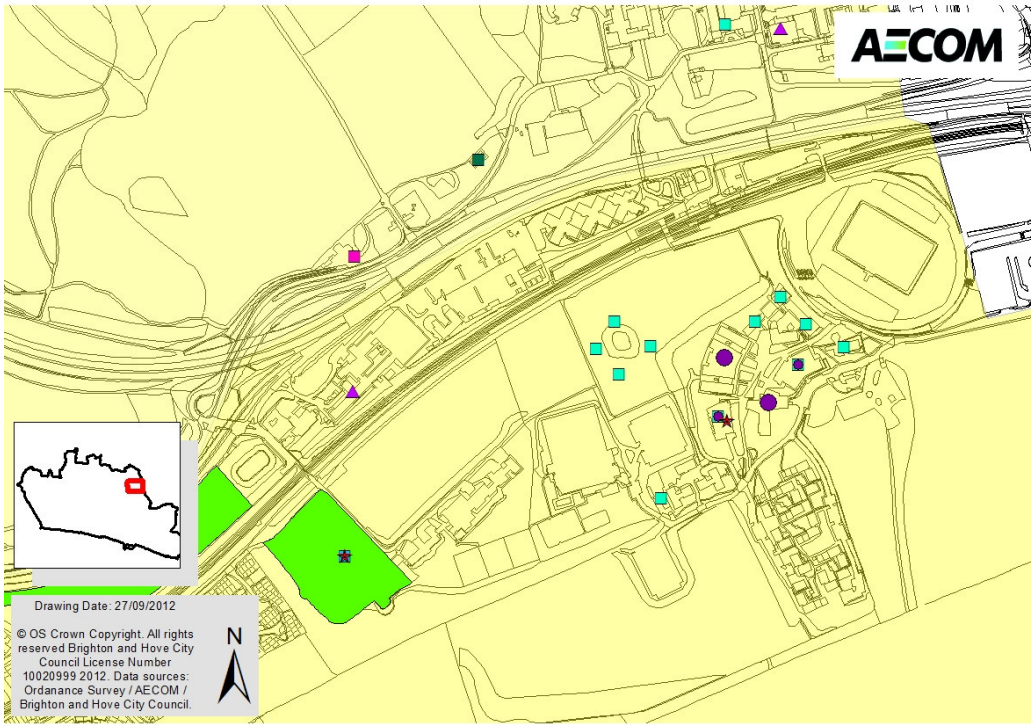
Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

7 University of Brighton Paddock Field

National Heat Map



Local District Heating Opportunity Map



Site Review	
Existing buildings	The existing buildings are mainly those on the University of Brighton campus, plus a private leisure centre, the Amex stadium and the Brighton Aldridge Community Academy.
Proposed buildings/ development sites	Approx 600m from Falmer Release Land (Lewes Road Development Area).
Potential constraints	The motorway and railway present potential barriers to connection with Sussex University.
Potential opportunities	Potential to explore the use of biomass or anaerobic digestion given the location of the site. The University of Brighton Varley Halls student accommodation is currently onsite with a gas CHP DH system, although this is on the other side of the railway track and A270.
Links to other clusters	The area is relatively isolated from the main Cluster 6 – Sussex University.
Policy and Strategies	Draft City Plan Part 1, forthcoming draft City Plan Part 2. Development Area 3: Lewes Rd.
Building Ownership/Key stakeholders	University of Brighton, Esporta, Sussex University, (to explore connection).

Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	Amex Stadium		Leisure	BHFC	
2	Ringmore House		University	UoB	Gas CHP at Falmer Site (building?)
3	Small Hall		University	UoB	
4	Mayfield House	473 MWh/yr	University	UoB	

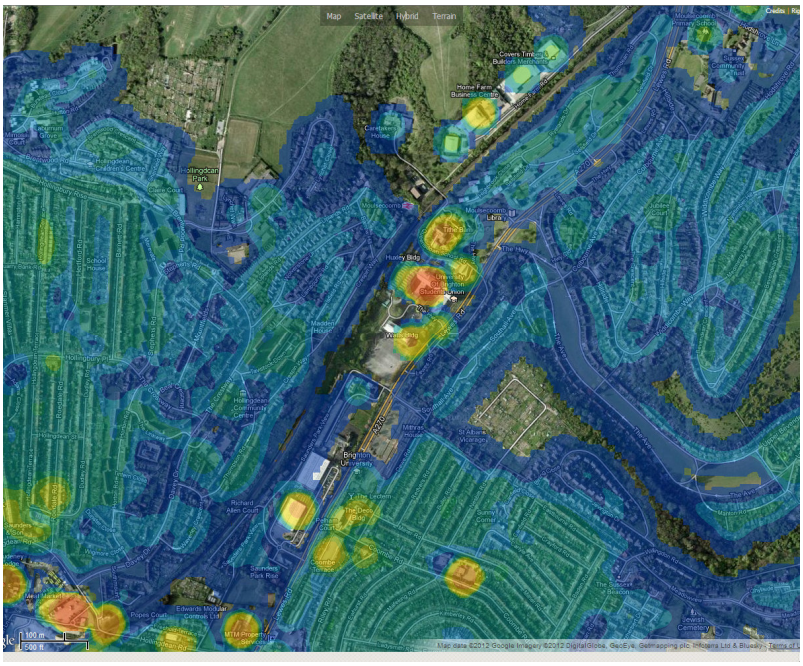
5	Westlain House	2650 MWh/yr	University	UoB	
6	Falmer Library	477 MWh/yr	University	UoB	
7	Checkland Building	1518 MWh/yr	University	UoB	
8	Coldean House		University	UoB	
9	Bevendean House		University	UoB	
10	Dallington House		University	UoB	
11	Falmer Sports Centre		Leisure	UoB	
12	Paddock Field		Student Accommodation	UoB	
13	Esporta Health Club		Leisure	Private	
14	Brighton Aldridge Community Academy		Education	Private	550kW Biomass
15	The Keep, Woollards Field		Public	ESCC/ BHCC	0.3MWe Biomass. Other side of railway track.

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building Type**	**Status / Timing**	**Notes**
A	Falmer Released Land		Not yet determined	Unknown	

Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

8 University of Brighton Moulsecoomb

National Heat Map



Local District Heating Opportunity Map

Site Review	
Existing buildings	The existing buildings are those on the University of Brighton's Moulsecoomb campus, and a few Council-owned bulidings.
Proposed buildings/ development sites	The Preston Barracks site.
Physical constraints	The A270 presents a major barrier with several buildings located on each side of the road.
Potential opportunities	The new development site presents an opportunity to initiate a network that could use the existing campus to provide an anchor load to improve the potential of the scheme. There is an existing gas boiler communal heating system in the Cockcroft Building which also serves the Heavy Engineering Block.
Links to other clusters	No other clusters are located nearby.
Policy and Strategies	Draft City Plan Part 1, forthcoming draft City Plan Part 2. Development Area 3: Lewes Rd.
Building Ownership/Key stakeholders	University of Brighton, Council, Developers of Preston Barracks.

Key existing buildings

Ref	Name	Heat Demand	Building type	Owner	Notes
1	Tithe Barn		University	UoB	
2	Manor House		University	UoB	
3	Moulsecoomb Place		Student Accommodation	UoB	
4	Huxley Building		University	UoB	
5	Aldrich Library	520 MWh/yr	University	UoB	
6	Cockcroft Building		University	UoB	Gas boiler serving Heavy Engineering Block
7	Heavy Engineering		University	UoB	

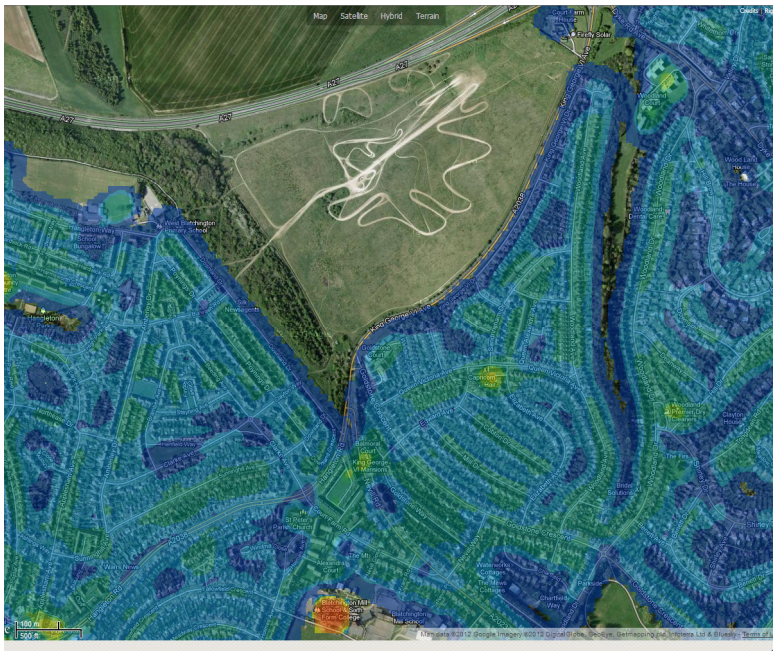
	Block				
8	Watts Building		University	UoB	
9	Tithe Barn		University	UoB	
10	Mithras House		University	UoB	
11	Steam House	86 MWh/yr	University	UoB	
12	Mithras House Annexe		University	UoB	
13	B&Q		Retail	Private	
14	William Moon Lodge		Care home	Charity	Gas CHP c.400m from main cluster and across Lewes Rd
15	Moulsecoomb Library		Cultural	Council	
16	St Josephs RC Primary	215 MWh/yr	School	School trustees (voluntary aided)	c.400m from main cluster and across Lewes Rd
17	Lindfield Court	450 MWh/yr	Residential	Council	Communal boiler (due for replacement 2008). 28 properties. c.400m from main cluster and across Lewes Rd
18	Coombe Rd Primary School		School	Council	c.450m from main cluster

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building Type**	**Status / Timing**	**Notes**
A	Preston Barracks		Office 10,600sqm Student Accommodation 11,250sqm Academic 16,000sqm Residential 300units	2014-24 for non-domestic 2013-30 for domestic	

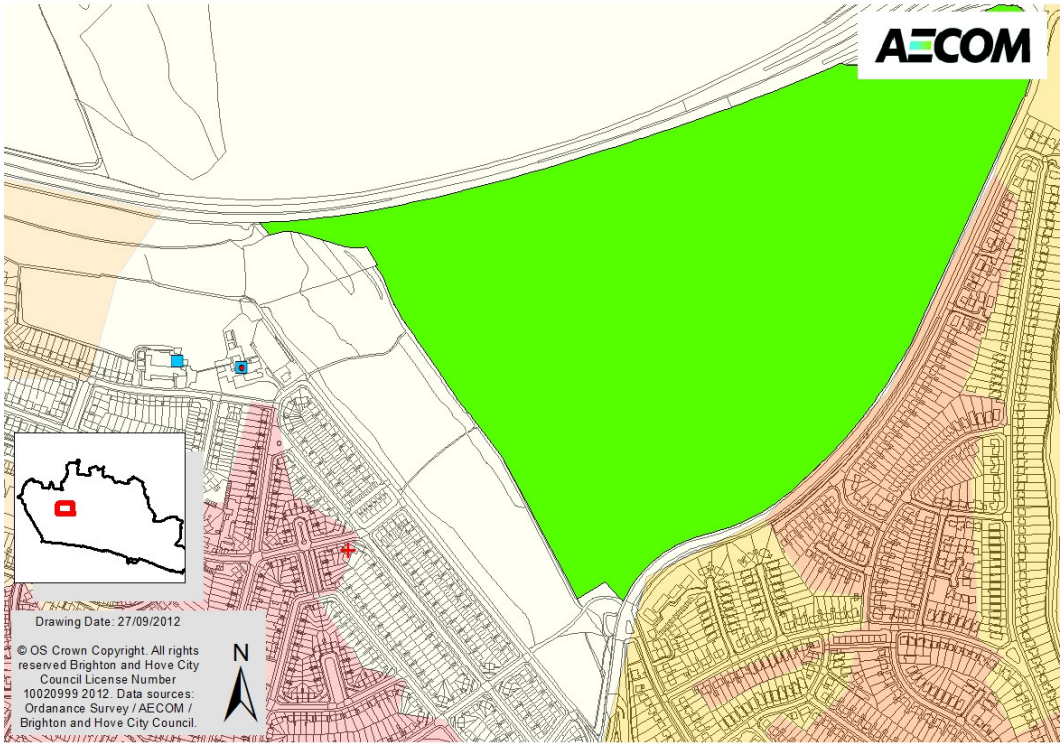
Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

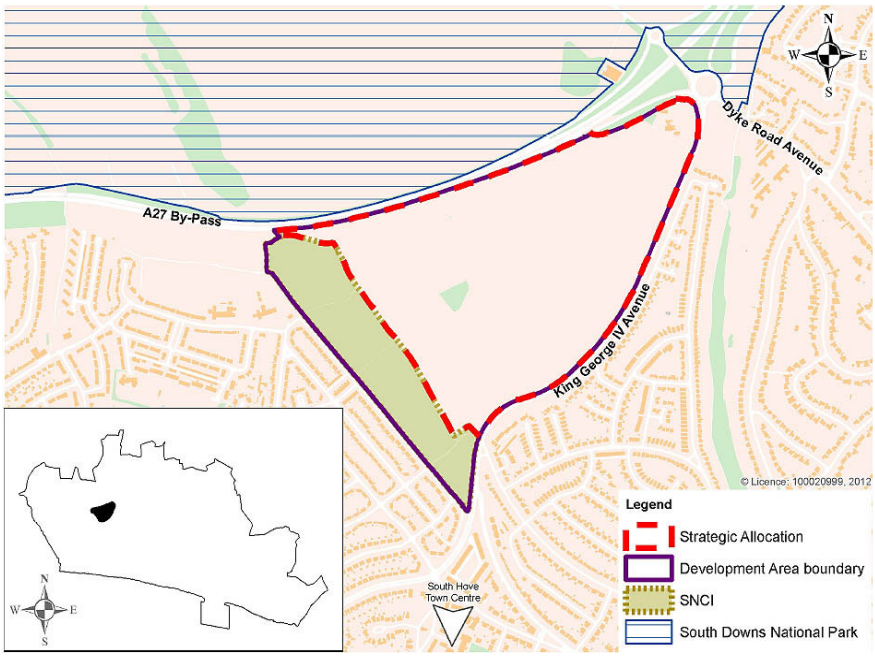
9 Toads Hole

National Heat Map



Local District Heating Opportunity Map



Site Review	
Existing buildings	West Blatchington Primary School
Proposed buildings/ development sites	The Toads Hole site has the potential to incorporate around 700 new homes as well as 25,000sqm office space, a new secondary school, community facilities, ancillary retail uses and open space. 
Potential constraints	Site topography could make a network difficult, the ecology park may make connection to the neighbouring school difficult.
Potential opportunities	A Greenfield site could make the planning and installation of a heat network and energy centre much more straightforward and cost effective. High sustainability and energy targets are being proposed for the site which may require a district heating network to meet them.
Links to other clusters	Cluster 10 (Hove Park) is located around 1km from the Southern edge of the site.
Policies and Strategies	Draft City Plan Part 1, forthcoming draft City Plan Part 2.Development Area 7: Toads Hole Valley.
Building Ownership/Key stakeholders	Toads Hole developer

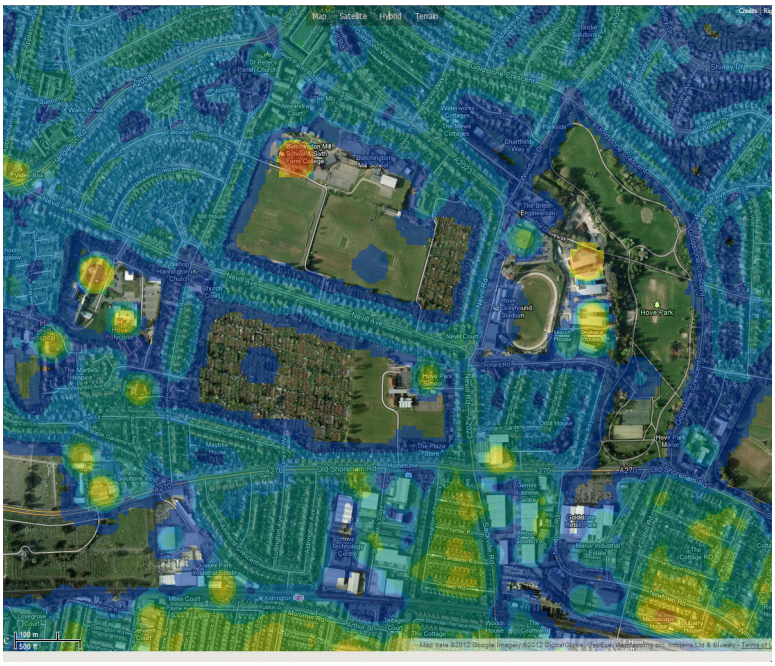
Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	West Blatchington Primary School	320 MWh/yr	School	Council	

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building Type**	**Status / Timing**	**Notes**
A	Toads Hole		Office 25,000sqm Secondary School 9,000sqm Community 1,000sqm Retail 500sqm Residential 700units	2016-20	

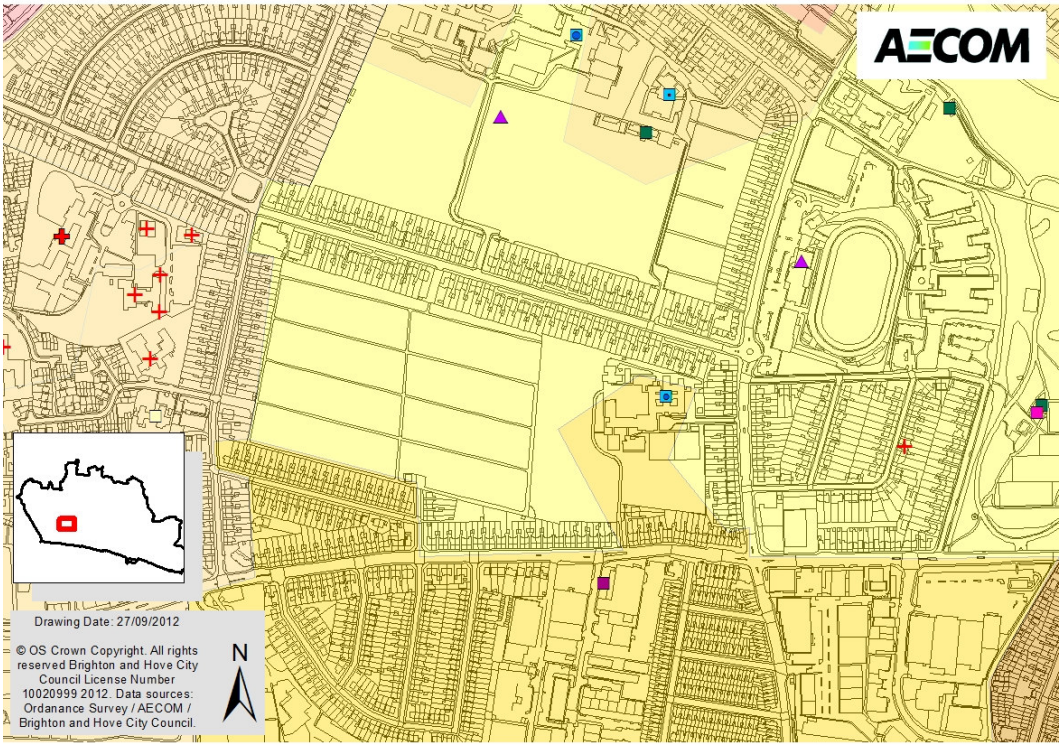
Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

10 Hove Park

National Heat Map



Local District Heating Opportunity Map



Site Review	
Existing buildings	This cluster comprises the health centres at Nevill Avenue as well as several schools and the Legal and General offices, although these buildings are relatively spread out.
Proposed buildings/ development sites	There are no significant development sites in the cluster.
Potential constraints	Large distance (c.2km) from East to West ends of cluster, without significant heat loads in between.
Potential opportunities	Potential to change from oil-heated fuel for a couple of the schools.
Links to other clusters	The site is located around 800m to the north of Cluster 11 (Hove Station) and 1km south of Cluster 9 (Toads Hole).
Policies and Strategies	Draft City Plan Part 1, forthcoming draft City Plan Part 2.
Building Ownership/Key stakeholders	NHS (Sussex Partnership NHS Foundation Trust, Sussex Community NHS Trust, Brighton & Sussex University Hospitals NHS Trust), Council, Legal and General.

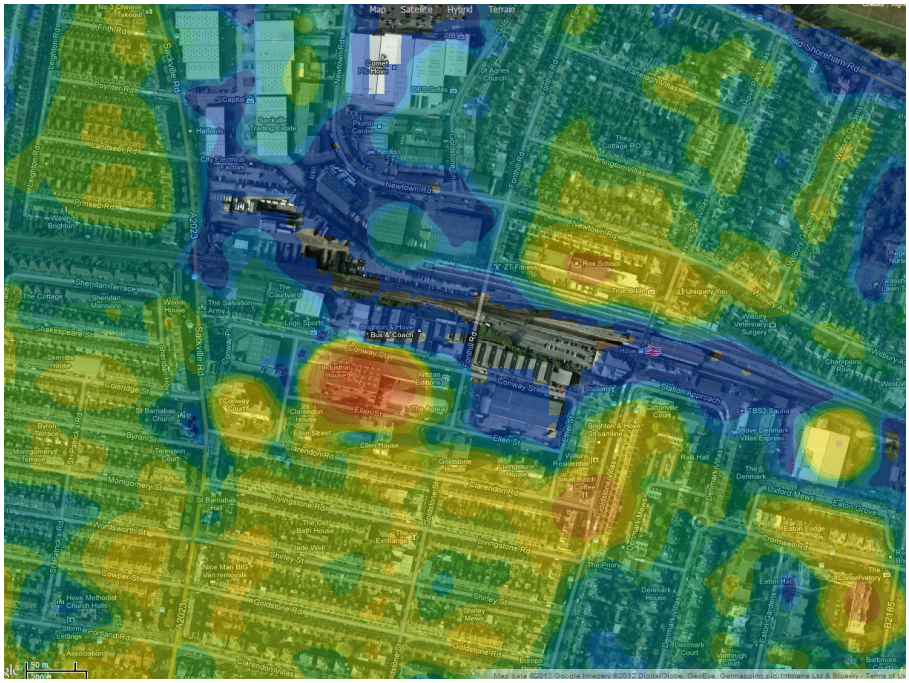
Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	Blatchington Mill High School	520 MWh/yr	School	Council	Currently oil-heated.
2	Hove Park Upper School	330 MWh/yr	School	Council	Currently oil-heated.
3	Goldstone Primary School	155 MWh/yr	School	Council	
4	Goldstone Childrens Centre		School	Council	
5	Aldrington CE Primary	75 MWh/yr	School	School trustees (voluntary	

				aided)	
6	Laburnum Avenue, Nevill Hospital		Hospital	NHS	
7	Hove Polyclinic		Hospital	NHS	
8	Mill View Hospital		Hospital	NHS	
9	Martletts Hospice		Nursing Home	NHS	
10	Butterfly Nursery		Education	NHS	
11	Sussex Education Centre		Education	NHS	
12	Legal & General		Offices	Private	

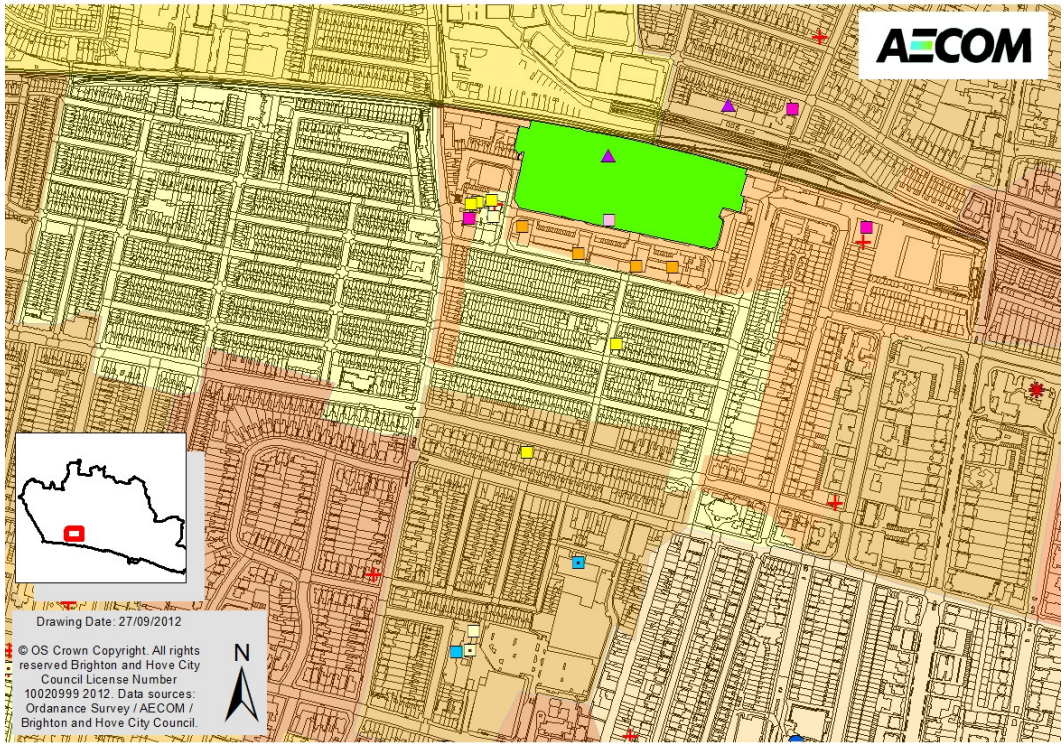
Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

11 Hove Station

National Heat Map



Local District Heating Opportunity Map



Site Review	
Existing buildings	Five Council owned residential tower blocks for which the Council is investigating the potential to install a communal heating network.
Proposed buildings/ development sites	Part of key development site DA6 (Hove Station).
Physical constraints	Railway to the north of the site. Within the Brighton AQMA.
Potential opportunities	Potential to use the new development to trigger a retrofit of the 5 residential towers and connect these to a small district heating network.
Links to other clusters	The site is around 800m south of Cluster 10 (Hove Park) and 1.7km north of Cluster 13 (Hove Beachfront).
Policies and Strategies	Draft City Plan Part 1, forthcoming draft City Plan Part 2. Development Area 6: Hove Station.
Building Ownership/Key stakeholders	Developer(s) of the Hove Station site, Council.

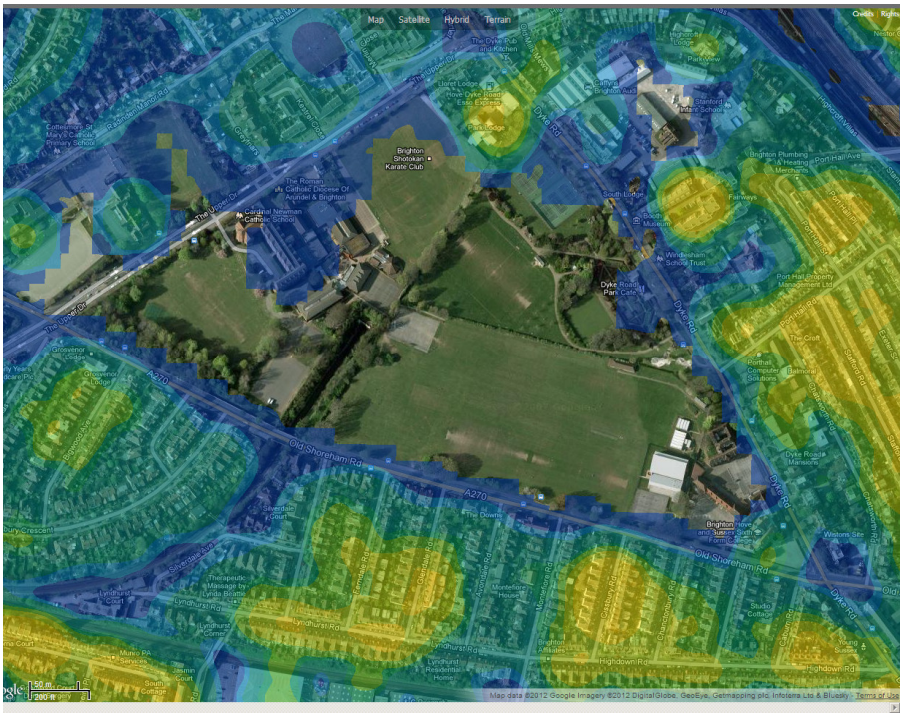
Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	Conway Court		Residential	Council	
2	Clarendon House		Residential	Council	
3	Ellen House		Residential	Council	
4	Goldstone House		Residential	Council	
5	Livingstone House		Residential	Council	
6	The Agora		Office	Other public	

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building Type**	**Status / Timing**	**Notes**
A	Hove Station Development Area		Office 4,000sqm. Residential 575 properties	Non-domestic 2014-20. Domestic 2014-19 and 2024-30	

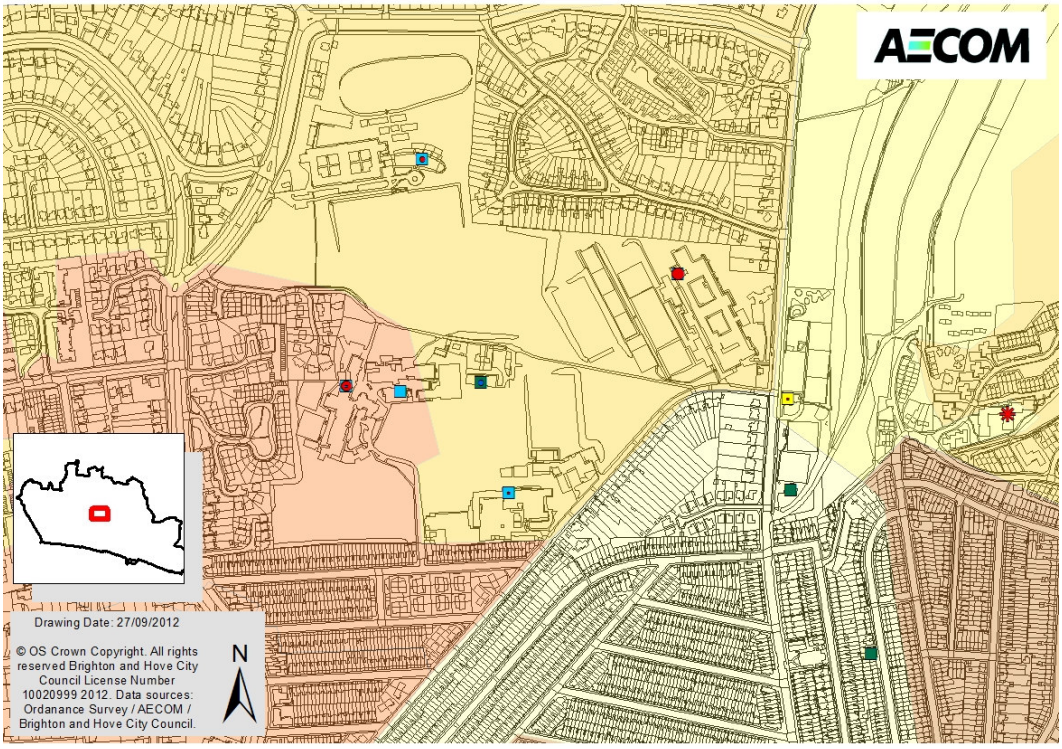
Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

12 Schools cluster

National Heat Map



Local District Heating Opportunity Map



Site Review	
Existing buildings	A cluster of five schools and a swimming pool in fairly close proximity.
Proposed buildings/ development sites	There are no significant development sites nearby.
Physical constraints	
Potential opportunities	Potential to lay heat network under green space rather than roads. Potential to shift from oil on two of the sites to cheaper, lower cost fuels.
Links to other clusters	No other clusters nearby.
Policies and Strategies	Draft City Plan Part 1, forthcoming draft City Plan Part 2.
Building Ownership/Key stakeholders	Council. A couple of the schools are PFIs.

Key existing buildings

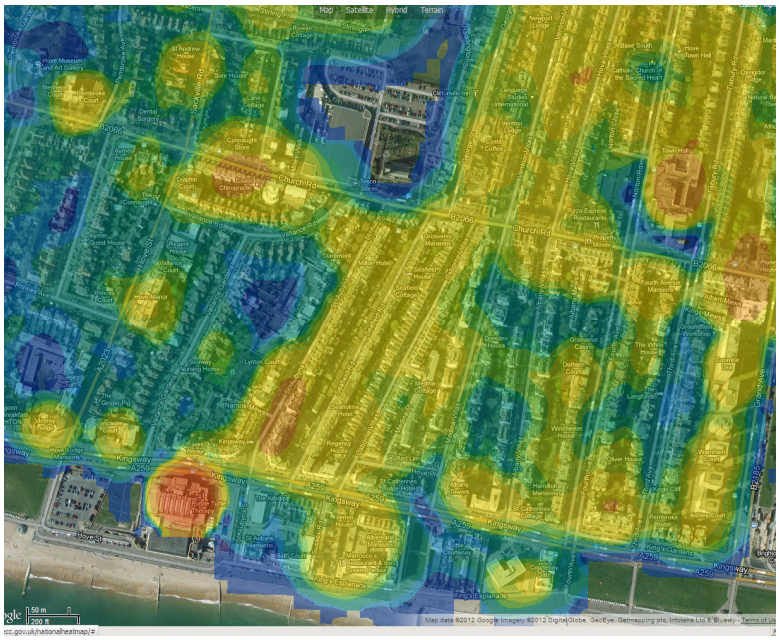
Ref	Name	Heat Demand	Building type	Owner	Notes
1	Varndean High School	835 MWh/yr	School	Council (PFI)	
2	Surrenden Swimming Pool	240 MWh/yr	Leisure	School	Currently oil-heated
3	Varndean College – DownsView Link College	230 MWh/yr	School	Council	
4	Dorothy Stringer High School	190 MWh/yr	School	Council (PFI)	Currently oil-heated
5	Balfour Primary School	260 MWh/yr	School	Council	

Cluster assessment

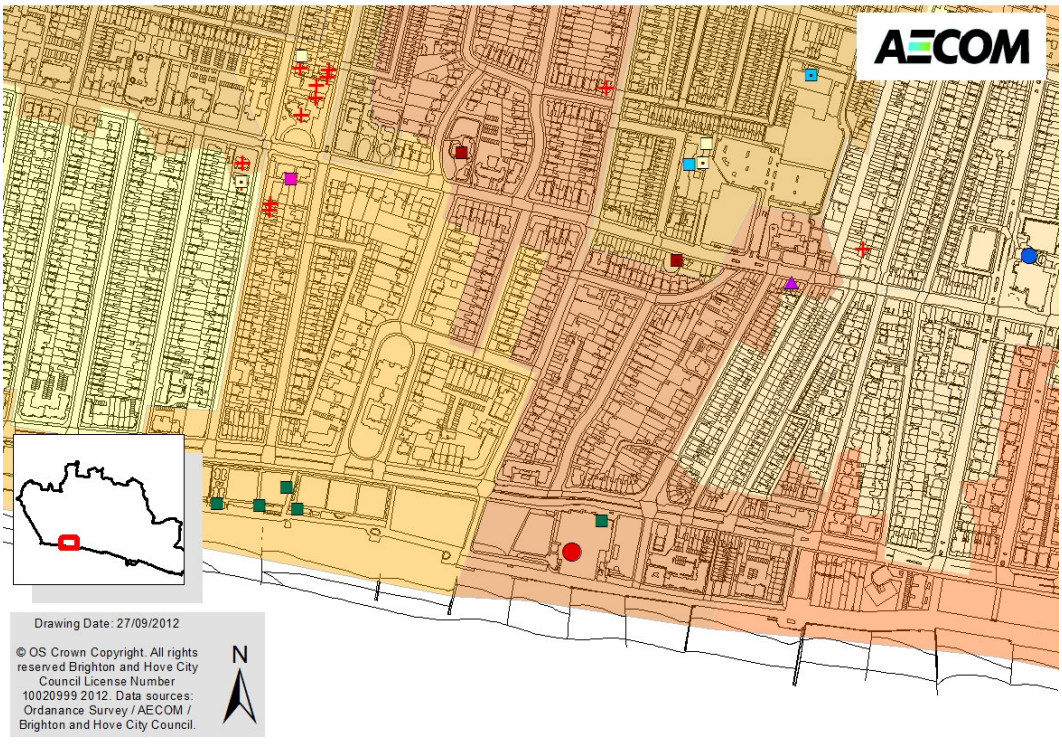
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

13 Hove Beachfront

National Heat Map



Local District Heating Opportunity Map



Site Review	
Existing buildings	The opportunity is focussed around the King Alfred Leisure Centre, a very large heat user. However few other significant potential anchor loads have been identified in the vicinity.
Proposed buildings/ development sites	No significant development sites nearby.
Physical constraints	Major road (A259) between leisure centre and most other buildings.
Potential opportunities	Significant heat demand at leisure centre likely to have potential for CHP.
Links to other clusters	c.1.7km south of cluster 11 (Hove Station).
Policies and Strategies	Draft City Plan Part 1, forthcoming draft City Plan Part 2.
Building Ownership/Key stakeholders	Council.

Key existing buildings

Ref	Name	Heat Demand	Building type	Owner	Notes
1	King Alfred Leisure Centre	3180 MWh/yr	Leisure	Council	
2	Seaway Nursing Home		Care Home	Private	14 rooms
3	Bluebird Court	Unknown	Residential	Private	
4	Lancaster Court	Unknown	Residential	Private	
5	Essex House	Unknown	Residential	Private	
6	Viceroy Lodge	Unknown	Residential	Private	
7	Bath Court	Unknown	Residential	Private	
8	Spa Court	Unknown	Residential	Private	
9	Hove Town Hall	1040 MWh/yr	Office	Council	Currently oil-heated. Over 1.1km away.

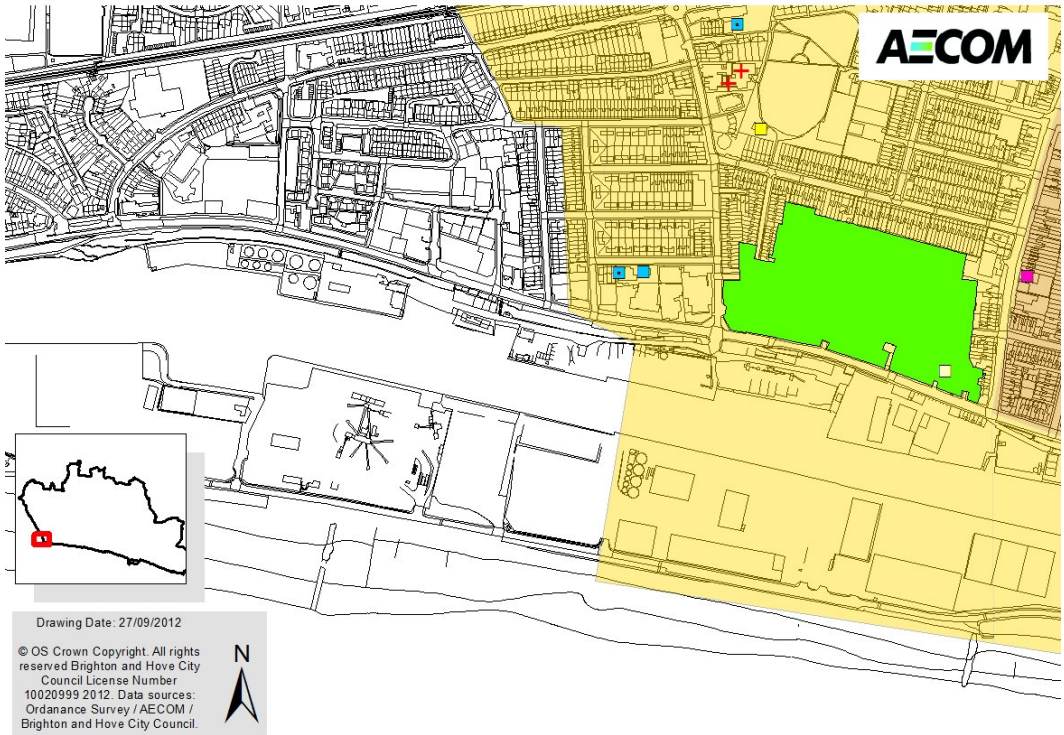
Cluster assessment

Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

14 Shoreham Harbour

National Heat Map

Local District Heating Opportunity Map



Site Review	
Existing buildings	Some Council buildings with small/unknown heat demands.
Proposed buildings/ development sites	Shoreham Harbour Development Area (DA8).
Physical constraints	The distance of several kilometres from the potential heat source is the most significant constraint.
Potential opportunities	Previous studies have indicated the potential for use of heat from the 400MWe CCGT power station in Adur, owned by Scottish Power. Edgeley Green Power also submitted a planning application in July 2012 for a 32MW biomass/biofuel CHP plant is also proposed at Shoreham Port Fishersgate Terminal.
Links to other clusters	Potential to link to heat demands in other neighbouring local authorities.
Policies and Strategies	Port Masterplan Final Report (2010), Joint Area Action Plan being prepared with neighbouring authorities. Draft City Plan Part 1, forthcoming draft City Plan Part 2. Development Area 8: Shoreham Harbour.
Building Ownership/Key stakeholders	Council, Shoreham Harbour developer.

Key existing buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Owner**	**Notes**
1	Belgrave Day Centre	Unknown	Day Centre	Council	
2	Heversham House	Unknown	Office	Council	
3	St Peters Nursery School	Unknown	School	Council	
4	St Peters Community Infant School	40 MWh/yr	School	Council	
5	Portslade Health Centre		Health	NHS	
6	St Marys RC Primary School	45 MWh/yr	School	Council	

Key proposed buildings					
Ref	**Name**	**Heat Demand**	**Building type**	**Status / Timing**	**Notes**
A	Shoreham Harbour		Office 7,500sqm Residential 400 properties	Non-domestic 2014-30 Domestic 2019-30	Smaller non-domestic schemes may commence pre-2014

Cluster assessment										
Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability

7.4 Selecting clusters for further analysis priority clusters

Based on the analysis of the technical and practical opportunities and constraints of each of the clusters (summarised in the table below), we have assigned a relative priority to each. This process was used to inform a discussion with the project team from Brighton and Hove City Council to select three networks - Eastern Road, Edward Street and London Road - for which to undertake more detailed technical and financial assessment of a potential scheme.

Other clusters also have potential, with Toads Hole Valley having the greatest potential of the new development sites in terms of straightforward installation and cost effectiveness due to being a greenfield site. This potential network was not shortlisted however, as it was considered that an energy networks study undertaken once more detailed proposals are made for the site would demonstrate feasibility more accurately than analysis undertaken at present.

Cluster Assessment Summary

Ref	Name	Total heat demand	Heat demand density	Key anchor loads	Building energy profiles	Existing Infrastructure	Development sites	Potential for expansion	Potential social benefits	Potential direct council benefit	Likely financial viability	Practical deliverability	Priority
1	Brighton Marina												**Medium**
2	Eastern Road												**High**
3	Edward Street												**High**
4	Brighton Centre												**Medium**
5	London Road												**Medium**
6	Sussex University												**Medium**
7	Brighton University 1												**Medium**
8	Brighton University 2												**Medium**
9	Toads Hole												**Medium**
10	Hove Park												**Low**
11	Hove Station												**Medium**
12	Schools Cluster												**Medium**
13	Hove Beachfront												**Medium**
14	Shoreham Harbour												**Low**

7.5 Technical and financial assessment of key heat network opportunities

To provide a more detailed understand of the potential opportunities for developing district heating networks in the three most promising clusters we have developed outline network designs in each location (based on the buildings identified within the long-list assessment) to assess the indicative technical feasibility and financial viability.

The networks have been tested based on the potential incorporation of gas-fired Combined Heat and Power (CHP) systems to provide environmental and financial benefits. At the current time gas CHP is the most common technology to be installed in city-wide district heating systems for a number of technical and financial reasons although more detailed further analysis could investigate alternative options such as the use of biomass fuel or fuel cell systems.

7.5.1 Energy demands

To assess the heat demands from buildings within each of the clusters, we have used either existing consumption data provided by the Council and other stakeholders or CIBSE TM46 benchmarks. Basic profiles have been applied to each building type to understand the relative consumption of heat used for space heating and hot water and to estimate the peak demands.

7.5.2 Network Design

We have used the information presented in the long-list analysis for each of the three selected clusters to identify the specific buildings to include within a network. The general approach taken in all three locations was to include as many of the buildings identified as possible. However, in some cases buildings were not included where they were relatively isolated because of the potential effect that this might have on the scheme viability (from the extra capital costs of connection outweighing the returns from the extra revenue generated). If a Further work to refine a project opportunity in any of the clusters would need to critically review the buildings proposed for inclusion and the efficiency and practicality of the network routes.

Based on the buildings selected for inclusion, a high level network design, based on a selected network route and indicative energy centre locations were developed. Using the defined network layout and information on the heat demand from the buildings connected the lengths and sizes of the pipework and trenches for the network were calculated.

Using the details of the sizes and lengths of pipework and trenches we have applied recent prices that have been sourced from a range of suppliers to identify the costs of the network.

7.5.3 Energy Centre

For each network we have identified a number of potential energy centre locations. The most significant factors affecting the location of an energy centre are set out below:

- Potential space available;
- Ability to develop an energy centre (either Council owned land or a development site);
- Potential location for a tall flue;
- Proximity to a large electricity consumer (to enable direct sale of electricity produced).

The locations we have identified are only indicative and do not necessarily fulfil all of the criteria set out above. As such, further analysis of these sites and other potential locations would be required as part of any further development work.

7.5.4 Plant sizing

For each network we have assessed the potential to incorporate gas CHP engines alongside standard gas boilers. The CHP engine has been modelled to meet the summer heat demand and provide information on the output of heat and electricity to enable calculation of the CO_2 savings (compared to standard individual gas boilers) and the system costs and revenues.

Further analysis is likely to be required to undertake an iterative assessment to define the optimum system size, which will be affected by whether the main priority of the network is to deliver greater CO2 emissions or higher financial viability.

We have not assessed the potential to use thermal stores, although these are common used on such networks to improve the running time of the CHP. Further work could also look into the potential to use alternative approaches including multiple CHP engines, biomass boilers and absorption chillers to provide cooling.

7.5.5 CO_2 savings

Based on the outputs from the plant analysis we have carried out modelling to assess the potential CO_2 savings compared to the base case assumption of using individual gas-fired boilers. If any buildings are using electric heating or another fossil fuel then the savings would be greater.

To calculate the CO_2 savings we have used the emissions factors in Building Regulations Part L 2010.

7.5.6 Financial assessment

To assess the commercial viability of the networks being assessed we have estimated the total capital costs associated with the network and plant, the costs associated with operation and maintenance and the revenue from the sales of heat and electricity.

We have also calculated a potential financial contribution that could be obtained from developers of sites connecting to a network based to reflect the reduced costs of meeting planning policy and building regulations requirements compared to alternative strategies. Plant replacement costs have also been included.

The costs have been run over a 25 year period to determine the cash flows and calculate the following:

- Annual costs – these are based on the fuel costs and annual maintenance costs. The year 1 data is presented but these figures change each year in line with the fuel price changes and inflation.
- Annual revenue – these are based on the heat and electricity sales in the case of CHP and heat sales. The year 1 data is presented but these figures change each year in line with the fuel price changes and inflation.
- Simple payback period – the time taken to return the initial capital expenditure.
- Net Present Value (NPV) – this is the yield of the investment based on the capital investment and the costs and returns over time together with the discount factor. We have reviewed the NPV for two discount rates, 4.2% and 10%. The former rate is based on an estimate of the standard value used for public sector borrowing and the latter reflects a rate that might attract private sector interest (and potentially investment). The NPV is a useful indicator as it shows, for any given discount factor and length of contract, how much gap funding may be required (if any) in order to make a project viable.
- Internal Rate of Return (IRR) – this shows the rate of return on the investment.

Our assumptions for the costs and utility prices are based on previous quotes from suppliers and from our understanding of systems and schemes currently in operation.

The results of our technical and financial assessment of potential networks within each of the three key opportunity areas are presented below.

1 Eastern Road

The Eastern Road cluster was selected for further technical and financial assessment because it was deemed to represent the most significant opportunity following the initial assessment of the long-list of clusters. In particular, it was found to have the highest density of heat demand from priority buildings, around 21,000kW/km^2. This compares favourably to work undertaken by DECC[40] to establish the density of heat demand that would be required to indicate that a district heating network could be possible, which identified a density of 3,000kW/km^2.

The cluster includes a range of different building types, many of which have relatively high and stable heat demands resulting from a higher proportion of hot water consumption which would greatly benefit the operation of the site. The key buildings include the hospital, two swimming pools, Brighton College and the numerous residential care homes.

For the Council this network potentially offers a number of direct benefits, in particular the opportunity to improve the services at a number of Council-owned social housing sites, including the Bristol Estate, Warwick Mount, Somerset Point and Leech Court, and deliver low carbon and low cost heat to their residents. It would also enable direct CO_2 savings to a number of other Council-owned buildings.

The network route that has been identified runs down Eastern Road with short branches running up streets to the north and south and only one relatively long branch extending up to the Bristol Estate. In regards to the Energy Centre locations, three potential options have been identified:

- The Freshfield development site – This site would have the area available to allow for the development of an energy centre and it is a Council-owned site although assigning an area to an Energy Centre would reduce the revenue generated by the sale of the site. Siting a flue in this location might also be difficult and there is not an existing large electricity user.

[40] DECC, *The Potential and Costs of District Heating Networks*, 2009

- The car park on Montague Street – This site is Council-owned and adjacent to several tall buildings that could carry the flue. It would have space for an energy centre although the impacts on the neighbouring properties would need to be asssed.
- BSUH site – An energy centre has already been planned as part of the development proposals on the site, although this has been designed to hold the plant that has been sized for the uses on the site (including a 3MWe CHP).

As this is such a large cluster with a relatively large CHP plant, it is likely that two separate energy centres could be supported, one of which could be the energy centre proposed as part of the hospital redevelopment. This approach would be more likely to be favourable to the hospital, having generation on-site and not affecting the current masterplan design, as well as reducing the size required for an energy centre on another site; although it would increase the operational costs associated with the network.

Eastern Road Illustrative Potential Network Layout

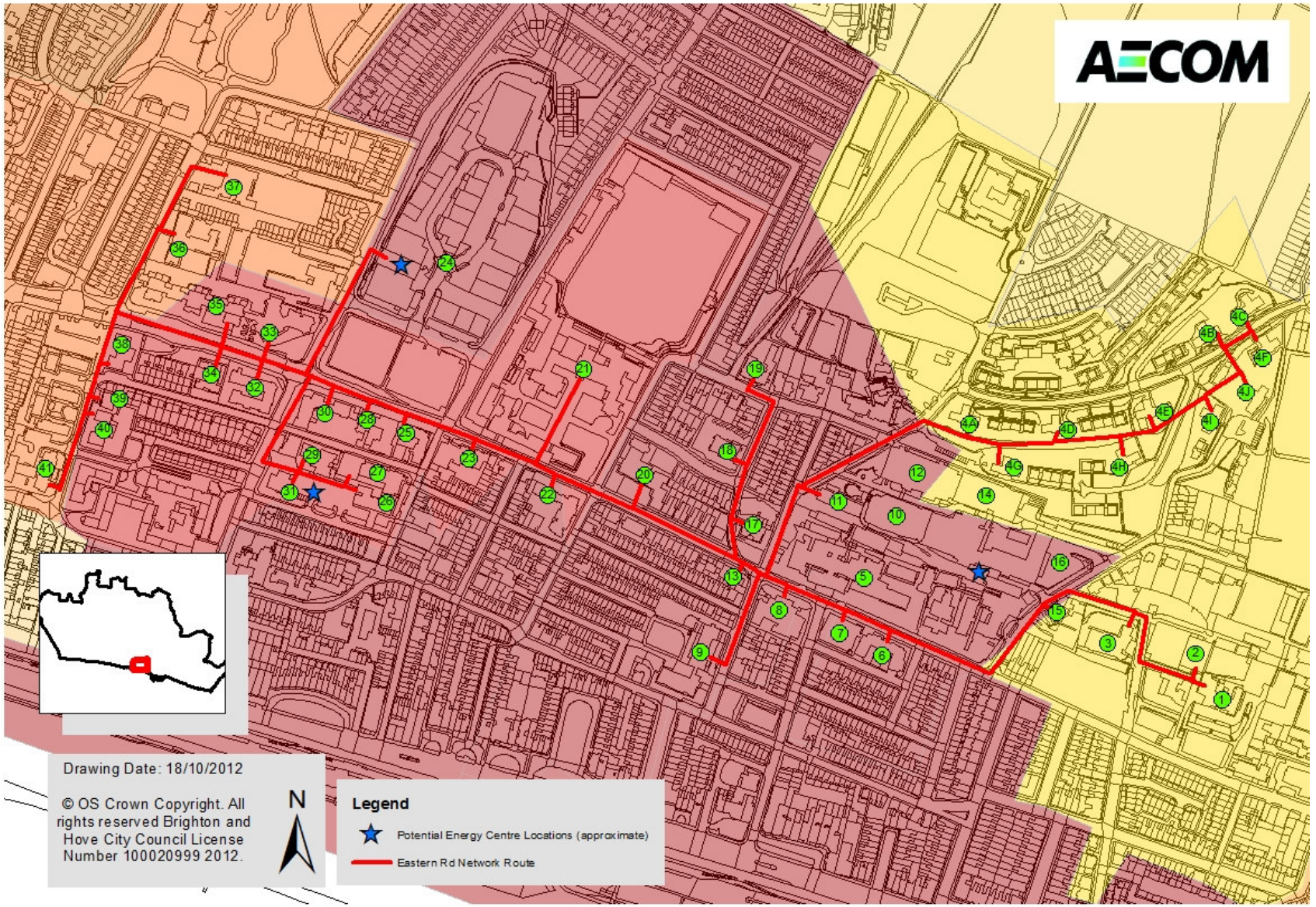


Figure 24: Eastern Road illustrative potential network layout

Heat loads connected to the Eastern Road network					
Ref	**Name**	**Building Type**	**Annual Heat Demand (kWh/year)**	**Est. Head Load (kW)**	**Ownership**
1	Former St Marys School	Office	1505	752	NHS
2	Brighton Swimming Centre	Swimming Pool	1193	199	Private
3	Brighton College Pre-Prep	School	528	264	Brighton College
4A	2-48 Donald Hall Rd	Residential	549	183	BHCC
4B	61-107 Donald Hall Rd	Residential	549	183	BHCC
4C	109-155 Donald Hall Rd	Residential	549	183	BHCC
4D	74-120 Donald Hall Rd	Residential	549	183	BHCC
4E	146-192 Donald Hall Rd	Residential	549	183	BHCC
4F	206-252 Donald Hall Rd	Residential	549	183	BHCC
4G	Turton Close	Residential	549	183	BHCC
4H	Chadborn Close	Residential	549	183	BHCC
4I	Bowring Way 13-59	Residential	549	183	BHCC
4J	Bowring Way 61-107	Residential	549	183	BHCC
5	RSH 3Ts redevelopment	Hospital	6704	1676	NHS
6	RSH Eye Hospital	Hospital	1144	286	NHS
7	RSH Audrey Emerton Building	Offices	338	169	NHS
8	RSH Outpatients	Hospital	966	241	NHS
9	RSH Sussex House	Hospital	1779	445	NHS
10	RSH Royal Alexandra Children's Hospital	Hospital	5282	1320	NHS
11	RSH Restaurant	Restaurant	814	204	NHS
12	RSH Sussex Kidney Unit	Hospital	6098	1525	NHS
13	RSH Ronald McDonald House	Residential	106	35	NHS
14	RSH Millenium Building	Hospital	4546	1137	NHS
15	RSH Rosaz House	Offices	51	25	NHS
16	RSH A&E	Hospital	5544	1386	NHS
17	Courtney King House	Residential Care	1087	217	RSL
18	Belle Vue Court	Residential	758	253	RSL
19	Hamilton Lodge School	School	554	277	Private
20	Brighton College Prep	School	1069	535	Brighton College
21	Brighton College	School	2970	1485	Brighton College
22	Donald Sheldon House	Residential Care	954	191	RSL

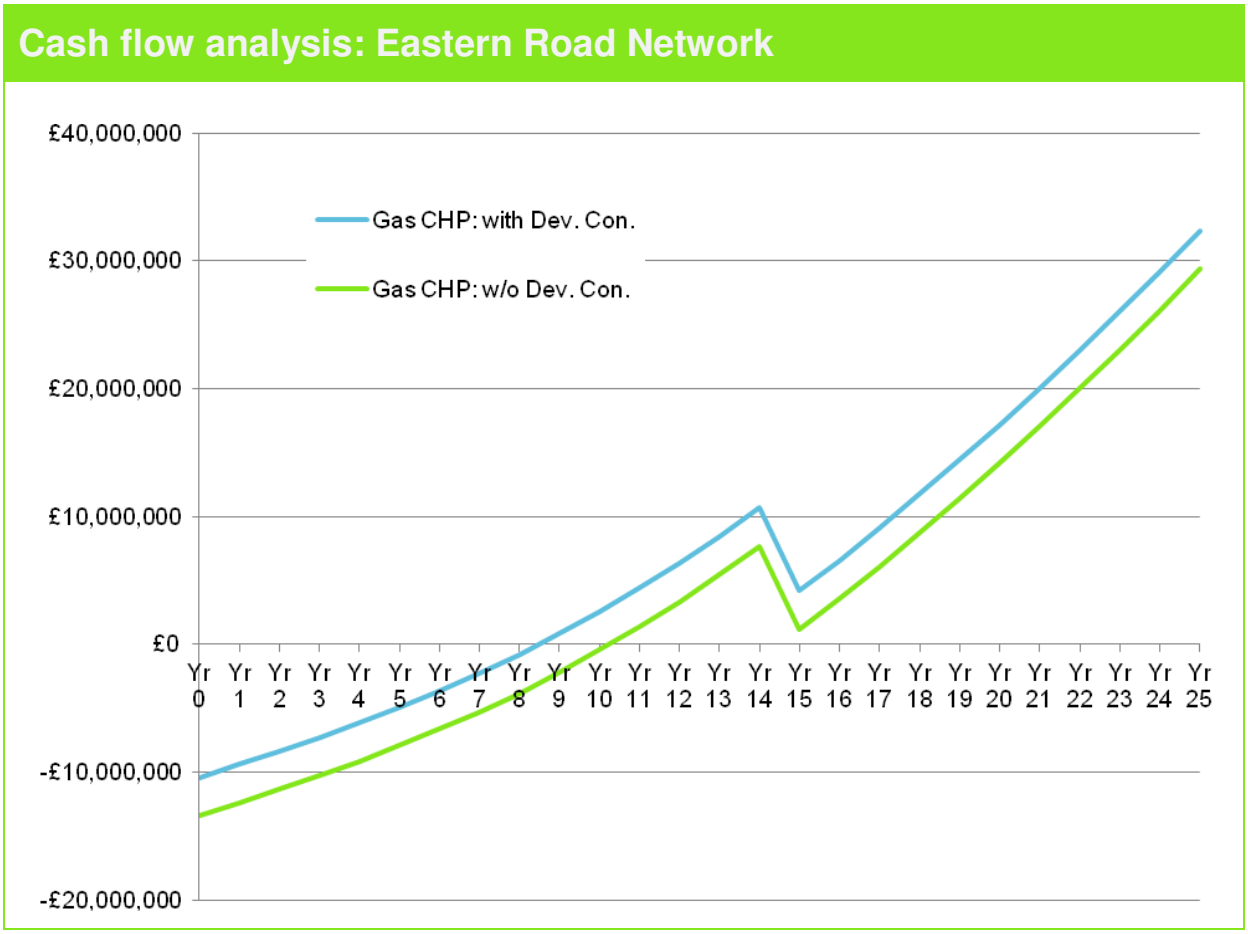
23	College Court	Residential Care	1131	226	RSL
24	Freshfields redevelopment	Mixed Use	2033	1017	Development Site
25	Cello Court	Residential Care	444	89	RSL
26	Essex Place	Residential	1716	572	RSL
27	Montague House Day Centre	Residential Care	165	41	BHCC
28	Evelyn Glennie Court	Residential Care	909	182	RSL
29	Somerset Point	Residential	1716	572	RSL
30	Jaqueline Du Pre Court	Residential Care	1020	204	RSL
31	Warwick Mount	Residential	1716	572	RSL
32	Martlet Court	Residential	523	174	RSL
33	Patching Lodge	Residential	1204	401	RSL
34	Hereford House	Residential Care	643	129	RSL
35	Leach Court	Residential	1800	600	BHCC
36	Sloane Court	Residential	510	170	BHCC
37	Queens Park Primary School	School	160	80	BHCC
38	Hereford Court	Residential	1571	524	RSL
39	Lavender Street Housing Office	Office	355	178	BHCC
40	Wiltshire House	Residential	1663	554	RSL
41	Lavender House	Residential Care	90	18	BHCC
42	St Marks CE Primary School	School	210	105	BHCC
43	St John the Baptist RC Primary	School	155	78	BHCC

Technical Assessment: Eastern Road Network	
Annual heating & hot water demand (kWh/year)	69,213,110
CHP system size (kWe)	7,000
CHP gas demand (MWh/year)	103,985
CHP heat output (MWh/year)	42,946
CHP electricity output (MWh/year)	38,163
Proportion of heat from CHP	56%
Gas boiler size (kWth)	22,700

Gas boiler gas demand (MWh/year)	36,876
Gas boiler heat output (MWh/year)	33,189
Network trench length (m)	3,470
Estimated network cost per meter	£1,070
Annual CO_2 reduction (year 1) (tonnes CO_2 /year)	8,200
Indicative Energy Centre size	1500m^2

Financial Assessment: Eastern Road Network	
Estimated capital costs	£13,414,800
Estimated capital cost after potential developer contributions	£10,399,000
Average heat sale price in year 1 (2013) (p/kWh)	4.00
Average electricity sale price in year 1 (2013) (p/kWh)	5.97
Proportion of electricity assumed to be sold direct	30%
Year 1 annual costs	£4,035,200
Year 1 annual revenue	£5,046,900
NPV @ 4.2% discount rate w/o dev cons	£1,847,000
NPV @ 10% discount rate w/o dev cons	-£866,400
IRR w/o dev cons	9.29%
IRR with dev cons	12.15%
Payback period (years)	10.09
Profit after 25 years	£32,365,600
Value of CO_2 saved based on capital costs (£/tCO2) without developer contributions	£1,638
Value of CO_2 saved over 25 years (£/tCO2) without developer contributions	-£717

Cash flow analysis: Eastern Road Network



2 Edward Street

The Edward Street cluster was selected for further technical and financial assessment because, like Eastern Road, it was deemed to represent a high priority following the assessment of the long-list of clusters. The density of heat demand from priority buildings in this area was estimated to be around 14,000kW/km^2.

The cluster includes a range of different building types with a number of key buildings, including the University and swimming pool that would provide a good base load for the scheme.

The cluster includes a high number of Council-owned buildings, including the swimming pool, Town Hall, offices and social housing which would all directly benefit from the delivery of low carbon (and potentially low cost) heat and power. In addition there are a number of other public buildings including the police station, courts and Brighton University, the latter of which has high carbon reduction targets that would be greatly benefited by such a network being created.

The network route that has been identified is non-linear so there may be some further work to refine this and undertake iterations to optimise it.

The potential locations identified for an energy centre are:

- The Edward Street development site – This site would potentially have the area available to allow for the development of an energy centre although some of the land is privately owned.
- The Circus Street development site – This site is Council-owned although siting an energy centre here could reduce the development potential of the site and the revenue realised from the sale. The location next to Brighton University would provide an option for the direct sale of electricity generated.
- Land on Sussex Street – This plot of land is Council-owned and might be of sufficient size for an energy centre although it is not located next to a large electricity user and locating a large flue here might be difficult.

Edward St Illustrative Potential Network Layout

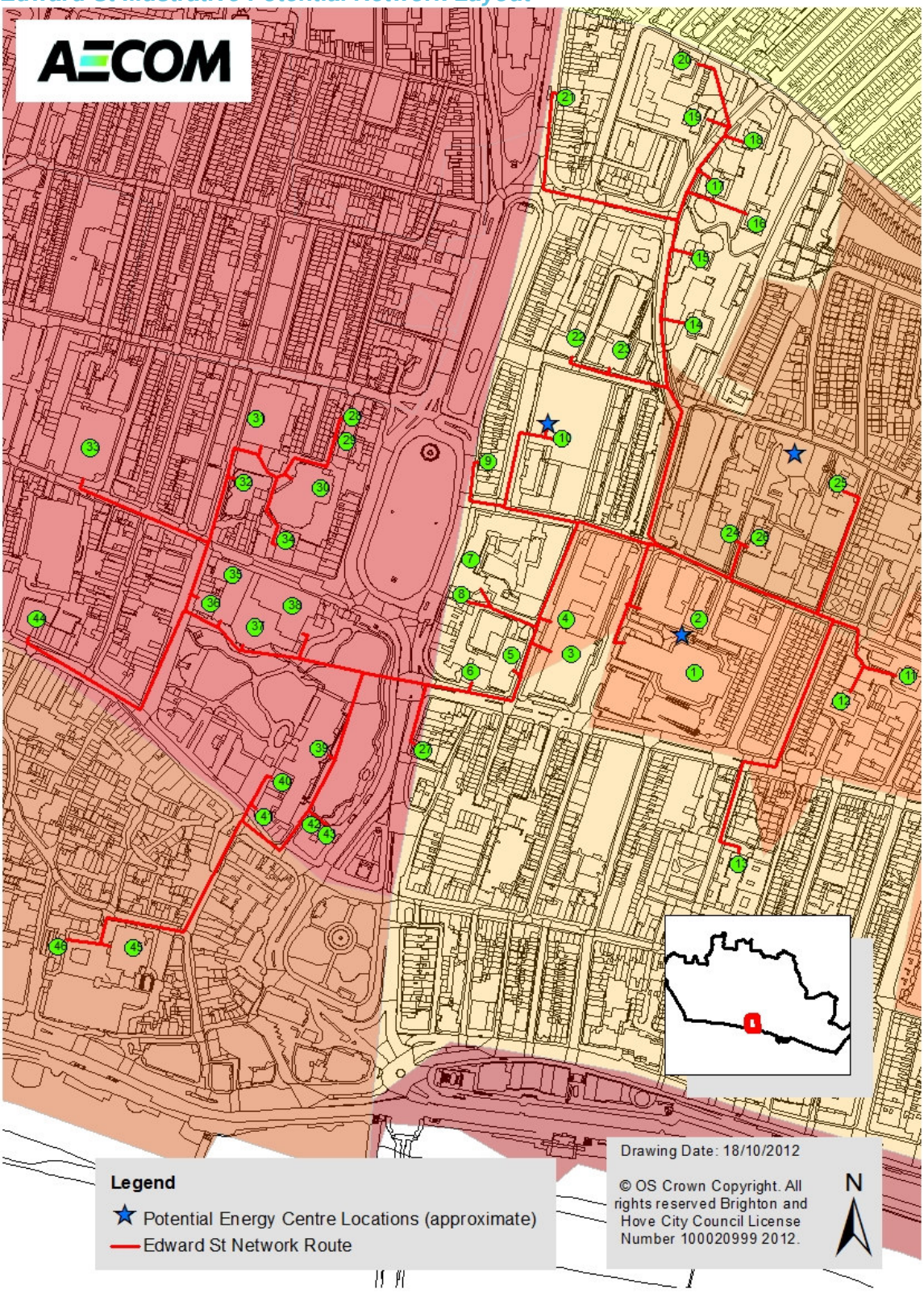


Figure 25: Edward St illustrative potential network layout

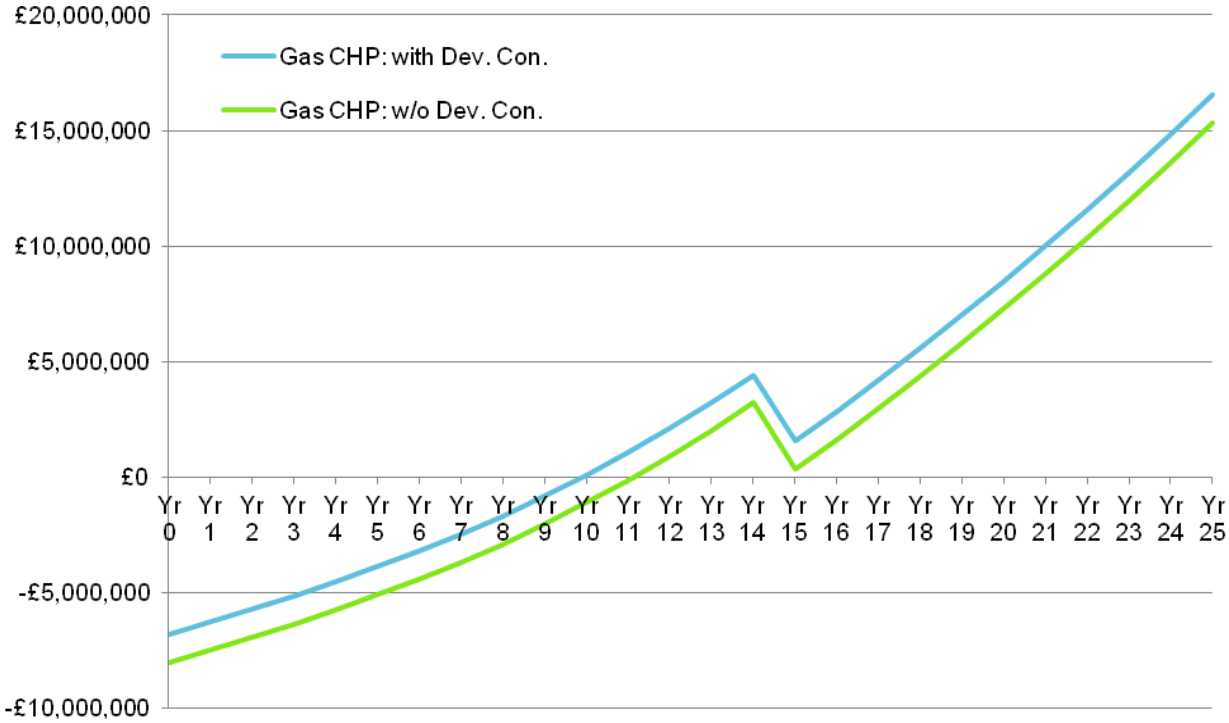
Heat loads connected to the Edward Street network					
Ref	**Name**	**Building Type**	**Annual Heat Demand (kWh/year)**	**Est. Head Load (kW)**	**Ownership**
1	Amex Building	Office	3,315	1658	AMEX
2	Edward St (new development)	Mixed use	1,400	700	Development Site
3	Brighton Magistrates Court	Court	675	225	Central Government
4	Brighton Police Station	Offices	1,183	591	Sussex Police
5	Brighton County Court	Court	321	107	Central Government
6	Brighton Family Centre	Office	118	59	Central Government
7	Main Building Grand Parade	University	2,120	707	Brighton University
8	68 Grand Parade	University	35	12	Brighton University
9	47 Grand Parade	Office	113	56	Brighton University
10	Circus St (new development)	Mixed use	1,861	931	Development Site
11	St John's Mount	Residential	1,368	456	BHCC
12	Tyson Place	Residential	1,312	437	BHCC
13	St James' House	Residential	2,010	670	BHCC
14	Saxonbury, Ashton Rise	Residential	832	277	BHCC
15	Courtlands, Ashton Rise	Residential	850	283	BHCC
16	Richmond Heights, John St	Residential	850	283	BHCC
17	Normanhurst, Grove Hill	Residential	832	277	BHCC
18	Highleigh, Grove Hill	Residential	832	277	BHCC
19	Ecclesden, Grove Hill	Residential	795	265	BHCC
20	Thornsdale, Albion Hill	Residential	813	271	BHCC
21	St Peter's House	University	65	22	Brighton University
22	Morley St/Globe House/ Health Unit	Health	186	46	NHS
23	Tarner Childrens Centre	School	151	38	BHCC
24	Carlton Hill Primary School	School	150	38	BHCC
25	Tarnerland Nursery School	School	50	13	BHCC
26	Priory House	Office	57	28	Private
27	10 and 11 Pavilion Parade	University	85	28	Brighton University
28	Slipper Baths Fitness Centre	Leisure	131	44	Private
29	Slipper Baths Nursery	School	139	46	Private
30	Prince Regent Pool	Swimming Pool	1,835	367	BHCC

31	Jubilee Library	Cultural	704	352	BHCC (PFI)
32	Myhotel Brighton	Hotel	1,127	376	Private
33	Sovereign House	Office	51	26	BHCC
34	Old Court House	Cultural	60	20	BHCC
35	Corn Exchange	Entertainment Halls	611	204	BHCC
36	Pavilion Theatre	Entertainment Halls	373	124	BHCC
37	Dome Theatre	Entertainment Halls	1,934	645	BHCC
38	Brighton Museum and Art Gallery	Cultural	809	270	BHCC
39	Royal Pavilion	Cultural	190	63	BHCC
40	4-7 Pavilion Buildings	Office	105	53	BHCC
41	12a Pavilion Buildings	Office	615	308	BHCC
42	3 Palace Place	Office	61	31	BHCC
43	62 and 63 Old Steine	Office	70	35	BHCC
44	Premier Inn	Hotel	1,039	346	Private
45	Brighton Town Hall	Office	295	148	BHCC
46	Bartholomew House	Office	256	128	BHCC

Technical Assessment: Edward Street Network	
Annual heating & hot water demand (kWh/year)	32,781,147
CHP system size (kWe)	3000
CHP gas demand (MWh/year)	45,410
CHP heat output (MWh/year)	18,754
CHP electricity ouput (MWh/year)	16,665
Proportion of heat from CHP	52%
Gas boiler size (kWth)	11,800
Gas boiler gas demand (MWh/year)	19,228
Gas boiler heat output (MWh/year)	17,305
Network trench length (m)	4072
Estimated network cost per meter	£900
Year 1 CO_2 reduction (tonnes CO_2/year)	3600
Indicative energy centre size	750m^2

Financial Assessment: Edward Street Network	
Estimated capital costs	£8,033,500
Estimated capital cost after potential developer contributions	£6,830,300
Heat sale price in year 1 (based on 2013) (p/kWh)	4.00
Average electricity sale price in year 1 (based on 2013) (p/kWh)	6.95
Proportion of electricity assumed to be sold directly	50%
Year 1 annual costs	£1,928,400
Year 1 annual revenue	£2,469,500
NPV @ 4.2% discount rate w/o dev cons	£4,869,500
NPV @ 10% discount rate w/o dev cons	-£1,202,600
IRR w/o dev cons	8.34%
IRR with dev cons	10.00%
Payback period (years)	11.08
Profit after 25 years	£16,541,600
Cost of CO_2 saved based on capital costs (£/tCO2) without developer contributions	£2,300
Cost of CO_2 saved over 25 years (£/tCO2) without developer contributions	-£270

Cash flow analysis: Edward Street Network



3 London Road

The London Road cluster was selected for further technical and financial assessment following consultation with the project team at Brighton and Hove City Council. There were a number of clusters identified with a medium priority and relatively similar opportunities and constraints; however London Road was selected for further analysis because of the high overall heat density, number of development sites and proximity to the two other clusters.

The cluster includes relatively few Council owned buildings, New England House and Theobald House being the most significant. The City College is the other major public sector organisation in the cluster and has plans to redevelop the site which could have further potential for the initiation of a heat network and location of an energy centre.

The network route that has been identified is non-linear so there may be some further work required to refine this and undertake iterations to optimise it based on selecting the best combination of buildings and most practical network route.

The potential locations identified for an energy centre are:

- The car park adjacent to the City College – This site would potentially have the area available to allow for the development of an energy centre although it is privately owned and may form part of the City College development proposals. Locating the plant next to City College would provide a significant consumer for the electricity produced.
- The car park adjacent to Theobald House – This site is Council-owned and adjacent to a tall building that could potentially be used to carry the flue. It may have sufficient space for an energy centre and the location next to City College could provide an option for the direct sale of electricity generated.
- The development site adjacent to Vantage Point – This plot of land might be of sufficient size for an energy centre and is located next to Vantage Point, which could be supplied with the electricity produced.

London Road Illustrative Potential Network Layout

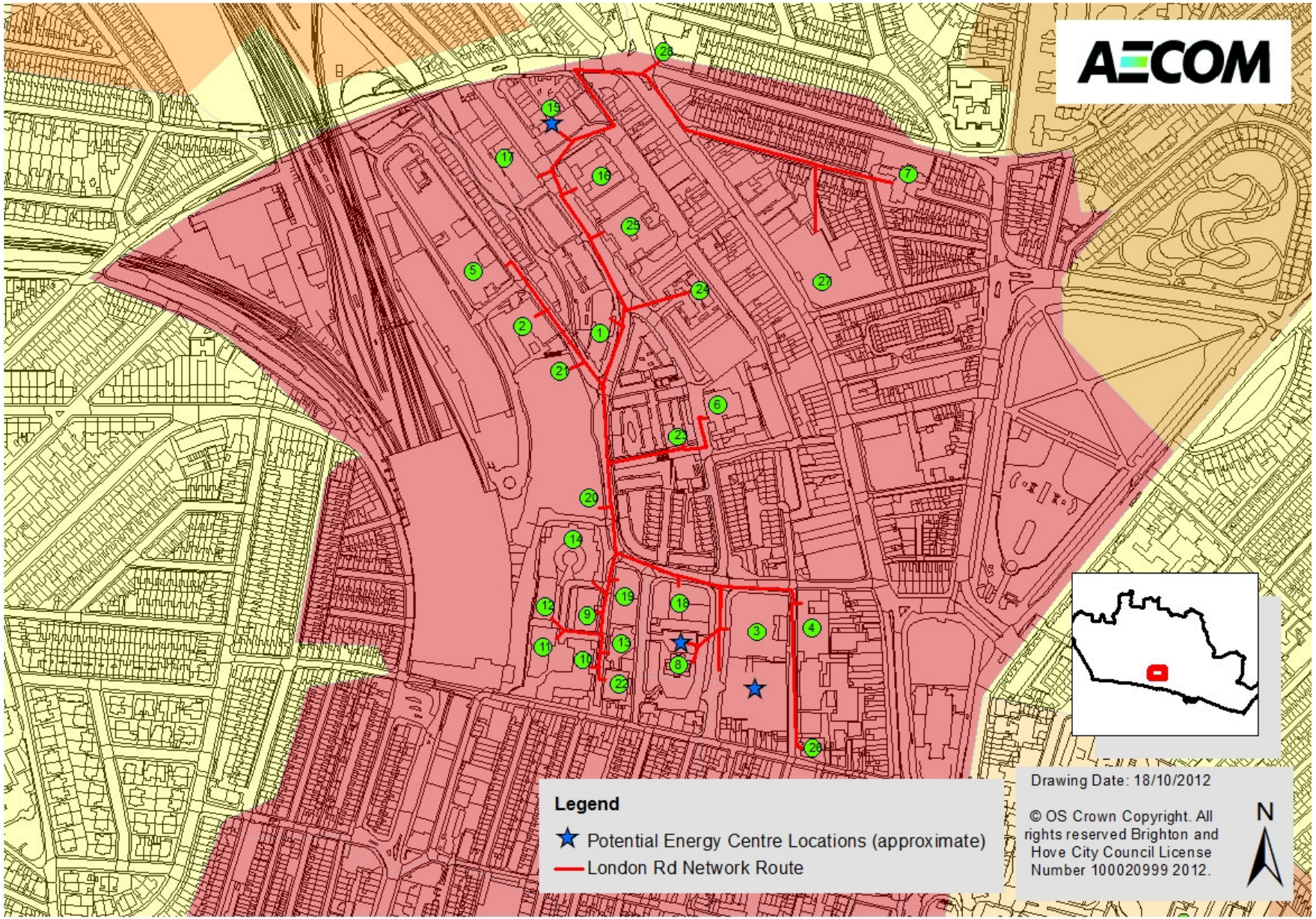


Figure 26: London Road illustrative potential network layout

Heat loads connected to the London Road Network					
Ref	**Name**	**Building Type**	**Annual Heat Demand (kWh/year)**	**Est. Head Load (kW)**	**Ownership**
1	One Brighton	Residential/community/commercial	981	392	Private
2	Jury's Inn	Hotel	2370	592	Jury's Inn
3	City College main building	Education	750	375	City College
4	City College smaller building	Education	214	107	City College
5	Bellerby College	Education	836	418	Bellerby College
6	St Bartholomew's Primary School	School	155	52	BHCC
7	Rose Hill Court	Residential	405	135	BHCC
8	Theobold House	Residential	1888	629	BHCC
9	Napier House	Office	355	178	Private
10	Lanchester House	Office	211	106	Private
11	Invicta House	Office	131	66	Private
12	Mocatta House	Office	62	31	Private
13	Britannia House	Office	144	72	Private
14	Victory House	Office	493	246	Private
15	Development site 1a) Vantage Point	1000sqm office, 200sqm retail	200	100	Development site
16	Development site 1b) Trade warehousing, New England St	3000sqm office, 200 sqm retail	234	117	Development site
17	Development site 1c) Richardson's Scrapyard, New England St	3000sqm office, 200 sqm retail	234	117	Development site
18	Development site 1d) Cheapside	2000sqm office, 200 sqm retail	217	109	Development site
19	Development site 1e) Blackman St	2000sqm office,e 200 sqm retail	217	109	Development site
20	Development site 1f) Block J Brighton Station site	3000sqm office	50	25	Development site
21	Development site 1g) Block K Brighton Station site	3000sqm office	50	25	Development site
22	Development site 1h) GB Liners site, Blackman St	3000sqm office	499	250	Development site
23	Sainsburys	Large Food Store	129	64	Sainsbury's
24	Mayflower Square	Residential	993	331	
25	New England House	Office	901	451	BHCC
26	Foyer	Multi-residential	1109	370	Private
27	Former Co-op Department Store	Office and Multi-res	416	208	Planning Application under consideration

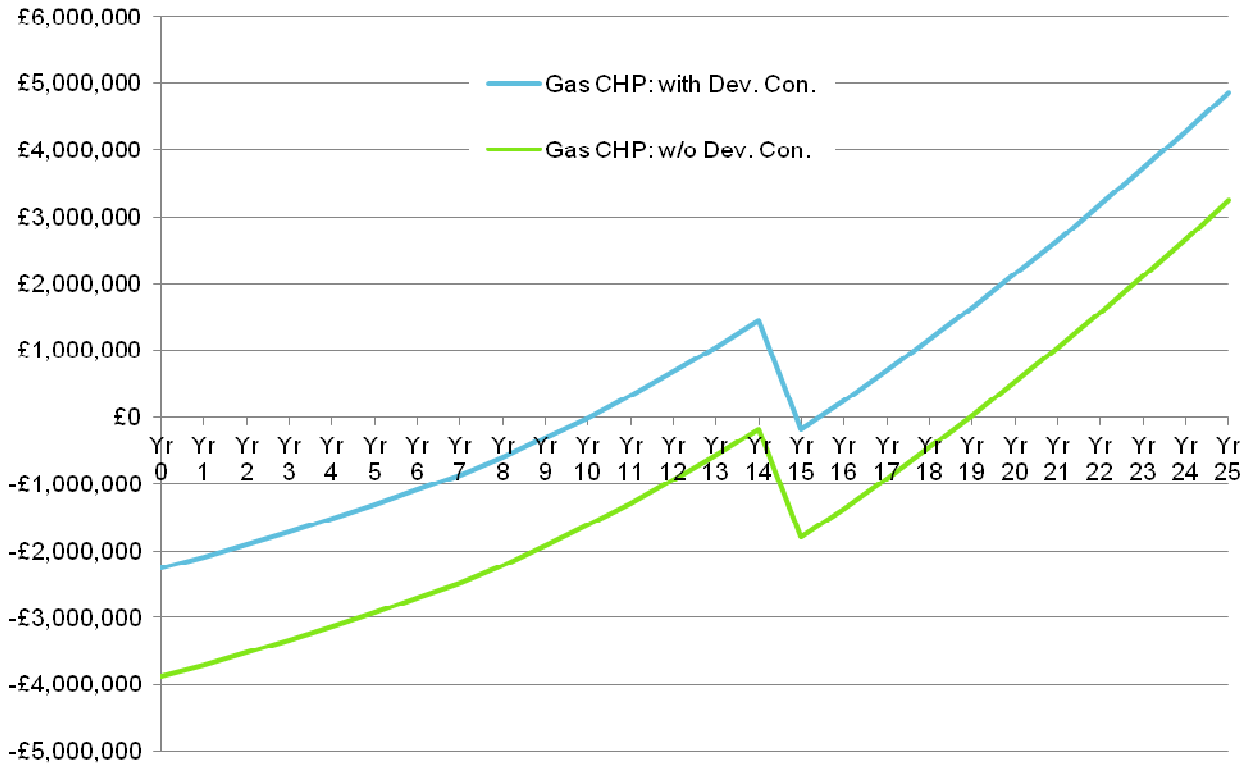
28	Preston Circus Fire Station	Emergency Services	518	173	Fire Service

Technical Assessment: London Road Network	
Annual heating & hot water demand (kWh/year)	13,652,774
CHP system size (kWe)	1,063
CHP gas demand (MWh/year)	16,416
CHP heat output (MWh/year)	6,747
CHP electricity ouput (MWh/year)	6,025
Proportion of heat from CHP	45%
Gas boiler size (kWth)	5,700
Gas boiler gas demand (MWh/year)	9,190
Gas boiler heat output (MWh/year)	8,271
Network trench length (m)	1938
Estimated network cost per meter	£801
Year 1 CO_2 reduction (tonnes CO_2/year)	1300
Indicative Energy Centre size	400m^2

Financial Assessment: London Road Network	
Estimated capital costs	£3,878,750
Estimated capital cost after potential developer contributions	£2,262,950
Heat sale price in year 1 (based on 2013) (p/kWh)	4.00
Average electricity sale price in year 1 (based on 2013) (p/kWh)	6.95
Proportion of electricity assumed to be sold directly	50%
Year 1 annual costs	£790,100
Year 1 annual revenue	£964,900
NPV @ 4.2% w/o dev cons	£47,500
NPV @ 10% w/o dev cons	-£1,783,800
IRR w/o dev cons	4.30%
IRR with dev cons	9.17%
Payback period (years) w/o dev cons	19.05
Profit after 25 years	£4,868,229
Value of CO_2 saved based on capital costs (£/tCO2) w/o dev cons	£3,100

Value of CO_2 saved over 25 years (£/tCO2) w/o dev cons	-£42

Cash flow analysis: London Road Network



7.6 Sensitivity Analysis

We have conducted a sensitivity analysis on a number of the key financial variables to demonstrate the implications of variation in the IRR outputs of the schemes assessed. These vary slightly between schemes but the general pattern is the same. The following analysis was undertaken for the Eastern Road network:

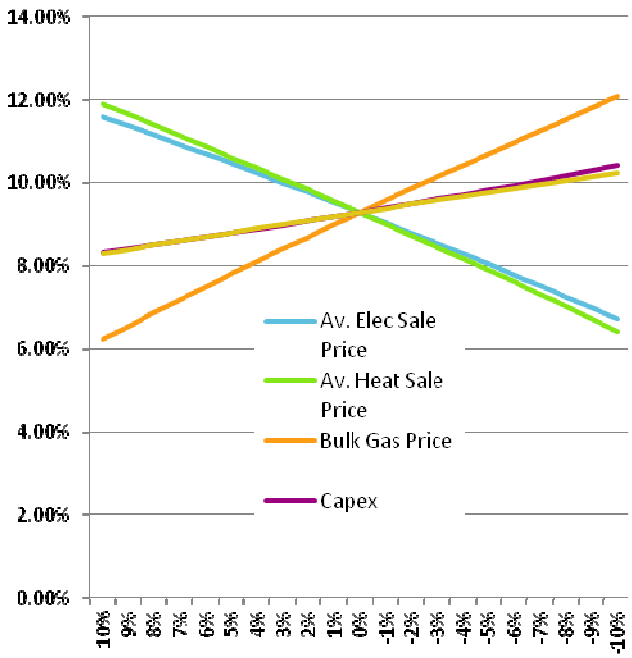


Figure 27: Sensitivity analysis showing the variation in the IRR resulting from variation in a selection of factors affecting the commercial viability of the Eastern Road network.

This analysis shows that the key factors that will affect the commercial viability of a scheme are:

- The bulk gas price;
- The average heat sale price;
- The average electricity sale price.

Further financial analysis will be required to more accurately understand the feasibility of the networks if they are to be pursued. This sensitivity analysis indicates that the accuracy of these key variables will be of critical importance to provide confidence in the commercial viability of a scheme.

7.6.1 Electricity sales revenue

The revenue from electricity exported to the grid is much lower than the commercial price of electricity bought from the grid so maximising the electricity that can be sold to a neighbouring building (at a rate equivalent to electricity bought from the grid) can have a significant impact on the commercial viability of a scheme.

Maximising the proportion of electricity sold directly to a local customer is a key measure which can be taken to improve the financial viability of the proposed network schemes. Technically this can either be achieved via a private wire (although there are legal issues around this), a power purchase agreement (PPA) or a Licence Lite arrangement (see section 7.8 for more details on this).

For our assessment we have assumed the following:

Cluster	Building(s) that could be supplied	Proportion of direct electricity sales assumed
Eastern Road	BSUH, Council owned buildings	30%
Edward Street	Council owned buildings, AMEX, Brighton University, Police Station, Courts	50%
London Road	Council owned buildings, City College, Sainsbury's, One Brighton	50%

Table 13: Direct sales of electricity assumed for each network in the modelling

7.6.2 Heat sales revenue

The heat sales revenue is based on the difference in the cost of buying bulk gas and price for heat sold on the network. Based on our understanding of prices paid by ESCos on similar schemes we have assumed a price for bulk gas of between 2.1 and 2.3p/kWh depending on the scheme size. For heat sales we have assumed a price of heat set at 20% above the commercial rate for gas, based on an assumption that heat is being delivered in place of gas boilers with an efficiency of 80%, meaning that the connected commercial premises would effectively be paying the same.

We have assumed that residential customers would be charged the same rate as commercial customers, which means that they would see a significant saving because commercial tariffs are normally much lower than residential tariffs.

7.6.3 Developer contributions

New development will be required to meet increasingly stringent targets for the reduction of CO2 emissions and this is likely to have high cost implications. Connection to a district heating system could offer a relatively practical and cost effective route towards achieving compliance. It is therefore possible to apply a connection charge that reflects the costs that the developer would otherwise have spent on an alternative strategy for meeting these energy standards towards the capital costs of a scheme to which they are connecting. The fee could potentially be set slightly below the costs of the alternative option in order to provide an incentive. Please note that this contribution would be separate from any local offset fund or future Allowable Solutions payment.

7.7 Key Conclusions and Recommendations

7.7.1 General Conclusions and Recommendations for all heat network opportunities

The following key conclusions and recommendations are relevant to all schemes:

- The commercial viability of delivering a district heating network served by gas CHP will depend on the ability to site an energy centre such that it is possible to sell a significant proportion of the electricity directly to a major consumer. We have highlighted potential locations within each of the clusters but further work would be required to define the buildings that could potentially use the electricity.
- Other alternatives to maximise the revenue of the electricity generated could also be explored, these include Power Purchase Agreements (PPAs) and the Licence Lite arrangement, which would enable the Council to link up with the designated network operator to supply electricity to its own buildings across the local network. Work on the practical and legal aspects of the Licence Lite arrangement has been undertaken by Haringey Council and this approach is being investigated although there are numerous issues hampering the uptake and we are not aware of any formal arrangements currently operating under this scheme.
- Obtaining financial contributions from developers is likely to be another important component of improving the commercial viability of all schemes to a level that would attract private finance. As discussed above, these 'developer contributions' could be set at a price that is equivalent to the costs of meeting the energy targets through alternative means, or set at a slightly lower price in order to ensure an incentive to connect. These contributions would be substituting for costs that would otherwise be spent on an alternative energy strategy and would therefore not impact on s106/CIL or Allowable Solutions payments.
- Planners should ensure that the potential for the development of the heat network opportunities identified is supported by proposed development within the clusters. Key to this will be to ensure that all development in close proximity

to the suggested networks is compatible with connection to a future DH network.

Planning policy should be put in place that uses the outcomes of this study as the evidence base to support the development of the opportunities highlighted. For the three clusters for which we have undertaken the more detailed technical and financial assessment and proved the potential viability for delivering heat networks the Council could require developments to either connect or design for connection to a future network in these locations. For developments in the other clusters the Council would perhaps not be able to use strong wording without the more detailed evidence in place but could encourage developers to design to enable future connection. These planning policy recommendations are discussed further in section 8.6.2.

Designing non-domestic buildings for compatibility with heat networks can be achieved by the following:

- Capped-off connections on the internal heating system
- Locating the plant room close to the planned network route
- Providing a trench or capped plastic sleeve to allow a point of entry for the pipework to enter the energy centre and thereby minimise or avoid future intervention requirements.

For residential developments compatibility is best achieved through the installation of communal heating systems. However, this can be expensive and may be an unattractive proposition for developers, especially in smaller schemes so a fallback position would be to require increased riser space for flow and return pipework that would at least make future retrofitting a possibility.

The design and cost of these measures are minimal and would help to support the implementation of district heating and reduce the risk of the opportunities being missed.

Planning policy can also be used to safeguard potential energy centre sites or network routes.

- Also, Local Development Orders (LDO) can potentially be applied by local authorities to extend permitted development rights across whole local authority areas or to grant permission for

certain types of development. Should the Council agree to lead installation of a district heating network then it is recommended that they explore the option of establishing a LDO in order to add certainty to the development process and potentially speed up delivery.

- The Council will need to commit to connecting its own buildings to the network in order to provide the 'anchor load' for any scheme. The Council will also be in a much better position to enter into a long-term energy contract and therefore reduce levels of risk and in so doing help to attract investment from third-parties.
- The Council will need to use its influence both in terms of planning policy (for new developments) and as a major landowner (for existing buildings) in order to encourage others to connect to the network. The following incentives (based on other schemes around the country) can be promoted:
    - CO2 savings – For existing developments the CO□ savings will be dependent on the system it replaces but the reductions should be considerable. These savings should prove attractive to most major businesses wishing to address their carbon footprint, particularly those that are large enough to qualify for the CRC Energy Efficient Scheme. For new development, connection to the network will offer a route to delivering significant CO_2 savings that could be a cost effective option relative to on-site solutions.
    - Running costs – depending on how the business model is set up savings of 5-10% could be offered compared to standard systems or the costs could be kept at the market rate but incentivised by the delivery of low carbon heat.
    - Space savings – for existing buildings connecting to a DH scheme would free up plant space for other uses. For new developments it means that additional lettable/useable floor space would be made available.
    - Operation and management risks – The district heating network operator would take most of the risks and the management of plant

away from the end user/manager of the building thus reducing operational, maintenance and management costs. Schemes are usually designed with full back-up plant. The resilience is further enhanced with additional energy generation systems being added to the network as it expands. As an example, over the last 22 years the district heating network in Southampton has achieved 99.98% availability.

- Planning requirements - Connection to a DH scheme could help to ensure compliance with planning policies and provide a route to compliance with the increasingly stringent Building Regulations standards.

- If there is clear support for the development of heat networks in the city it could be useful to set out a clear long-term vision. This could present a plan for the expansion of networks, starting with Eastern Road, linking to Edward Street and then on to London Road and the Brighton Centre clusters.

A long term technology plan is also likely to be useful to recognise that the CO_2 savings associated with the use of gas CHP are projected to fall in line with the decarbonisation of the national grid. In the short term gas CHP delivers both high CO_2 savings and substantial financial returns thereby enabling the installation of the infrastructure that would enable other low and zero carbon technologies to be utilised in the future. To deliver secure and increasing CO_2 savings over time however a transition plan would need to be considered to move to alternative technologies, potentially around the time of replacing the plant. It is impossible to say with certainty what the best options will be at this time but the potential for developing the following options could be considered:

- Incorporation of biomass boilers onto the network to support the transition away from gas;
- Replacement of LZC plant with alternative systems or fuels e.g. biomass CHP engines or fuel cells;
- Connection to Shoreham Power Station to utilise the waste heat;

- Connection to energy from waste, other power generation or waste heat sources.

7.7.2 Conclusions and Recommendations for the Eastern Road network opportunity

Technical Issues

The key technical issue for this cluster is the link with the hospital. This is a key component of the heat demands in the cluster and delivering the network that is set out in this report would require close cooperation between the Council and the BSUH NHS Trust. This could be difficult given the critical importance of energy systems to the hospital and the extent of their progress on the development. However this does not necessarily preclude connection as it would be possible to have an energy centre on the site as planned, with connection to the hospital as well as the wider heat network and an additional energy centre at another point on the network. There are examples of similar schemes in operation, such as the Birmingham Eastside Heat Network which was set up by a partnership between Birmingham City Council, the Birmingham Children's Hospital and Aston University, with the Council procuring the Energy Services Company (ESCo) contract with back-to-back agreements with the other partners.

Another technical issue is the location of the energy centre, which would need to be located on a site with sufficient space, potential to build a large industrial building with a tall flue and with a potential nearby customer for the electricity being generated. We have identified a couple of potential sites (in addition to the energy centre site at BSUH) but further work would be required.

Financing

This scheme is showing relatively high IRR levels indicating that private investment could be sought, although we have only undertaken a relatively crude financial assessment at this stage with a number of critical assumptions that would need to be tested further.

The high IRR levels indicate that the scheme could potentially be put to the market and may attract interest from Energy Service Companies (ESCos) that might be willing to part or fully fund the capital costs of the scheme. However, if Brighton and Hove City Council wished to have some control of the scheme, to define the utility prices, focus on issues other than maximising profitability and drive the development of the network, then it would need

to invest itself, either through direct spend, borrowing or obtaining funding from other sources.

Delivery Model

The likely delivery model would require a vehicle which would involve the local authority working in partnership with the NHS Trust and a private ESCo.

Next Steps

Further technical assessment of this network will need to include:

- Discussion with BSUH NHS Trust on the potential to connect to the proposed network and understand how they are proposing to commission and procure their energy systems;
- Consultation with the other owners of the properties identified as having potential to connect to the network, in order to obtain more accurate data of their energy consumption and explore their views on potential connection to a heat network;
- Detailed review of the network on the basis of consultation with the stakeholders identified (as described above) to refine the list of buildings to be connected;
- Iterative testing of network and plant options and financial inputs (including heat and electricity sales prices) to optimise CO_2 savings, financial viability and social benefits;
- More detailed assessment of the potential energy centre locations;
- Review of the highway and public realm development proposals in the area to assess opportunities for combining the works and reducing costs.

7.7.3 Conclusions and Recommendations for the Edward Street network opportunity

Technical Issues

The key technical issue for this cluster is likely to be the location of an energy centre. We have identified a number of locations that could potentially be used but these would need to be assessed in more detail.

Further work would be required to consult with the various owners and operators of the buildings identified in the cluster and other key stakeholders to identify the key buildings to be connected.

Financing

The financial analysis indicates that the scheme might be of sufficient interest to attract private investment. Subject to further technical and financial analysis, third party ESCos may be willing to provide all or some of the capital required to deliver the scheme.

Delivery Model

Given the number of Council-owned buildings identified for connection to a possible network there would be significant incentive for the Council to retain an element of control over the network.

A partnership arrangement with a third-party ESCo through a Special Purpose Vehicle (SPV) could enable a level of control to be retained at the same time as employing specialist services and segregating some of the risks. The level of profit retained would depend upon the proportion of capital investment by the Council.

Next Steps

Further technical assessment of this network will need to include:

- Consultation with the other owners of the properties identified as potential connections to the network, particularly Brighton University and AMEX, to explore their views on potential connection to a heat network;
- Detailed review of the network on the basis of consultation with the stakeholders identified (as described above) to refine the list of buildings to be connected;
- Iterative testing of network and plant options and financial inputs (including heat and electricity sales prices) to optimise CO_2 savings, financial viability and social benefits;
- More detailed assessment of the potential energy centre locations;
- Review of the highway and public realm development proposals in the area to assess opportunities for combining the works and reducing costs.

7.7.4 Conclusions and Recommendations for the London Road network opportunity

Technical Issues

The key technical issue for this development site is likely to be the location of an energy centre and, linked to this, a detailed

understanding of the future development in the area.

Planning policy could play a crucial role in realising this opportunity by providing the framework to require the proposed development sites to connect, thus providing a level of certainty for additional customers on the network and potentially a source of funding, through developer contributions, to invest in the infrastructure.

Financing

This scheme is showing relatively low returns on the initial investment indicating that private investment might be more difficult to obtain - although we have only undertaken a relatively crude financial assessment at this stage with a number of critical assumptions that would need to be reviewed.

One key to improving the returns is the collection of developer contributions. Our analysis shows an increase in the IRR from around 4% to 9% when our indicative potential developer contributions from the connection of new developments to the network are taken into account. We have used very general assumptions in our modelling aimed at reflecting the costs of achieving the same CO_2 savings as connection to the heat network through alternative on-site measures. If this approach is pursued then further work is likely to be required to provide more detailed justification to support setting a specific level of contributions. If additional funding is required by the Council to support the development of this scheme, the following sources may contribute:

- Direct investment;
- Prudential borrowing;
- Funding from sources such as Allowable Solutions/Local Offset fund, EU funding streams such as JESSICA, ELENA.

Next Steps

Further technical assessment of this network will need to include:

- Consultation with the owners/operators of the properties identified as potential connections to the network, including the City College, to obtain more accurate data of energy consumption and explore their views on potential connection to a heat network;
- Detailed review of the network on the basis of consultation with the stakeholders identified to refine the list of buildings to be connected;

- Iterative testing of network and plant options and financial inputs (including heat and electricity sales prices) to optimise CO_2 savings, financial viability and social benefits;
- More detailed assessment of the potential energy centre locations;
- Review of the highway and public realm development proposals in the area to assess opportunities for combining the works and reducing costs;
- Analysis to support setting a price for connection of new developments (reflecting the cost of delivering the same CO_2 savings through alternative on-site measures). Calculation of potential developer contributions to input into a more detailed viability model.

8 New Buildings Planning Policy Assessment

This section presents the results of modelling undertaken to test the impacts of the carbon reduction requirements of Policy CP8 in Brighton and Hove's draft City Plan Part 1 on major new development in the area, compared to the targets expected to be set in future Building Regulations Part L. It makes recommendations on policies relating to carbon reduction in the draft City Plan based on the findings of this energy study.

The relevant sections of Policy CP8 are set out in Section 8.1. Sections 8.2 to 8.5 summarise the results of the policy testing. Section 8.6 then sets out particular recommendations for the draft City Plan Part 1 arising from the energy study.

8.1 Policy Targets

The policy targets being tested are outlined below:

CP8 Sustainable Buildings

Unless it can be demonstrated that doing so is not technically feasible and/or would make the scheme unviable:

All development will be required to achieve the minimum standards as set out below or equivalent standards from a quality assured scheme;

2013-2016	Development Size		
NEW BUILD	Non-major	Major	Greenfield
Residential Code for Sustainable Homes	Level 4	Level 5	Level 6
Non-Residential BREEAM	Excellent	Outstanding	

Revised standards beyond 2016 will be set in other DPD documents and/or a review of this policy....

...When onsite sustainability standards cannot be met mitigation measures may be sought, including those in accordance with Policy CP7 Infrastructure and Developer Contributions.

The Sustainability Checklist and the Annual Monitoring Report (AMR) will be used to assess planning applications, monitor the effectiveness of the policy and inform the council of revised standards over the plan period.

Supporting text (draft City Plan 4.78) states:

More is asked of larger, new build and Greenfield types of development as these tend to benefit from economies of scale and easier, cheaper ways in which sustainable design and construction features can be designed in. A growing number of flagship schemes in the UK and in Brighton & Hove have demonstrated the viability of such developments. In order to provide clarity and flexibility for developers, criteria for

considering instances where compliance with standards may not be possible as well and opportunities and mechanisms for mitigation are identified. In assessing technical feasibility and/or viability the council will consider site constraints, technical restrictions; financial viability and the delivery of additional benefits to the city. Given the contextual nature of these issues, the council will expect developers to make a case on a site by site basis.

8.2 New Development Policy Testing Methodology

The policies have been tested using a model created by AECOM. Our site testing work provides an analysis of the technical and financial viability of meeting the targets set out in CP8 (summarised above). The key assumptions and elements of the modelling methodology are set out below.

8.2.1 Technology Options for Meeting Targets

Based on the technologies considered to potentially be applicable to the development proposed in Brighton and Hove the following scenarios have been tested:

- Gas Boilers (Part L 2010 Compliant Base Case)
- Gas Boilers & PV 25% (i.e. 25% of max potential on an typical roof)
- Gas Boilers & PV 50%
- Gas Boilers & PV 75%
- Gas Boilers & PV 100%
- CHP District Heating & PV 50%
- Air Source Heat Pump & PV 50%
- Air Source Heat Pump & Solar Hot Water & PV 50%
- Ground Source Heat Pump & Solar Hot Water & PV 50%
- Air Source Heat Pump & PV 25%
- CHP District Heating & PV 25%
- CHP District Heating
- CHP District Heating & PV 100%
- Solar Hot Water
- Biomass Heating (either district heating or individual systems)
- Air Source Heat Pump
- Ground Source Heat Pump
- Solar Hot Water & PV 50%
- Biomass Heating & PV 100%
- Air Source Heat Pump & PV 100%
- Ground Source Heat Pump & PV 100%
- Biomass Heating & PV 200%

All the options except the gas boiler Part L 2010 Compliant Base Case assume a high level of energy efficiency. The technologies

modelled are at individual building level with the exception of district heating, but communal systems would show broadly similar results in regards to the relative carbon savings.

Flats are assumed to have flat roofs and houses to have pitched roofs, which determines the limit for the maximum '100% 'roof area available for PV. The 200% PV option goes beyond this so for flats would require additional PV output either by designing for more PV capacity (e.g. using panels inclined at 15° rather than 30°) and/or more efficient panels and for houses would mean assuming a mono-pitch roof and/or more efficient panels. It therefore has not been shown as an option for flats due to their restrictions.

The list of solutions above does not cover the full range of possible approaches that could be delivered on site. We have applied a range of reasonable scenarios but there are numerous other options that could potentially be applied. Some alternative options can be approximated to those above; for example a solution of high energy efficiency, biomass, PV and SHW which has sometimes been used in Brighton would have very similar results in terms of carbon savings to the energy efficiency, biomass and PV option. Capital costs would be higher but operational costs lower (the latter are not shown in the modelling).

Costings are based on capital cost of installation and do not indicate running costs.

8.2.2 Developments Used to Test Policies

The details of the new developments included in the testing have been taken from the draft City Plan Part 1 and further assumptions on development sizes and timescales have been made by AECOM where necessary, in discussion with Brighton and Hove City Council. Although the projections agreed are only based on early stage assumptions of the sizes, timings and types of buildings to come forward, they represent a reasonable set of data on which to assess the relative effects of different policy options for the development proposed in Brighton and Hove's draft City Plan Part 1. The types of development expected in the following development areas have been tested:

- DA3 Lewes Road;
- DA5 Eastern Road and Edward Street;
- DA7 Toads Hole;
- A small office development;
- A small domestic development.

The resulting carbon emission reductions from the different technology scenarios are compared to expected future Building Regulations in 2013, 2016 and 2019.

8.2.3 Future Building Regulations Assumptions and Code for Sustainable Homes and BREEAM Requirements

The assumptions made for future Building Regulations are set out in the table below. At this stage the zero carbon buildings targets in 2016 for domestic buildings and 2019 for non-domestic have been committed to by government, but the other targets (2013, 2016, and carbon compliance levels) are subject to further work and the results of the 2013 Building Regulations consultation process. Therefore it should be noted that the targets presented are based upon consultations and reports currently available, and are likely to be refined in the future. The targets required by the Code for Sustainable Homes (CSH) and BREEAM 2011 at the levels proposed to be required in Brighton and Hove are also given.

It can be seen that the targets proposed by Brighton and Hove are significantly in advance of Building Regulations.

TARGET	DOMESTIC	NON-DOMESTIC
Building Regulations 2013	**Aggregate 8% reduction over 2010**	**Aggregate 20% reduction over 2010**[41]
Source	CLG, *2012 consultation on changes to the Building Regulations in England* (preferred options)	
Building Regulations 2016	**100% reduction in regulated emissions; 25% / 41% / 47% carbon compliance compared to 2010 for flats / semis and terraces / detached plus Allowable Solutions**	**Aggregate 25% over 2010**
Source	Government commitment; Zero Carbon Hub, *Carbon Compliance: Setting an Appropriate Limit for Zero Carbon Homes - Findings and Recommendations*, Feb 2011[42]	CLG, *Zero carbon non-domestic buildings Phase 3 final report*, July 2011 - high scenario[43]
Building Regulations 2019	**As per 2016**	**100% reduction in regulated emissions; 32% through carbon compliance over 2010**[44]
Source	AECOM assumption	Government commitment to zero carbon; CLG, Zero carbon non-domestic buildings Phase 3 final report, July 2011 - high scenario
Code Level 4	**25% reduction in regulated emissions (no Allowable Solutions)**	n/a
Code Level 5	**100% reduction in regulated emissions (no Allowable Solutions)**	

[41] Other options are proposed, ranging between 8% - 20% aggregate reductions for non-domestic buildings. The 20% scenario has been taken as the preferred option. Disaggregated targets have been applied to different building types where these are given in the consultation stage impact assessment. Aggregate targets are proposed in recognition of the fact that it is harder to make carbon reductions within certain building types compared to others.

[42] The carbon compliance targets are proposed to relate to *as built* not *as designed* performance, which has not been taken into account in this assessment. The percentage reduction over Part L 2010 figures are estimates take n from the Zero Carbon Hub report, translated from 2006 to 2010.

[43] The high scenarios have been chosen for non-domestic buildings in 2016 and 2019 as they align best with the preferred option in the 2012 Building Regulations consultation; however these do not reflect government preferences, which have not yet been stated. Although both are proposed to be aggregate targets, i.e. varied across different building types, they have been presented at a fixed level for all building types due to the uncertainty around the disaggregated levels for different building types at this stage.

[44] Zero carbon standards for non-domestic buildings are not yet well-defined; it is assumed they will be similar to those for domestic buildings.

Code Level 6	**100% reduction in regulated AND 100% reduction in unregulated emissions (equivalent to 150-190% reduction in regulated emissions) (no Allowable Solutions)**	
Source	CLG, *Code for Sustainable Homes Technical Guide*, Nov 2010	
BREEAM Excellent	n/a	**25% reduction in regulated emissions over 2010 (no Allowable Solutions)**
BREEAM Outstanding		**40% reduction in regulated emissions over 2010 (no Allowable Solutions)**
Source		BRE, *BREEAM New Construction: Non-Domestic Buildings Technical Manual*, 2011

Table 14: Summary of current carbon targets required in environmental assessment methods (BREEAM and Code for Sustainable Homes) and assumptions made for future Building Regulations Part L carbon reduction targets

The carbon reductions required by CSH Level 6 have been translated to an equivalent percentage reduction over Part L 2010 (which only covers regulated emissions – i.e. not those associated with appliance use) so that they can be compared to the same baseline as other targets. This has been done using data from CLG's *Zero Carbon Homes Impact Assessment*, May 2011 (table AB5) which compares the typical emissions from regulated and unregulated energy use in properties complying with Part L 2010:

Emissions for Typical Part L 2010 Compliant Property (tCO_2/yr)	Detached	Semi	Mid	Flat
Regulated	1.9	1.3	1.2	1
Unregulated	1.4	1.1	1.1	0.7
Total	3.3	2.4	2.3	1.5
Total as % of Regulated Emissions in 2010 (CSH Level 6 carbon reduction target over Part L 2010)	174%	185%	192%	150%

Table 15: Details of CSH Level 6 target assumptions made to allow comparison to Building Regulations targets. Source: CLG, Zero Carbon Homes Impact Assessment, May 2011

8.2.4 Allowable Solutions

The revisions of Building Regulations proposed to take effect in 2016 (for dwellings) and 2019 (for non-domestic buildings) are expected to require a 'zero carbon' standard to be achieved which includes the use of 'allowable solutions'. This is a significant difference from current versions of the Code and BREEAM which effectively require carbon reductions to be achieved on or near-site (via private wire arrangements).

The definition of the 'Zero Carbon' standard has changed a number of times since it was first proposed in 2007. The current proposed approach suggests that it should be achieved through three steps:

- Energy Efficiency – which will set minimum standard for the performance of the building fabric;
- Carbon Compliance – which will set a minimum on-site CO_2reduction target;
- Allowable Solutions – which will require the residual CO2 emissions from the development to be 'offset' through payment into a fund to be used for CO_2 reductions elsewhere.

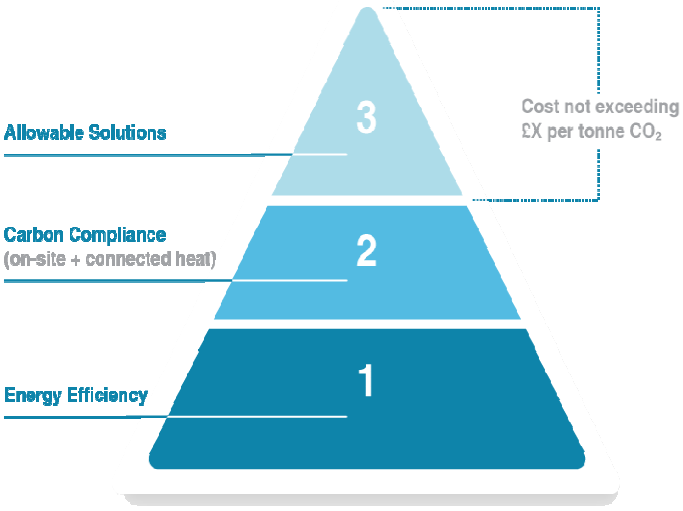


Figure 28: Proposed Zero Carbon Methodology

This concept behind Allowable Solutions reflects the understanding that there are diminishing returns for the money invested in reducing CO2 emissions on site and that the ability to do this can be technically constrained, so money can be better spent at scale on projects such as retrofitting programmes for existing buildings or on large scale low and zero carbon energy projects.

Work is still underway to define the Allowable Solutions and to create a mechanism for operating them. Recent work has been undertaken by the Zero Carbon Hub which has suggested that the most likely mechanism for allowable solutions will be a fund administered by the Green Investment Bank which developers would pay into and which Local Authorities could then draw on to spend on C CO_2 mitigation measures. The government's impact assessment used an illustrative figure of £46/tonne CO_2over 30 years (discounted). Indicative estimates by the Zero Carbon Hub indicate that this could represent around £1,000 - £1,600 per dwelling depending on dwelling type.[45]

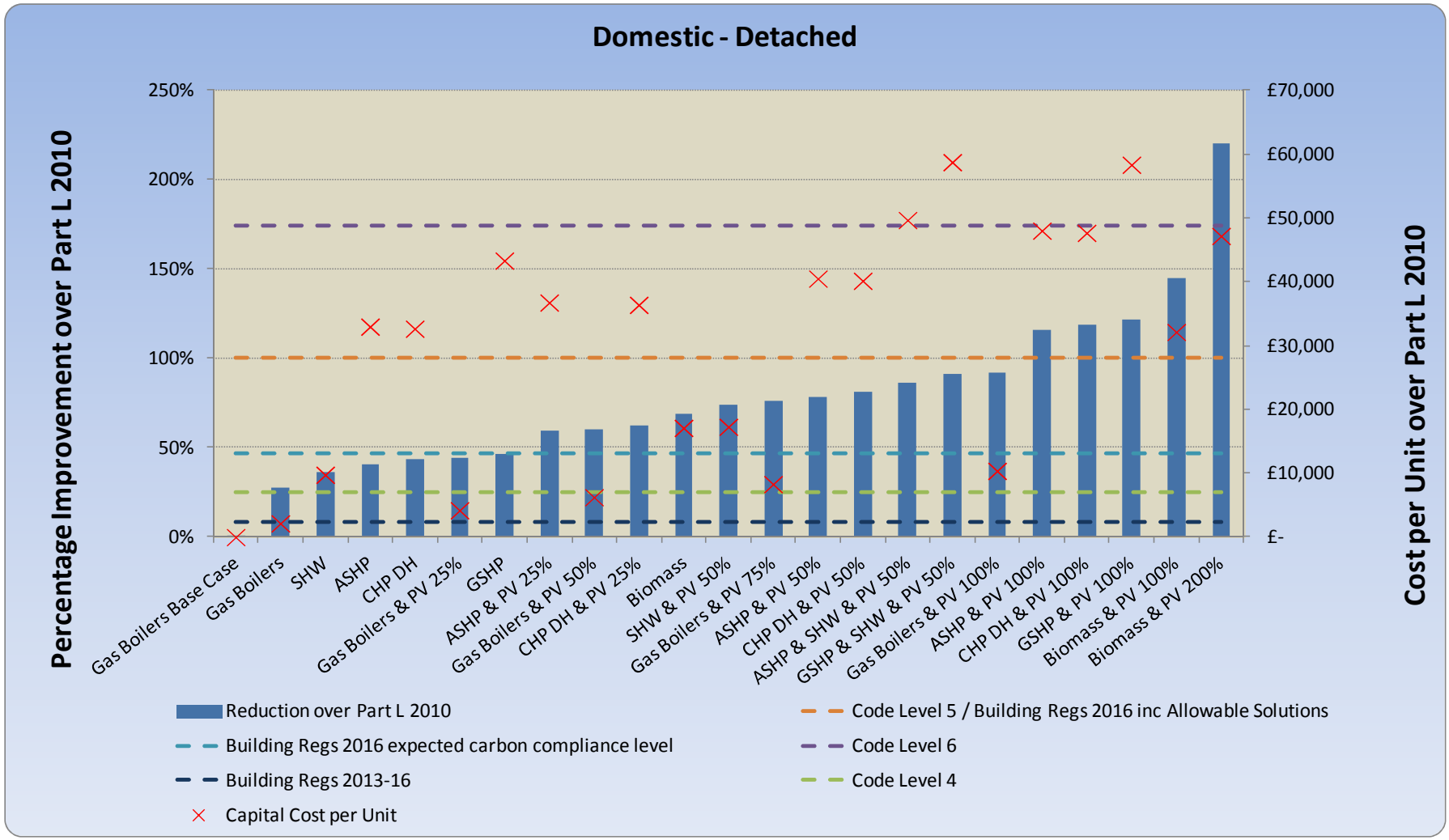
8.3 Policy Testing Results

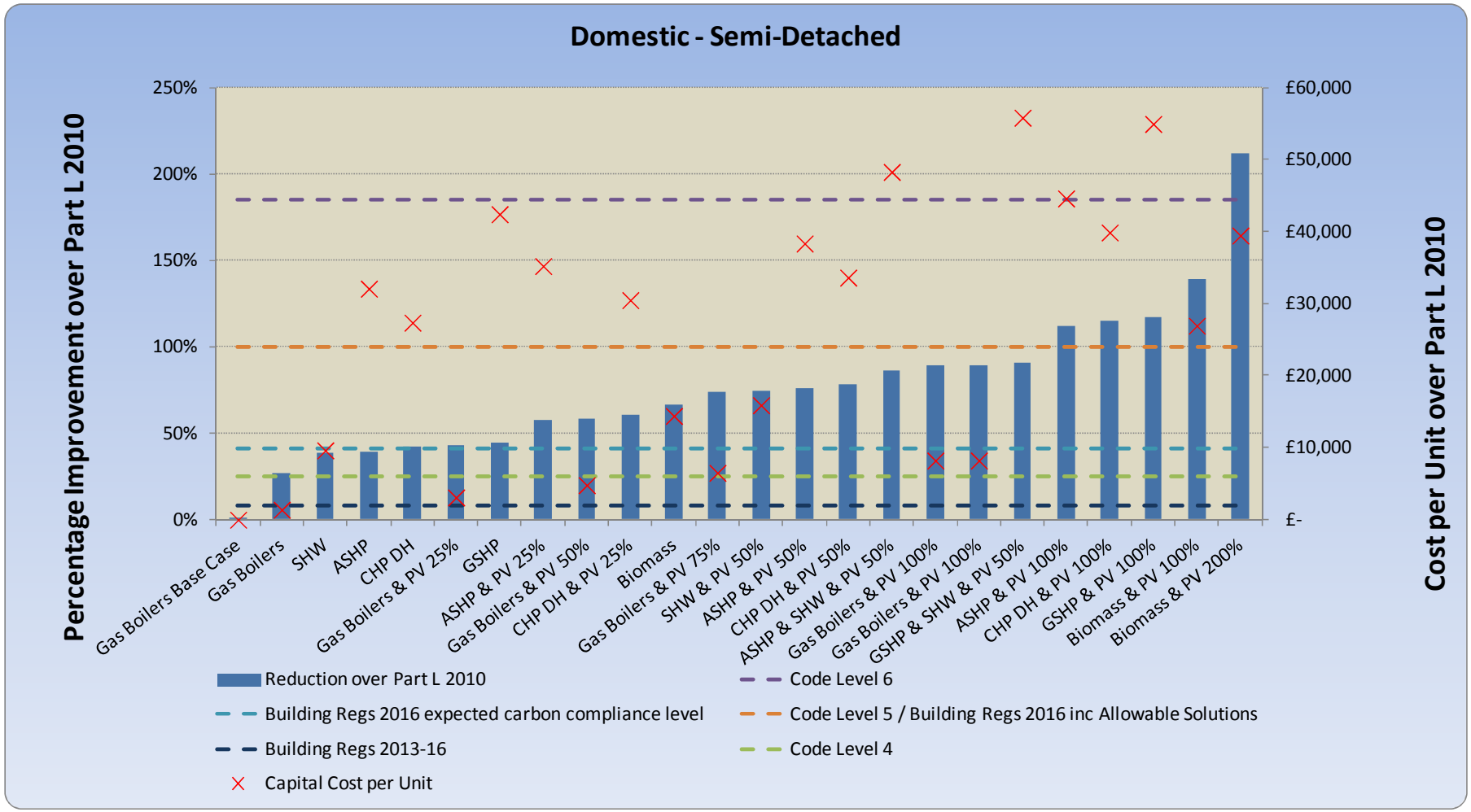
The graphs on the following pages show the estimated potential of various technology options to achieve improvements in the CO2 emissions of a sample of different building types within the developments tested, relative to Building Regulations Part L 2010, and the costs associated with these options.

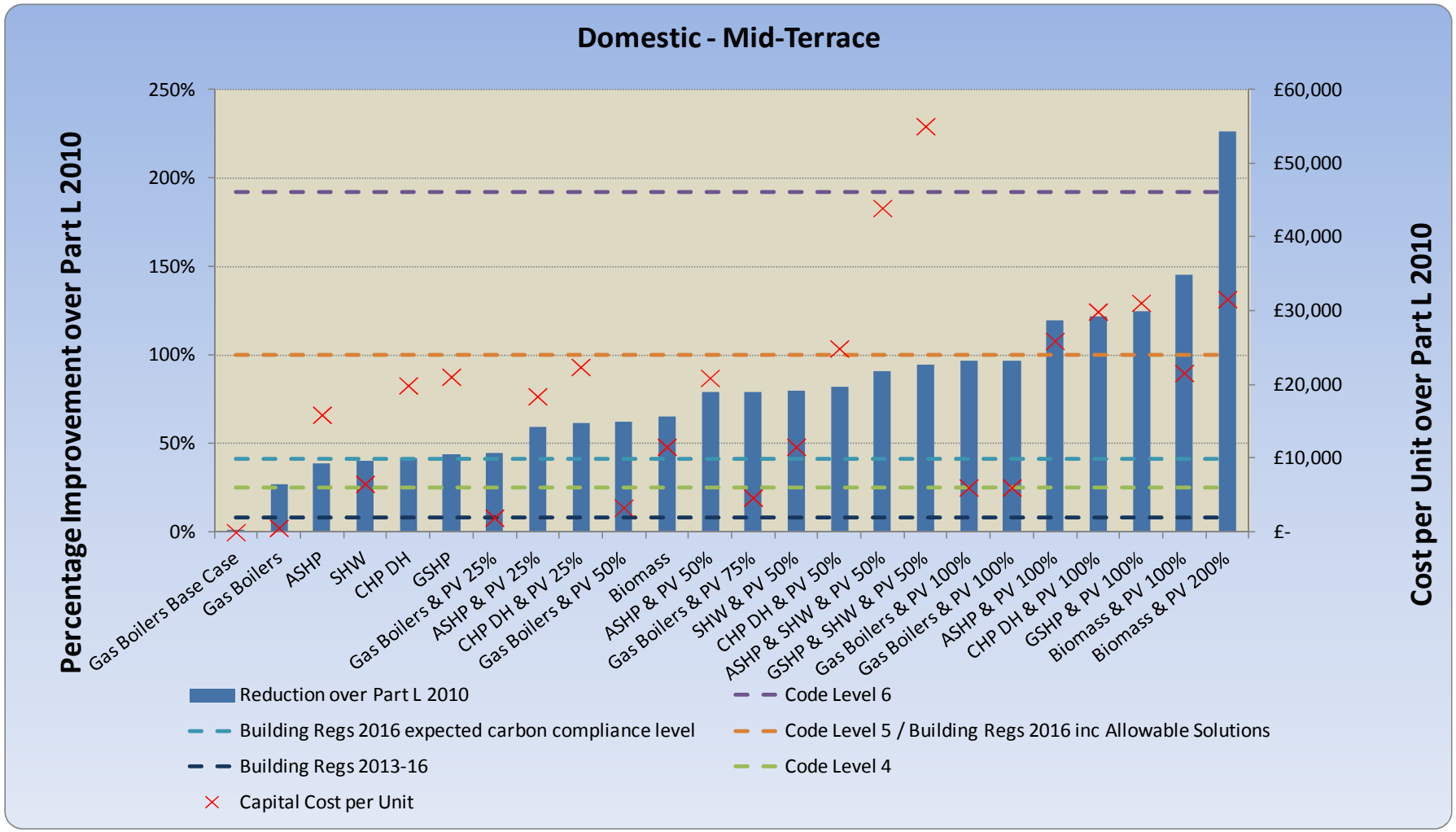
All costs are shown compared to the costs of meeting Building Regulations Part L 2010. The incremental costs for achieving higher standards will clearly reduce when compared against the costs of future regulatory periods, for example when new Building Regulations are introduced in 2013.

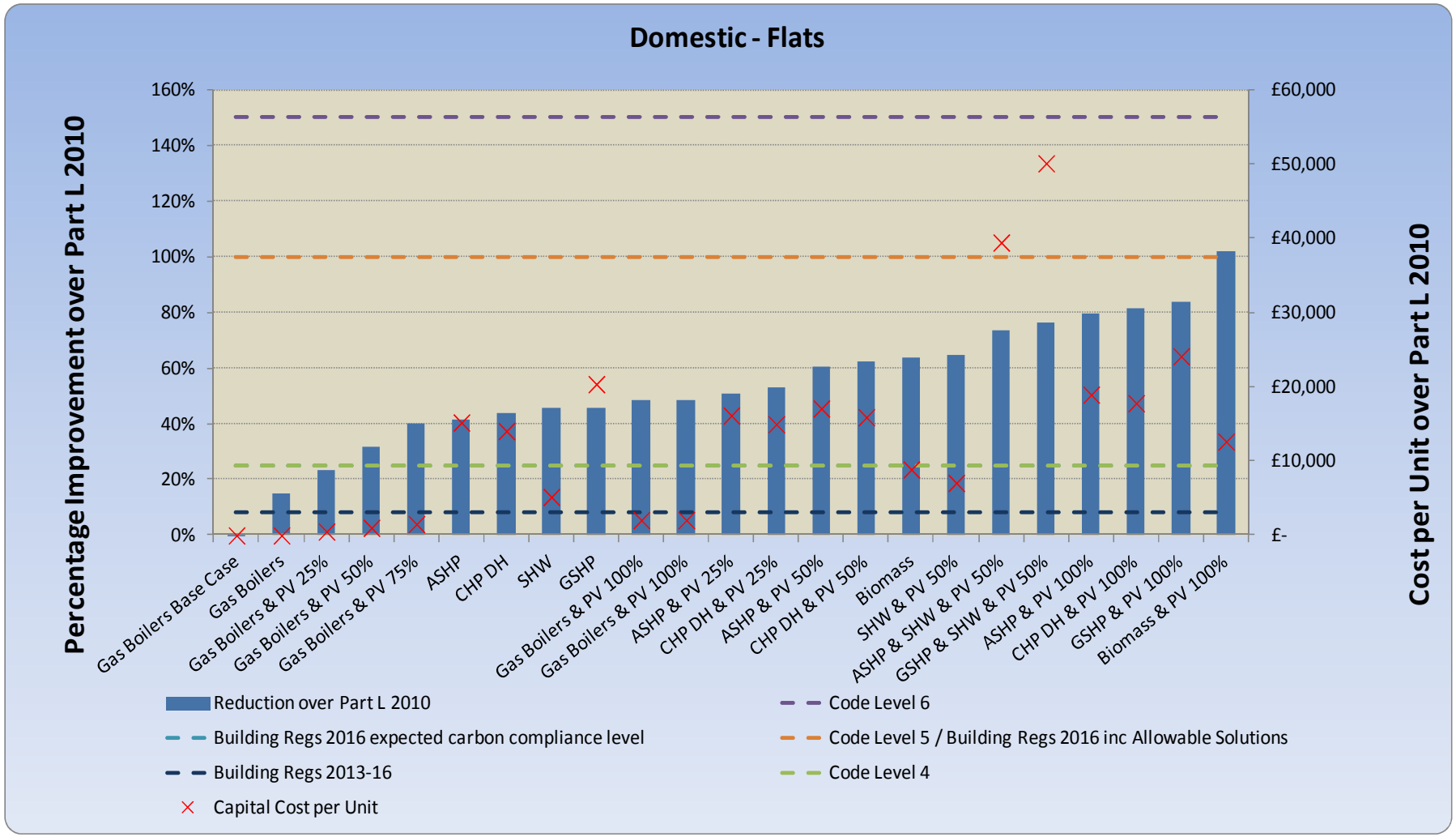
[45] Zero Carbon Hub, *Estimated Cost of Zero Carbon Homes*, August 2012.
The discounted cost is the upfront cost incurred, calculated as the cumulative value of the carbon emitted from a house in present value terms over 30 years.

Domestic Results

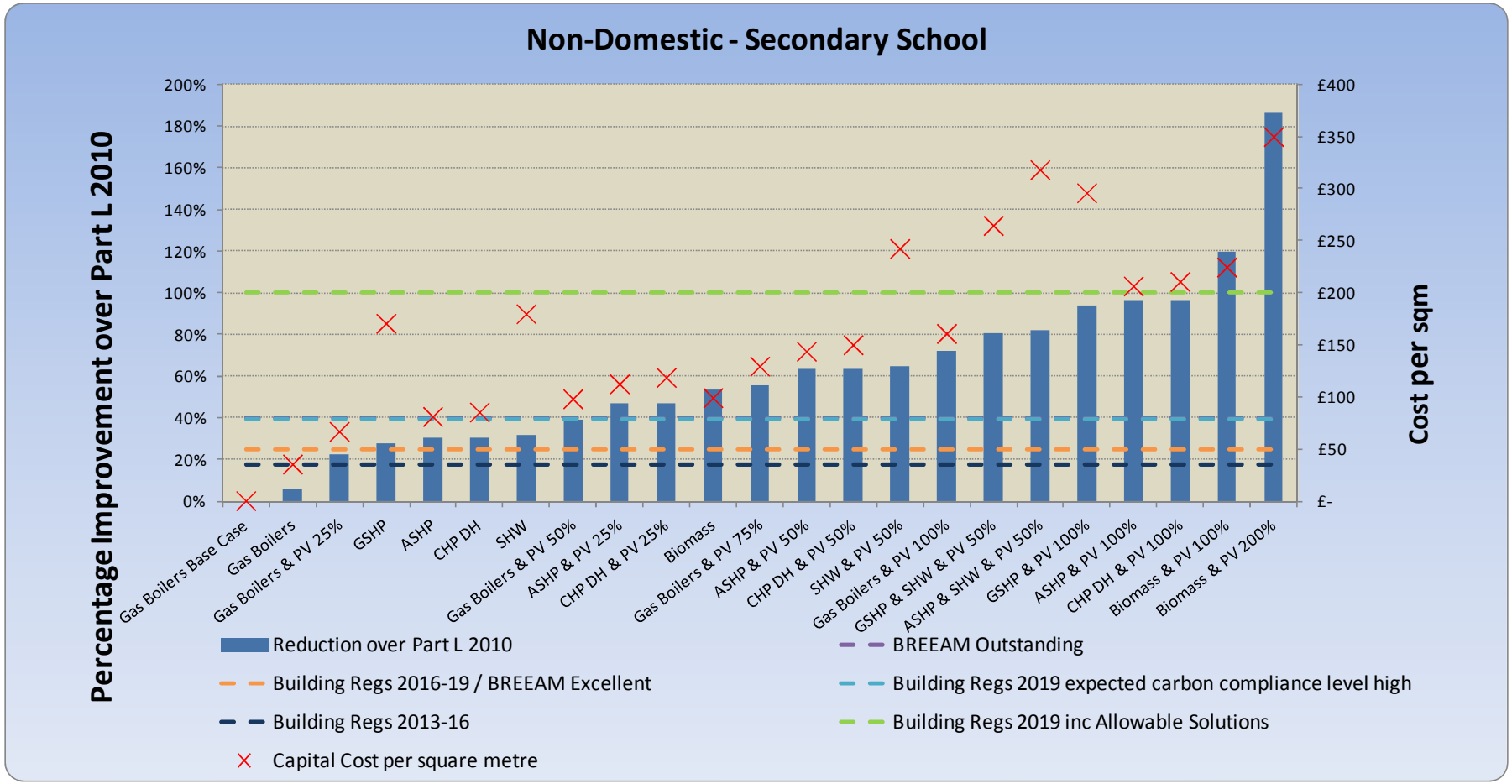


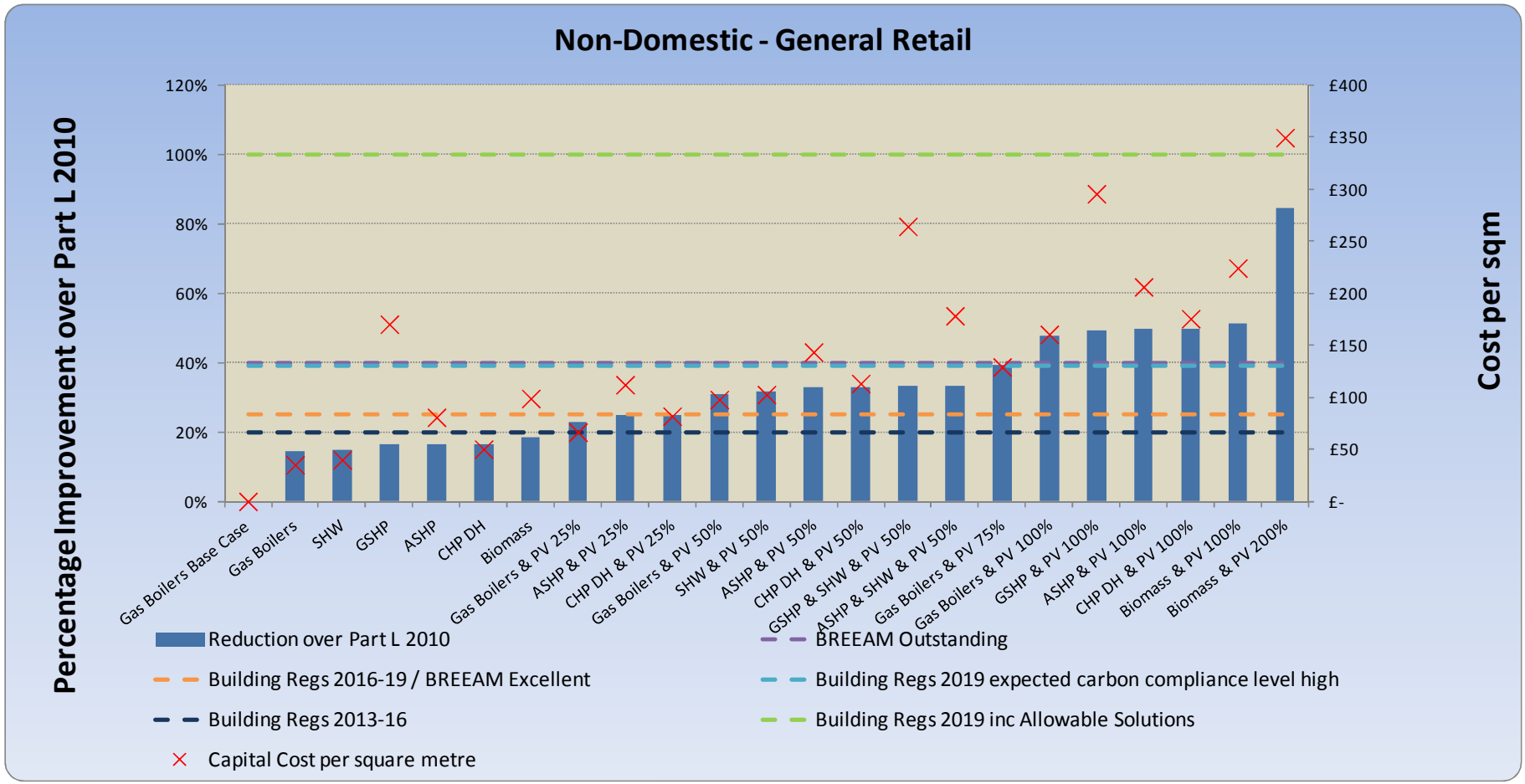

Domestic - Semi-Detached
Percentage Improvement over Part L 2010
Cost per Unit over Part L 2010
250%
200%
150%
100%
50%
0%
£60,000
£50,000
£40,000
£30,000
£20,000
£10,000
£-
Gas Boilers Base Case
Gas Boilers
SHW
ASHP
CHP DH
Gas Boilers & PV 25%
GSHP
ASHP & PV 25%
Gas Boilers & PV 50%
CHP DH & PV 25%
Biomass
Gas Boilers & PV 75%
SHW & PV 50%
ASHP & PV 50%
CHP DH & PV 50%
ASHP & SHW & PV 50%
Gas Boilers & PV 100%
Gas Boilers & PV 100%
GSHP & SHW & PV 50%
ASHP & PV 100%
CHP DH & PV 100%
GSHP & PV 100%
Biomass & PV 100%
Biomass & PV 200%
Reduction over Part L 2010
Code Level 6
Building Regs 2016 expected carbon compliance level
Code Level 5 / Building Regs 2016 inc Allowable Solutions
Building Regs 2013-16
Code Level 4
Capital Cost per Unit

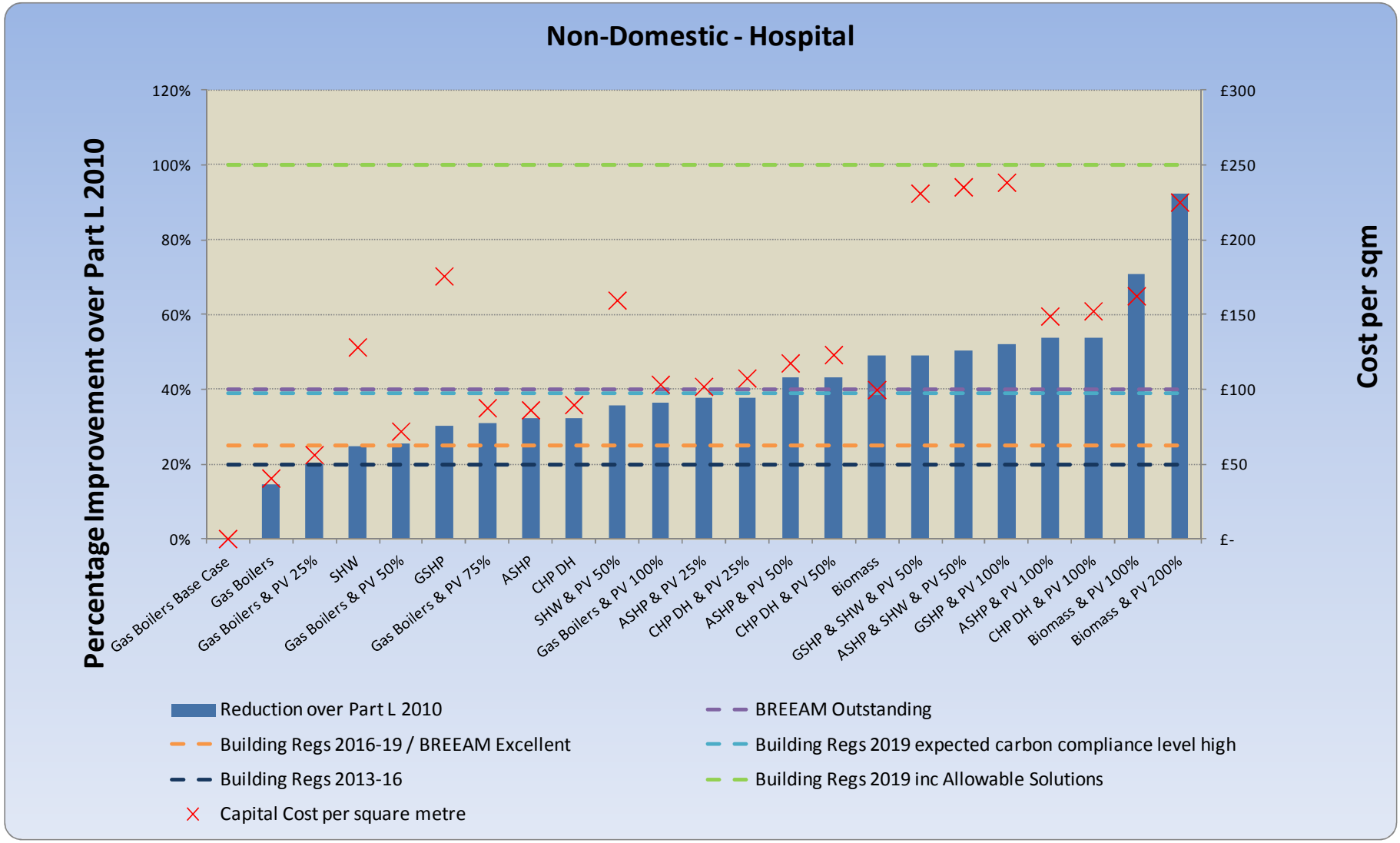

Domestic - Mid-Terrace
Percentage Improvement over Part L 2010
Cost per Unit over Part L 2010
250%
200%
150%
100%
50%
0%
£60,000
£50,000
£40,000
£30,000
£20,000
£10,000
£-
Gas Boilers Base Case
Gas Boilers
ASHP
SHW
CHP DH
GSHP
Gas Boilers & PV 25%
ASHP & PV 25%
CHP DH & PV 25%
Gas Boilers & PV 50%
Biomass
ASHP & PV 50%
Gas Boilers & PV 75%
SHW & PV 50%
CHP DH & PV 50%
ASHP & SHW & PV 50%
GSHP & SHW & PV 50%
Gas Boilers & PV 100%
Gas Boilers & PV 100%
ASHP & PV 100%
CHP DH & PV 100%
GSHP & PV 100%
Biomass & PV 100%
Biomass & PV 200%
Reduction over Part L 2010
Code Level 6
Building Regs 2016 expected carbon compliance level
Code Level 5 / Building Regs 2016 inc Allowable Solutions
Building Regs 2013-16
Code Level 4
Capital Cost per Unit

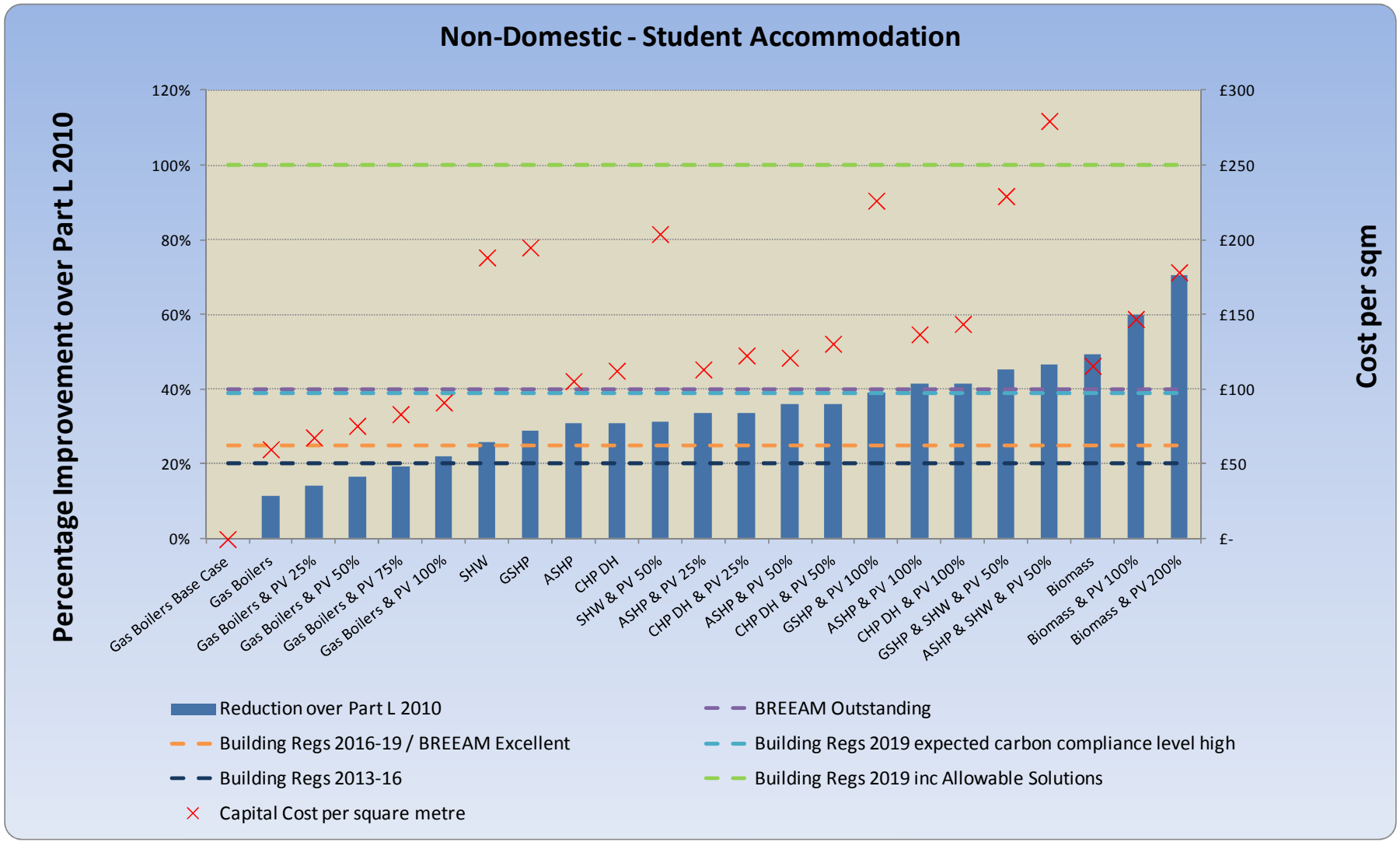

Domestic - Flats
Percentage Improvement over Part L 2010
Cost per Unit over Part L 2010
160%
140%
120%
100%
80%
60%
40%
20%
0%
£60,000
£50,000
£40,000
£30,000
£20,000
£10,000
£-
Gas Boilers Base Case
Gas Boilers
Gas Boilers & PV 25%
Gas Boilers & PV 50%
Gas Boilers & PV 75%
ASHP
CHP DH
SHW
GSHP
Gas Boilers & PV 100%
Gas Boilers & PV 100%
ASHP & PV 25%
CHP DH & PV 25%
ASHP & PV 50%
CHP DH & PV 50%
Biomass
SHW & PV 50%
ASHP & SHW & PV 50%
GSHP & SHW & PV 50%
ASHP & PV 100%
CHP DH & PV 100%
GSHP & PV 100%
Biomass & PV 100%
Reduction over Part L 2010
Building Regs 2016 expected carbon compliance level
Building Regs 2013-16
Capital Cost per Unit
Code Level 6
Code Level 5 / Building Regs 2016 inc Allowable Solutions
Code Level 4

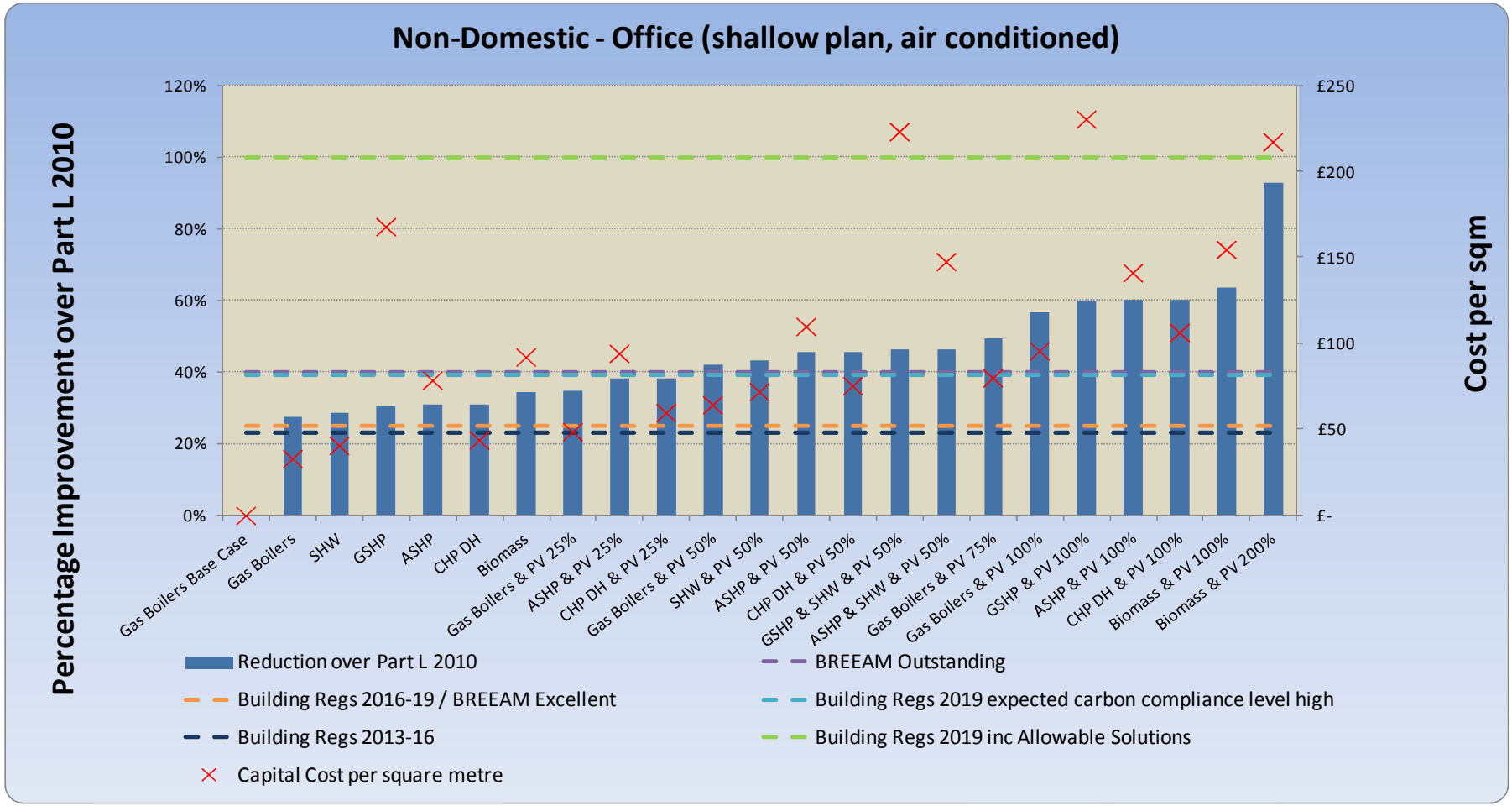
Non-Domestic Results

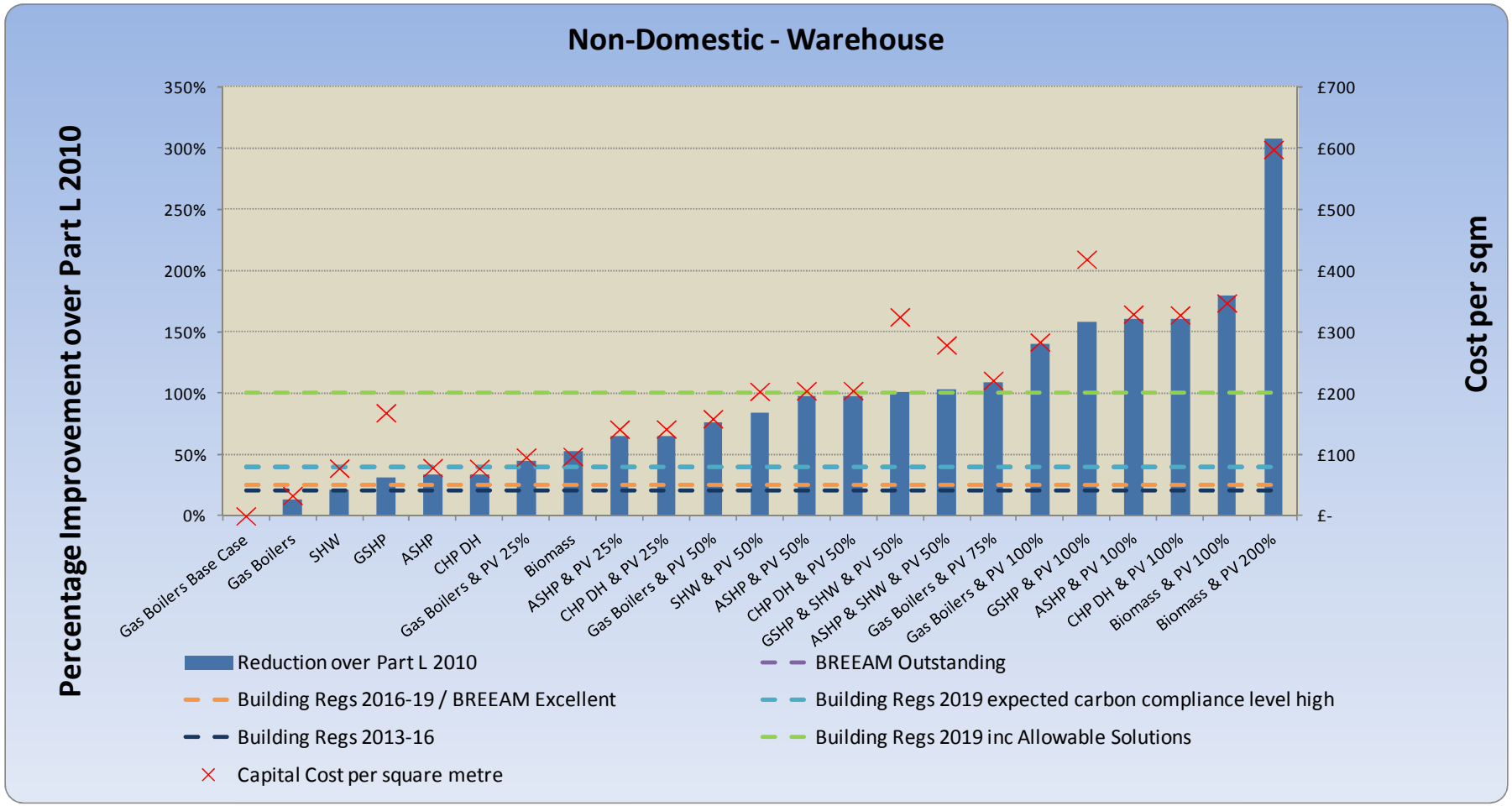



Non-Domestic - General Retail
Percentage Improvement over Part L 2010
Cost per sqm
120%
100%
80%
60%
40%
20%
0%
£400
£350
£300
£250
£200
£150
£100
£50
£-
Gas Boilers Base Case
Gas Boilers
SHW
GSHP
ASHP
CHP DH
Biomass
Gas Boilers & PV 25%
ASHP & PV 25%
CHP DH & PV 25%
Gas Boilers & PV 50%
SHW & PV 50%
ASHP & PV 50%
CHP DH & PV 50%
GSHP & SHW & PV 50%
ASHP & SHW & PV 50%
Gas Boilers & PV 75%
Gas Boilers & PV 100%
GSHP & PV 100%
ASHP & PV 100%
CHP DH & PV 100%
Biomass & PV 100%
Biomass & PV 200%
Reduction over Part L 2010
BREEAM Outstanding
Building Regs 2016-19 / BREEAM Excellent
Building Regs 2019 expected carbon compliance level high
Building Regs 2013-16
Building Regs 2019 inc Allowable Solutions
Capital Cost per square metre


Non-Domestic - Hospital
Percentage Improvement over Part L 2010
Cost per sqm
120%
100%
80%
60%
40%
20%
0%
£300
£250
£200
£150
£100
£50
£-
Gas Boilers Base Case
Gas Boilers
Gas Boilers & PV 25%
SHW
Gas Boilers & PV 50%
GSHP
Gas Boilers & PV 75%
ASHP
CHP DH
SHW & PV 50%
Gas Boilers & PV 100%
ASHP & PV 25%
CHP DH & PV 25%
ASHP & PV 50%
CHP DH & PV 50%
Biomass
GSHP & SHW & PV 50%
ASHP & SHW & PV 50%
GSHP & PV 100%
ASHP & PV 100%
CHP DH & PV 100%
Biomass & PV 100%
Biomass & PV 200%
Reduction over Part L 2010
BREEAM Outstanding
Building Regs 2016-19 / BREEAM Excellent
Building Regs 2019 expected carbon compliance level high
Building Regs 2013-16
Building Regs 2019 inc Allowable Solutions
Capital Cost per square metre


Non-Domestic - Student Accommodation
Percentage Improvement over Part L 2010
Cost per sqm
120%
100%
80%
60%
40%
20%
0%
£300
£250
£200
£150
£100
£50
£-
Gas Boilers Base Case
Gas Boilers
Gas Boilers & PV 25%
Gas Boilers & PV 50%
Gas Boilers & PV 75%
Gas Boilers & PV 100%
SHW
GSHP
ASHP
CHP DH
SHW & PV 50%
ASHP & PV 25%
CHP DH & PV 25%
ASHP & PV 50%
CHP DH & PV 50%
GSHP & PV 100%
ASHP & PV 100%
CHP DH & PV 100%
GSHP & SHW & PV 50%
ASHP & SHW & PV 50%
Biomass
Biomass & PV 100%
Biomass & PV 200%
Reduction over Part L 2010
BREEAM Outstanding
Building Regs 2016-19 / BREEAM Excellent
Building Regs 2019 expected carbon compliance level high
Building Regs 2013-16
Building Regs 2019 inc Allowable Solutions
Capital Cost per square metre


Non-Domestic - Office (shallow plan, air conditioned)
Percentage Improvement over Part L 2010
Cost per sqm
120%
100%
80%
60%
40%
20%
0%
£250
£200
£150
£100
£50
£-
Gas Boilers Base Case
Gas Boilers
SHW
GSHP
ASHP
CHP DH
Biomass
Gas Boilers & PV 25%
ASHP & PV 25%
CHP DH & PV 25%
Gas Boilers & PV 50%
SHW & PV 50%
ASHP & PV 50%
CHP DH & PV 50%
GSHP & SHW & PV 50%
ASHP & SHW & PV 50%
Gas Boilers & PV 75%
Gas Boilers & PV 100%
GSHP & PV 100%
ASHP & PV 100%
CHP DH & PV 100%
Biomass & PV 100%
Biomass & PV 200%
Reduction over Part L 2010
BREEAM Outstanding
Building Regs 2016-19 / BREEAM Excellent
Building Regs 2019 expected carbon compliance level high
Building Regs 2013-16
Building Regs 2019 inc Allowable Solutions
Capital Cost per square metre


Non-Domestic - Warehouse
Percentage Improvement over Part L 2010
Cost per sqm
350%
300%
250%
200%
150%
100%
50%
0%
£700
£600
£500
£400
£300
£200
£100
£-
Gas Boilers Base Case
Gas Boilers
SHW
GSHP
ASHP
CHP DH
Gas Boilers & PV 25%
Biomass
ASHP & PV 25%
CHP DH & PV 25%
Gas Boilers & PV 50%
SHW & PV 50%
ASHP & PV 50%
CHP DH & PV 50%
GSHP & SHW & PV 50%
ASHP & SHW & PV 50%
Gas Boilers & PV 75%
Gas Boilers & PV 100%
GSHP & PV 100%
ASHP & PV 100%
CHP DH & PV 100%
Biomass & PV 100%
Biomass & PV 200%
Reduction over Part L 2010
BREEAM Outstanding
Building Regs 2016-19 / BREEAM Excellent
Building Regs 2019 expected carbon compliance level high
Building Regs 2013-16
Building Regs 2019 inc Allowable Solutions
Capital Cost per square metre

8.4 Conclusions from Modelling

8.4.1 Domestic

The modelling suggests that there are a range of technology options which could potentially achieve expected future Building Regulations targets in 2013 and 2016 (carbon compliance) for domestic properties, although this will depend upon the final targets set.

There were tested technology solutions that could meet the CSH Level 5 target of a 100% on-site reduction in regulated emissions without allowable solutions in the detached, semi-detached and terraced house scenarios. Air or ground source heat pumps or biomass heating combined with PV covering 100% of the roof area (assuming standard pitched roof design) were identified as potential solutions which could meet the target. Extensive fabric efficiency or CHP district heating with 100% PV also approached the target. In the modelling undertaken, these solutions were not available to flats due to the limited roof space available per unit for the use of PV.

Examples of homes which have achieved CSH 5 include:

- Mariners Quay, Old Town Dock, Newport, - 101 unit scheme including 35 x 1 bed apartments and 51 x 2 bed apartments, advanced fabric performance, airtightness of 3, community heating biomass boiler, PV, whole house ventilation and heat recovery system.
- Northfield, Aberdeen - 16 four-bedroom houses and 12 three-bedroom flats, advanced fabric performance, airtightness of 3, air source heat pump, solar thermal panels, solar photovoltaic cells, mechanical ventilation heat recovery.
- South Nutfield - ground and first floor flats, Passive solar design, low energy lighting, PV array, biomass pellet boiler, low energy rated white goods, and MVHR.
- Mid Street, Surrey - 2 x two bedroom flats Passive solar design, High levels of insulation, Low air-permeability, low energy lighting, triple gazed windows, MVHR, biomass pellet boiler.

Meeting the requirements for Code Level 6 (as it is currently defined) was indicated to be more difficult. Flats in particular are most likely to need an Allowable Solutions or alternative carbon offset mechanism in order to meet higher targets.

Code Level 6 can be technically achievable on sites where there is sufficient space for larger dwellings and therefore the application of larger

scale PV systems through the application of design adaptations to increase the available roof space. Advanced practice in fabric efficiency is also an approach implemented in developments which have achieved CSH 6, in combination with renewable technologies. This is evidenced by the existing examples of CSH 6 houses that have been delivered to date, such as:

- The Kingspan Lighthouse – passive design, high fabric specification, energy efficiency, biomass boiler, solar thermal and PV on a mono-pitch roof designed to maximise south facing roof space.
- Greenwatt Way – A cluster of terraced houses with passive design measures, high fabric specification, energy efficiency and mono-pitched roofs with large PV arrays linked to a low temperature communal heat network served by low and zero carbon energy technologies (used separately as a test-bed).
- North Upton – Six terraced houses using passive design measures, high fabric specification, energy efficiency, PV, micro-wind turbines and linked to a heat network served by biomass boilers.
- Stoneham Green, Southampton – Eleven terraced houses using passive design measures, high fabric specification, energy efficiency and mono-pitched roofs with large PV arrays linked to a small heat network served by biomass boilers.

However, as recognised in the wording of policy CP8, it will not be possible to meet CSH Level 6 in all cases. This is supported by our analysis since in the case of flats, where the ability to increase the area of roof space is not necessarily straightforward, technical solutions can be limited. The costs of meeting this standard can be high and may impact on viability, though considerations of viability are factored into policy CP8.

8.4.2 Non-Domestic

The non-domestic modelling suggests that there are a range of technology options which could potentially achieve carbon reductions equivalent to Building Regulations targets in 2013 and 2016, although again this will depend upon the final targets set. It should be noted that in the calculation methodology for non-domestic buildings the '% improvement' is calculated relative to a 'notional building' that uses a set specification in which the same heating system is applied to both. This means that there is no improvement for using low carbon heating, such as a biomass boiler or gas CHP systems in place of gas boilers, since

the same system is applied to the notional building as well. Our results have shown improvements for different heating systems relative to a gas boiler as we have assumed that this will be calculated and accepted for the purposes of demonstrating CO_2 reductions for planning. However for Building Regulations compliance and credit Ene1 in BREEAM, which uses Building Regulations outputs, these savings will not count.

It should also be noted that the energy efficiency levels assumed for the non-domestic building cases are within the limit of what is currently possible through standard practice and the costs reflect this.

Our modelling identified a limited number of options to achieve a carbon reduction saving equivalent to the BREEAM Outstanding mandatory ENE1 credit requirement of a 40% reduction over Part L 2010 (currently excluding Allowable Solutions), or the 39% carbon compliance aggregate reduction over Part L 2010 derived from the high scenario of the CLG's *Zero carbon non-domestic buildings Phase 3 final report*, July 2011, which is the latest report on future non-domestic Building Regulations beyond 2013. The carbon compliance target is expected be introduced in 2019 for non-domestic buildings, The 'high' scenario is slightly less stringent than BREEAM Outstanding requirements, but it is not yet clear what final target will be set for 2019 – low and medium scenarios were also shown in the CLG report which suggested carbon compliance levels lower than 39% (25% / 32% over 2010). Achieving higher standards was found to be more difficult for building types with predominantly electrical demands such as offices and retail. It should also be noted that the 2016 and 2019 Building Regulation targets are anticipated to be aggregate targets, i.e. different targets will apply to different building types. As different target levels have not yet been suggested or defined, the same overall target is shown for all different building types, which is likely to make these targets appear more challenging than they may actually be for certain building types.

This issue is intended to be recognised in future non-domestic Building Regulations through setting varied targets for different building types. It is likely that as more work is undertaken to support the future revisions of the Building Regulations for non-domestic buildings in 2013, 2016 and 2019 that government will provide further guidance on the application of specific targets to different non-domestic building types.

Whilst the results of the analysis show that there is room for planning policy to require improvements beyond Building Regulations there are clearly restrictions on how far this is possible through carbon compliance measures alone, particularly for some building types. Flats and non-domestic buildings in particular are most likely to need an Allowable Solutions or alternative carbon offset mechanism in order to meet higher targets.

8.5 Code and BREEAM

8.5.1 Cost of the Code

Whilst AECOM has supported developers in achieving CSH levels 5 and 6, and has supported Local Authorities in encouraging high levels of the CSH where appropriate, it is our experience that these levels have not been achieved very widely and can be costly. Figure 29 shows the achievement of different CSH levels for different housing sectors from March 2008 to June 2012. 536 homes to date have achieved CSH Level 5 at design stage, and 360 have achieved CSH Level 6 at design stage.

CSH Level 5 represents a position which is harder to meet than the anticipated zero carbon homes standard to be set in Building Regulations in 2016, because it does not include the proposed Allowable Solutions mechanism and currently requires 100% reduction in regulated energy (energy consumed for space heating, hot water, fixed lighting and pumps and fans) through on-site or near-site measures alone. Similarly CSH Level 6 currently requires 100% reduction in regulated plus unregulated energy (energy consumed for cooking and appliances) through on-site or near-site measures alone.

Table 16 below shows modelled extra-over costs of meeting higher CSH levels on a per unit basis, compared to a Part L 2010 compliant unit, as estimated in CLG's *Cost of building to the Code for Sustainable Homes*[46] report for an urban regeneration development.

These costs do not take into account potential future changes to the CSH assessment methodology.

Prices may also reduce in the future and are likely to have reduced by the time policy CP8 is adopted. When compared to the cost of meeting Part L 2013 (rather than Part L 2010) the extra-over costs will reduce, based on CSH Level 4 extra-over costs compared to Part L 2010 and considering that Code Level 4

[46] Davis Langdon and Element Energy for CLG, *Cost of building to the Code for Sustainable Homes: Updated Cost Review*, 2011.

requires a 25% reduction over Part L 2010 whereas the 2013 Building Regulation consultation proposes a reduction of 8% over Part L 2010.

Table 17 below uses the same data to show the relative uplift to CSH Levels 5 and 6 on a per unit basis, as compared to a unit achieving CSH Level 4 compared to a 2010 compliant dwelling. The Cost of the Code report shows that the majority of the additional costs relate to energy credits (57% in the case of a 3 bed semi on an urban regeneration site achieving CSH Level 5), a significant proportion to water credits (29% in the same case), and the remainder to health, management and ecology in that order of significance.

For comparison, Table 18 below shows the extra-over cost of zero carbon homes on a per unit basis, compared to Part L 2010 compliance, as estimated by the Zero Carbon Hub in their *Estimated Cost of Zero Carbon Homes*, December 2011 report (at 2010 prices).[47]

Whilst the zero carbon homes target, like the CSH Level 5 mandatory credit ENE1, requires a 100% reduction in emissions associated with regulated energy use, the costs are much lower on a per unit basis as the zero carbon homes costing includes an Allowable Solutions mechanism indicatively costed at £46/tonne of carbon over 30 years. The tables above could be used to estimate the cost to a developer for achieving a certain level of the CSH for a particular site, or a proportion of their site, and may be helpful for the Council to give them an understanding of the costs involved.

Other challenges would include the water requirements of Code Levels 5 and 6, although it is recognised that Brighton and Hove has particular reasons for promoting these, as the area is highly water-stressed. It is also worth noting that the difficultly of achieving the overall scores required for the higher levels of the CSH and BREEAM can be significantly affected in some locations by local factors that might affect the ability to achieve credits relating to site-wide issues over which developers potentially have less or no control (e.g. ecology, flooding, surface water run-off).

[47] http://www.zerocarbonhub.org/resourcefiles/Estimated_Cost_of_Zero_Carbon_Homes.pdf

Number of dwellings which have achieved different CSH levels at design stage

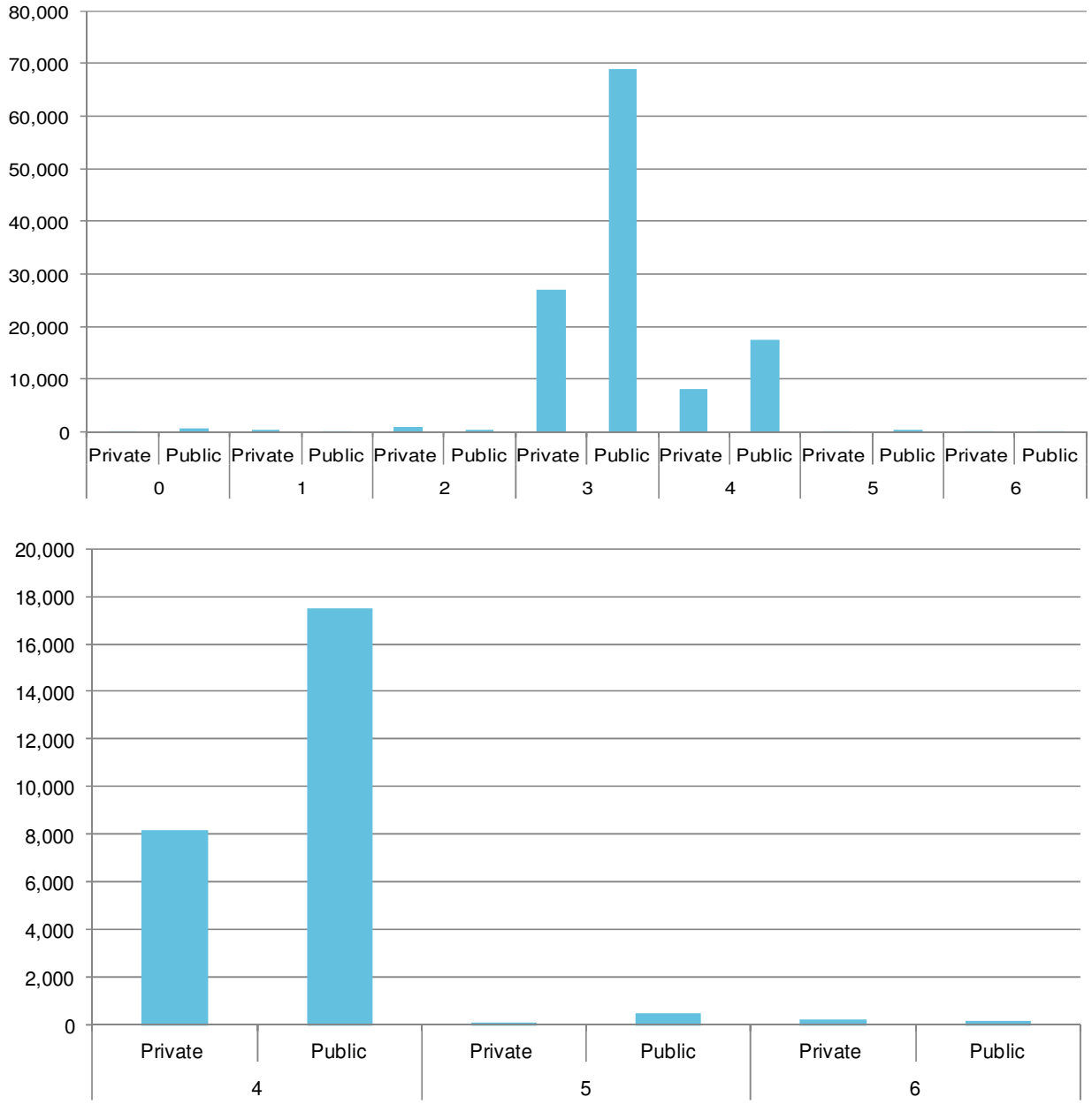


Figure 29: Number of dwellings achieving different levels of the Code for Sustainable Homes at design stage between March 2008 and June 2012. The second graph shows CSH 4 to 6 only (Code for Sustainable Homes Statistics, June 2012)

Code Level	2b-Flat		2b-Terrace		3b-Semi		4b-detached	
	E/O cost	% uplift	E/O cost	% uplift	E/O cost	% uplift	E/O cost	% uplift
4	£3,330	6.1%	£3,210	4.0%	£4,300	5.0%	£4,390	5.3%
5	£14,790	27.1%	£15,210	19.0%	£16,410	19.0%	£17,740	19.2%
6	£27,270	49.9%	£28,410	35.5%	£31,130	36.1%	£34,550	37.3%

Table 16: Extra-over costs of CSH Levels on a per unit basis compared to Part L 2010 compliant units

Code Level	2b-Flat		2b-Terrace		3b-Semi		4b-detached	
	E/O cost	% uplift	E/O cost	% uplift	E/O cost	% uplift	E/O cost	% uplift
5	£11,460	21%	£12,000	15%	£12,110	14%	£13,350	15%
6	£23,940	44%	£25,200	31%	£26,830	31%	£30,160	34%

Table 17: Extra-over costs of CSH Levels 5 and 6 on a per unit basis compared to units achieving CSH Level 4

Unit Type	Flat	Mid-terrace	Semi	Detached
Fabric (over 2010)	£0	£700	£1,300	£3,900
Carbon Compliance (excl fabric)	£2,600	£5,752	£6,632	£7,809
Allowable Solutions (at £46/tCO_2 over 30yrs)	£1,055	£1,159	£1,159	£1,627
Total Cost of Zero Carbon Homes over Part L 2010	**£3,655**	**£7,611**	**£9,091**	**£13,336**

Table 18: Estimated costs of zero carbon homes (i.e. expected Building Regulations 2016) compliance compared to Part L 2010

8.5.2 BREEAM Excellent and Outstanding

The BREEAM Excellent and Outstanding ratings set very high standards for non-domestic buildings that go significantly beyond current practice. As with the higher levels of the Code, the most challenging aspect of achieving these ratings, both in terms of the technical and financial implications, relates to the mandatory energy performance requirements.

The maps below show the number of BREEAM Outstanding (33 to date) and Excellent certified buildings in the UK. It should be noted that these buildings achieved these ratings under previous versions of BREEAM which are significantly less demanding than BREEAM 2011, the current version.

BREEAM Outstanding (ENE1) requires a 40% reduction over Part L 2010, which theoretically can be partly through accredited offsite low and zero carbon technologies; however it is noted in the BREEAM 2011 New Construction Technical Manual that there are currently no accreditation schemes which would allow BREEAM's offsite renewable requirements to be met. We are not aware of any buildings which have yet achieved BREEAM Outstanding under the 2011 version of the scheme.

Through our experience of delivering buildings to the BREEAM Excellent and Outstanding ratings (under previous versions of the scheme), we are aware that the technical requirements for meeting the mandatory energy performance standards can be onerous as they can necessitate the installation of technologies which require significant space and the presence of specific opportunities or absence of specific constraints (e.g. for the application of biomass boilers and wind turbines).

Also, it should be recognised that the mandatory energy requirements in BREEAM Outstanding and BREEAM Excellent are much harder to achieve in certain building types For example, it is easier to deliver energy improvements for warehouses where regulated demands are already very low and in buildings with high heat demands where improvements can be made relative to the specification applied to the notional building against which the performance is tested (although these types can also be limited by the fact that Building Regulations tests compliance against a notional building with the same heating fuel as the actual building, as discussed above). It can be harder for offices and general retail where a high proportion of energy use is electrical. Also in the case of retail units on the

ground floor of mixed use schemes in urban locations, the opportunities to deliver improvements in energy performance relative to the notional building are extremely limited because of the limited intervention opportunities that are available. These issues are evident in the policy testing assessment outlined above and supported by AECOM's own research for CLG on the Building Regulations[48] as well as our extensive experience of undertaking BREEAM assessments.

Policy CP8 recognises that the achievement of the required standards may not be viable in all locations and for all building types. The application of the BREEAM rating requirements for non-domestic buildings in non-major, major and Greenfield sites will therefore need to take the development context into consideration and be applied on a case by case basis (as stated in the supporting text 4.78). In applying this policy where site constraints, technical restrictions, financial viability of the delivery of additional benefits to the city can be demonstrated by the developer, it may be necessary to apply a lower rating, such as using BREEAM Very Good in place of BREEAM Excellent or BREEAM Very Good or Excellent in place of BREEAM Outstanding. These alternatives would still deliver a good standard of environmental performance, going significantly beyond current practice.

.

[48] CLG, *Zero carbon non-domestic buildings Phase 3 final report*, July 2011

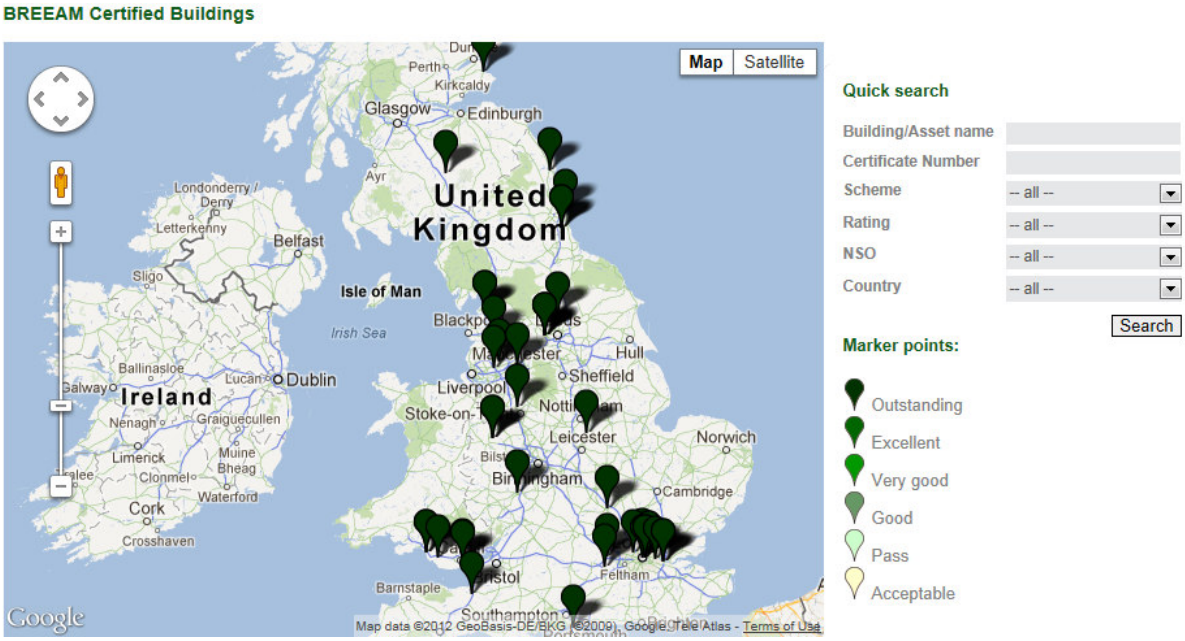


Figure 30: BREEAM Outstanding Certified Buildings [BRE Green Book Live http://www.greenbooklive.com October 2012]

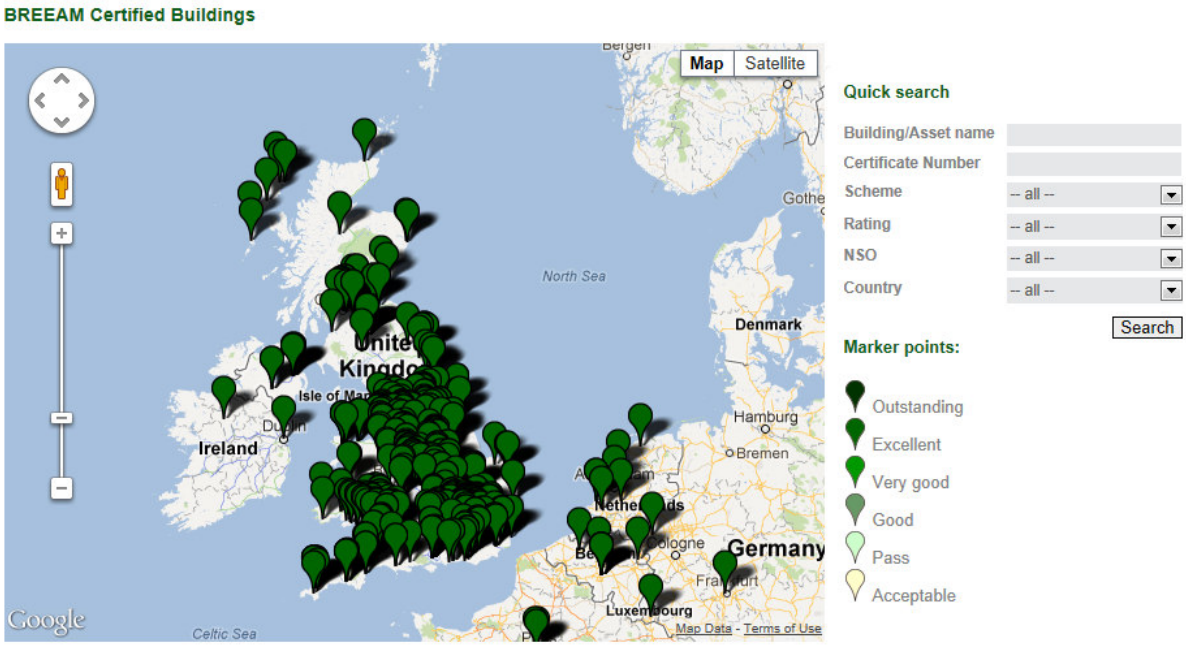


Figure 31: BREEAM Excellent Certified Buildings [BRE Green Book Live http://www.greenbooklive.com, October 2012]

8.6 Conclusions and Recommendations for Planning Policy

8.6.1 New Development Requirements

The key conclusions arising from the site testing analysis of the CSH and BREEAM requirements for new developments is summarised below:

- There is good evidence to demonstrate that delivering CSH Level 4 should be technically feasible and financially viable in most instances.
- There are solutions for achieving CSH Levels 5 and 6 but these standards are likely to be technically and financial challenging, particularly for some development types and in locations with particular constraints.
- Delivering BREEAM Excellent will be both technically and financially challenging to deliver, mainly (but not solely) because of the significantly higher mandatory energy requirements.
- Delivering BREEAM Outstanding will be even more difficult, particularly for some building types and in locations with particular constraints.

Our recommendations for policy CP8 on the basis of these conclusions are as follows:

- **The Council will need to consider how best to build flexibility into the application of Policy CP8**

  As noted in policy CP8 itself and the supporting text in 4.78, the standards that are applied to non-major, major and Greenfield site developments will need to reflect technical feasibility and financial viability. As such, the Council may need to work with developers to assess the suitability of the standards based on the development/building type, the specific constraints on the site and the factors affecting the viability of the scheme. On some sites this may require the developer to undertake a more detailed and site-specific evidence base to support the requirement of the standards set out in CP8 – for example by undertaking a study for the particular site to investigate the potential for meeting higher standards. A case by case approach is inherent in planning policy and legislation.

- **Make reference to minimum standards in the case where the targets cannot be met.**

  In the case where the targets set out in CP8 cannot be met on site, a 'backstop' standard (i.e. a fall-back minimum standard should the preferred higher standard not be feasible or viable) could be applied and reference could be made to this, for example in guidance within the supplementary planning document which is to be adopted ahead of the City Plan.

  In the case of residential development, CSH Level 4 could represent a backstop position that could be easily supported by the evidence from this study and the CLG study into the Cost of the Code study.[49] The mandatory energy standard of CSH Level 4 goes beyond what is proposed in Building Regulations 2013 and so would deliver a performance that went beyond the standard requirements.

  In the case of non-domestic development, BREEAM Very Good, could be applied and would similarly easily be supported by existing evidence as deliverable across all building types and locations.

  A more complicated approach would be to select a specific performance standard. This could require specific improvements relative to building regulations or specific overall scores in the CSH or BREEAM assessments or scores under specific sections. Such an approach would require the Council to either carry out an assessment of appropriate standards that could be applied to different building types of assess sites as they came forward and to develop an evidence base to support specific requirements for each.

- **Provide a local offset mechanism**

  Where developers struggle to meet the higher energy targets a local mechanism to enable offsetting could be used (in advance of the proposed Allowable Solutions mechanism within future Building Regulations).

  This approach could be used in combination with the backstop standards described above, so the additional emissions resulting from the lower standard being applied are

[49] Davis Langdon and Element Energy for CLG, *Cost of building to the Code for Sustainable Homes: Updated Cost Review*, 2011

instead offset by applying a carbon price that can be used to generate a fund to make the equivalent CO_2 savings elsewhere.

Other local authorities have set up such mechanisms, including Milton Keynes and Islington, and such a scheme was previously proposed in Brighton and Hove. Such a mechanism could potentially be used to provide the funding to pay for the carbon reduction measures that have been identified in this study (see section 9).

There are numerous complications involved in setting up such a fund, not least because of the lack of a suitable delivery mechanism available to do so, although in theory either s106 and CIL could be used.

If the Council wished to set up such a fund further work would be required to define a carbon price and a mechanism to operate it as well as the transition to the possible future Allowable Solutions mechanism.

- **Make specific reference to allowable solutions**

  This is already proposed as an addition to the current text in policy CP8 referring to mitigation measures; this should include reference to the Council potentially working with partners to bring forward potential allowable solutions opportunities. This might include the creation of an energy strategy for the city and/or specific energy plans for particular priority areas and further guidance on allowable solutions, possibly in the form of an SPD.

8.6.2 Heat Network Policy

Currently the wording of CP8 does not refer specifically to the potential opportunities within Brighton and Hove for district heat networks (except in the Development Area text for the Marina and Toads Hole Valley) or include specific requirements on developers to support district heat networks.

With the analysis of the opportunities for district heating undertaken in this Energy Study there is now potential to include more specific references or policies including:

- Identification of the locations of the 14 priority clusters with the option of including the map of these areas.

- Specific wording requiring developers to investigate connection and/or provision for future connection to existing/planned networks
- Specific wording stating that development within the long-list of cluster areas will be 'encouraged to consider' heat networks and 'required' to either connect where a suitable system was in place (or would be at the time of construction) or design systems so that they are compatible with future connection to a network.
- Specific wording stating that development within the high priority cluster areas where further technical and financial feasibility was undertaken and viability was demonstrated developments will be 'expected' to incorporate infrastructure to support heat networks (subject to viability).
- Reference within the City Plan text on the development areas and special areas to heat networks where the areas have been identified as having potential for district heating – either as priorities for the areas or within the supporting text. For the three sites where feasibility assessments have been undertaken and outline viability has been demonstrated the consideration of connection or future compatibility with heat networks could be included as a requirement.
- Reference to heat network opportunities in the Infrastructure Plan.

Examples from other authorities' Core Strategies include Bath and North East Somerset's draft Core Strategy policy CP4 where similar policies were supported by a similar evidence base study, and Manchester's adopted Core Strategy EN4 which states: "Where appropriate new development and retrofit projects will be required to connect to and/or make contributions to low or zero carbon energy schemes and/or to incorporate provision to enable future connection to any existing / potential decentralized energy schemes." Manchester's policy EN6 (Target Framework for CO_2 reductions from low or zero carbon energy supplies) also states that developments within 'network development areas' are required to be a CHP/district heating anchor or connection unless this can be shown not to be viable.

8.6.3 Energy Opportunities Mapping

- The current wording in CP8 gives general support for renewable energy technologies, however the evidence provided in this Energy Study can allow for more specific identification of the type, location and total capacity for different technologies within Brighton and Hove as well as showing potential constraints within certain areas.
- There is an option to include the energy opportunities map from this Energy Study which can help the Council and developers to identify particular areas of opportunity for different low and zero carbon technologies.

8.6.4 Energy Efficiency

- Carbon reduction scenario testing work in the Energy Study has identified the costs and benefits for delivering carbon reductions through a range of energy efficiency measures.
- In theory this provides the basis to support more specific references to the types of projects and actions which the Council should be supporting.
- Our initial results show that to deliver significant carbon savings during the Plan period the Council will need to address emissions associated with the existing building stock. Reflecting this fact in the wording of the policy could act as a potential hook for including further supporting policy for some of the energy efficiency measures identified.
- Such supporting policy might include a Consequential Improvements Policy, or guidance on retrofit in Conservation Areas, or use of Allowable Solutions to fund retrofit projects. The potential for further supporting policy relating to energy efficiency could be referred to in the City Plan.

Uttlesford District Council already has a consequential improvements policy in place, and a similar policy is proposed in the 2012 Building Regulations consultation.[50] Another policy example is Manchester's adopted Core Strategy EN4: "Where possible new development and retrofit projects will be used as a mechanism to help improve energy efficiency and provide low and zero carbon energy supplies to existing buildings."

[50] Uttlesford District Council, *SPD Home Extensions Adopted November 2005*: http://www.uttlesford.gov.uk/documents/website/Planning/SPD/spdextensionsadoptednov05docfinalversion.doc

9 Existing Buildings Measures

This section focuses on the assessment of the technical potential and cost of different energy efficiency and microgeneration measures for existing buildings in Brighton and Hove. It describes the methodology used along with practical constraints and opportunities for delivery. The assessment methodology outlined below feeds into a scenario modelling tool created by AECOM to allow the generation and further assessment of overall carbon reduction scenarios for the city.

9.1 Introduction

This section of the study seeks to provide high-level estimates of the costs and benefits of different potential measures and programmes that can be implemented at the local level, in order to assist Brighton and Hove City Council in investigating potential delivery strategies for achieving their carbon reduction targets.

For each measure identified the following factors have been assessed:

- Maximum technical capacity;
- Potential carbon savings;
- Costs – given at current or near-current prices (indicative, generally not taking into account variations in building stock);
- Recent installation trends;
- Indicative lifetime costs of measures per tCO_2saved;
- Lead delivery agent;
- Potential uptake rates;
- Delivery constraints.

The methodology for assessing these factors is set out in the text below and the results of the assessment are summarised in the matrix at the end of this section.

Measures are divided into the following sectors:

- Domestic (Council and non-Council);
- Non-Domestic (Council and non-Council);
- Cross-Sector.

The results of the assessment are summarised in the matrix at the end of this section, and feed into the scenario development in the following section except for a couple of measures which are discussed separately after the cross-sector measures.

Council housing measures are the subject of a separate report being undertaken in parallel with this study (Brighton and Hove City Council Strategic Housing Study) so are covered at a high level here; results will be discussed further in the Strategic Housing study.

9.2 Domestic Measures

The domestic sector accounts for around 57% of Brighton and Hove's emissions from buildings and is therefore very important to target. As the Council will have more control over the implementation of measures in its own stock, domestic measures have been assessed separately for their potential impact on Council homes and their potential impact on privately owned homes - in order to show how much direct control the Council has, and where achieving reductions is likely to be more challenging. As council housing makes up only around 10% of the borough's housing stock however, measures in private homes will be vital in achieving carbon reductions.

There are around 121,540 households in Brighton and Hove,[51] of which around 64% are owner occupied and 21% owned by private landlords. The Council owns over 14,000 Council homes, around 12% of the housing stock. The remainder is largely in housing association ownership. Across all tenure types, detached properties account for around 11% of the total domestic stock, semi-detached 20%, terraced 22% and flats or bedsits 47%.[52] Brighton's private sector housing stock condition survey in 2008 highlighted the high levels of converted flats – proportionally over seven times the national average. A significant proportion of houses are in multiple occupancy.

The age profile of the private stock in Brighton and Hove differs from the average for England as it contains a substantially higher proportion of pre-1919 stock (c.40% compared to the national average of 25%). There are also slightly higher levels in the 1919 to 1945 age group (26% compared to 19%) and significantly fewer built post 1944. This gives a total of around 66% built before 1945 compared to 43% in England as a whole.

The key potential carbon reduction opportunities within the domestic sector are identified below, and the methodology for assessing each is discussed. The measures can largely be divided into the categories of energy efficiency and renewables.

9.2.1 Energy Efficiency

9.2.1.1 Cavity Wall Insulation

Technical Capacity – Data from Brighton & Hove City Council's Private Sector Housing Condition Survey 2008 was made available to AECOM for the purposes of this study. The data includes information on energy efficiency

[51] ONS, Census 2011, data released 24th September 2012.
[52] ONS, Census 2001

measures in the homes surveyed and this was scaled to the whole of Brighton and Hove to assess the potential for various measures at the city level.

The Council's rdSAP data for Council Housing was also made available and this was used to estimate potential for various energy efficiency measures within Council housing. The data was scaled to include all Council housing and where there were unknowns for a portion of the housing stock (as was the case for glazing and loft insulation) the potential was estimated using the proportions from the Private Sector Housing Condition Survey.

If further work was being considered, the Energy Saving Trust (EST) has a model providing information on energy efficiency and renewable energy generation potential down to address level, which could be obtained and used to identify and target homes more accurately. This could potentially be cross-checked against properties for which the Council holds data. The datasets are available at a cost from the EST.[53]

Carbon reduction estimates will be sensitive to potential inaccuracies in the data, and inaccuracies inherent in scaling the survey data to cover the city as a whole but this should be less of a concern where uptake rates are set to less than 100% estimated capacity.

The data suggests that there are around 18,300 dwellings with uninsulated cavity walls in the city.

Carbon Saving Potential – Estimates for the carbon saving potential for cavity wall insulation have been based upon Ofgem's Community Energy Saving Programme (CESP) Carbon Scores, May 2011, assuming that a thermal conductivity of 0.44W/mK is achieved.[54] Properties in the city have been divided into broad housing types (flat, terraced, bungalow, semi-detached and detached) using the private sector housing survey data and data on Council housing described above. For the purposes of attributing carbon savings to each of these housing types, typical unit sizes have been chosen (a 2 bed flat, 3 bed terrace, 2 bed bungalow, 3 bed semi detached, 4 bed detached).

The resulting figures indicate that there is significant technical potential for carbon savings from cavity wall insulation in Brighton

[53] http://www.energysavingtrust.org.uk/Professional-resources/Existing-Housing/EST-Home-Analytics-Housing-data-and-analysis

[54] http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=19&refer=Sustainability/Environment/EnergyEff/cesp

and Hove. **Based on the assumptions above, if all the uninsulated cavities were insulated this could save an estimated c.6,300 tonnes of CO_2 per year.**

Costs – Capital costs have been estimated using the costs in DECC's Green Deal Impact Assessment.[55] The impact assessment document gives different costs for hard and easy to treat cavities as hard to treat cavities are significantly more expensive (the Impact Assessment estimates £1620 for hard to treat, compared to £376 for easy to treat, based on a 3 bed semi). The government estimates that 65% of the remaining uninsulated domestic cavity walls in the UK are hard to treat (this is explained below under 'delivery constraints').[56] It has been assumed that Brighton and Hove reflects the national picture for the purposes of estimating costs.

Operational savings have been estimated based on EST's *Annual Insulation Savings and Paybacks Update 2011/2012*.

Recent Installation Trends – Historic installation trends have been assessed in order to give a figure to which future targets could be compared. The Private Sector Housing Condition Survey data for uptake in 2006-7 has been used and scaled to the city level. This suggests installation of 2,230 homes per year (in non-Council homes).

Lifetime Cost per Tonne of CO_2- A lifetime cost per tonne of CO_2 has been sourced from the Committee on Climate Change (CCC)'s *Building a Low Carbon Economy* MAC curves and supporting documentation, which assessed measures at a UK-wide level.[57] The CCC's modelling of costs and technical abatement potential is based on the concept of 'social costs'. This means they look at the actual costs of resources used by the UK as a whole in building and installing measures, rather than the cost for any one individual. Therefore government incentives which would improve the case for an individual are not taken into account. The discount rate used is from the Treasury Green Book (3.5%).

The CCC analysis gives this measure a negative lifetime cost per tonne of CO_2

Lead Delivery Agent – The majority of installations would be in private sector homes,

[55] DECC, *Energy Bill: Green Deal Impact Assessment*, 2011. Costs are based on a three bed semi-detached house.
[56] DECC, *UK Carbon Plan*, 2011

[57] Committee on Climate Change (CCC), *Building a low-carbon economy – the UK's contribution to tackling climate change*, 2008 and supporting documentation: CCC, *Energy Use in Buildings and Industry: Technical Appendix*, 2009; AEA and Ecofys for CCC, *Review and update of UK abatement costs curves for the industrial, domestic and non-domestic sectors*, 2008.

and therefore private homeowners are a key delivery agent for this measure, with the support of national government financing mechanisms such as the Green Deal. The data on the Council's housing stock also indicates potential within Council housing, for which the Council could control delivery. The potential and target uptake rates for the measure are split into Council/private in the scenarios developed for Brighton & Hove City Council and discussed in the following section of this report.

Uptake Rates – It is unlikely that most measures will be exploited to their full capacity over the period to 2030, due to costs and other barriers. In order to assist the development of realistic scenarios for delivery of carbon reduction measures, a range of uptake rates have been incorporated into AECOM's scenario modelling tool. These rates are expressed in terms of percentages applied to the total identified technical capacity. For easy to treat cavity walls in the private sector these are as follows (in addition to 'zero' which is an option for all measures):

- Low/Med/High: in this case all set to 100%, based on the government's Green Deal Impact Assessment low and high scenarios, both of which assume 100% uptake over the period to 2020.[58]

100% uptake is not likely to be achieved for hard to treat cavity walls, however, and the range of uptake rates set for these is therefore different:

- Low: 0%, in line with Green Deal Impact Assessment low scenario;
- Medium: 22% (mid-value);
- High: 44%, in line with Green Deal Impact Assessment high scenario.

For Council housing, all energy efficiency measures are set at the following uptake rates:

- **Low: 30% of capacity;**
- **Medium: 60% of capacity;**
- **High: 90% of capacity (100% for boiler and window replacement and smart meters).**

DECC note that the Green Deal Impact Assessment scenarios - used in the private sector uptake rates for cavity walls, and also for solid wall and loft insulation measures - do not explicitly model the expected take-up of measures under the Green Deal and the

[58] DECC, *Energy Bill Green Deal Impact Assessment*, 2011.

Energy Company Obligation. However they state that "the high scenario can be thought of as reflecting very strong take-up of Green Deal Finance while the low scenario reflects the risk that demand for measures under the Green Deal is more muted." The Green Deal scenarios cover the period to 2020; however to take a more conservative approach the same assumptions have been used in this study to cover the period to 2030. This is somewhat in line with the government's latest impact assessment for the Green Deal which reduces the uptake of some measures compared to the scenarios used here.

Delivery Constraints – Some cavity walls will be hard to treat. Cavity walls which are likely to be more difficult to treat include: those in high rise buildings, those with narrow cavities, those in exposed locations, and those in timber or steel framed houses. Barriers can include access difficulties, building condition, and work to make good internal/external building elements if these are affected by the installation, which will raise costs and in some cases may make the measure impracticable. A study on hard to treat cavities undertaken by Davis Langdon and Inbuilt Ltd for DECC provides useful further guidance on how to address these difficulties and the different costs of various solutions.[59]

9.2.1.2 Solid Wall Insulation

Technical Capacity – As for cavity walls, this is based on the private sector housing survey and Council housing data. It suggests that there are just over 44,500 uninsulated solid walls in Brighton and Hove.

Carbon Saving Potential – Again, as for cavity walls, this is based on CESP carbon scores. A u-value improvement from 2.1 to 0.35W/m2K is assumed. Based on the private sector housing and Council housing data and CESP data, **should all the solid walls in Brighton and Hove be insulated, an estimated 36,400 tonnes of CO_2/yr would be saved** – showing that this measure has high potential.

Costs – These are based on the average cost by unit type given in the DECC Green Deal and Energy Company Obligation Consultation.[60] The cost for flats assumes some benefits are obtained from packaging up multiple installations. Solid wall insulation is an

[59] Inbuilt Ltd and Davis Langdon for DECC, *Study on hard to treat cavity walls in domestic buildings in Great Britain*, 2010.
[60] DECC, *The Green Deal and Energy Company Obligation Consultation Document*, 2011.

expensive measure, but has significant benefits as noted above.

Operational savings have again been estimated based on EST's *Annual Insulation Savings and Paybacks Update 2011/2012*.

Recent Installation Trends – Trends have been estimated based on the Private Sector Housing Condition Survey data for uptake in 2006-7. This suggests an installation trend of around 250 homes per year (in non-Council homes).

Lifetime Cost per Tonne of CO_2 - As for cavity walls, a lifetime cost per tonne of CO_2 has been sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves. The CCC analysis gives this measure a low lifetime cost per tonne of CO_2

Lead Delivery Agent – As for cavity walls: private sector with government support (e.g. through the Energy Company Obligation), plus Council for Council homes.

Uptake Rates – For Council homes low 30%, medium 60%, high 90%. For private sector homes, uptake rates again reflect the government's Green Deal Impact Assessment scenarios:

- Low: 58%, Green Deal low scenario;
- Medium: 64% (mid-value);
- High: 71%, Green Deal high scenario.

Delivery Constraints – Solid wall insulation is expensive and relatively disruptive, and is not expected to meet the Green Deal's 'golden rule' without subsidy (the payback period is expected to exceed 25 years). Planning constraints may also apply for external solid wall insulation in some areas, particularly in Conservation Areas and in listed buildings. The Energy Company Obligation is intended to provide some subsidy for this measure however. A study in 2009 by Element Energy for the CCC suggested that even if provided at no cost, solid wall insulation uptake would be no more than 47%, suggesting that setting high uptake rates has risk attached.[61]

9.2.1.3 Loft Insulation

Technical Capacity – Again, capacity has been based upon the private sector housing and Council housing data, which has been used to split dwellings in Brighton and Hove into the following categories: no loft / 0-75mm insulation / 75-150mm insulation / 150mm+ insulation. This suggests that around 31,300 dwellings

[61] Element Energy for CCC *Uptake of energy efficiency in buildings*, 2009

have insulation under 75mm, and around 38,100 dwellings have insulation between 75-150mm which could be topped up.

Carbon Saving Potential – Carbon saving estimates are again based on Ofgem's CESP carbon scores, assuming that insulation is installed to reach a total of 250mm. **Should all the dwellings identified above have loft insulation installed or topped up, an estimated 14,000 tonnes of CO2 per year could be saved .**

Costs – Capital costs are based upon the Green Deal Impact Assessment, and operational savings are based on EST's *Annual Insulation Savings and Paybacks Update 2011/2012*.

Recent Installation Trends – These are based upon the Private Sector Housing Condition Survey data for uptake in 2006-7. It suggests that around 4,200 lofts were insulated per year in Brighton and Hove over this period (in non-Council homes).

Lifetime Cost per Tonne of CO_2- sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves. The CCC analysis gives this measure a negative lifetime cost per tonne of CO_2

Lead Delivery Agent – Private home owners with government support, or the Council for Council homes. However given that the majority of Council-owned homes are flats, the potential for the Council to directly deliver loft insulation is limited as many flats will not contain lofts.

Uptake Rates – For Council homes low 30%, medium 60%, high 90%. For private sector, based on the Green Deal Impact Assessment:

- Low/Med/High: 76% (no variation between Green Deal low and high scenarios).

Delivery Constraints – No major constraints.

9.2.1.4 Boiler Replacement

Technical Capacity – Based on the Private Sector Housing Condition Survey and Council rdSAP data which suggests that around 25,100 boilers could currently benefit from replacement.

Carbon Saving Potential – Based on Ofgem CESP carbon scores. **Should all boilers in the City identified with potential for upgrading be replaced this data suggests that around 20,800 tonnes of CO2 per year could be saved.**

Costs – Capital costs based on the Green Deal Impact Assessment; operational cost savings based on EST estimates.[62]

Recent Installation Trends – Based on the English Housing Condition Survey data for 2005-10 which suggests that 3,870 boilers may have been replaced on average per year in non-Council homes. This figure was taken in place of Brighton's Private Sector Housing Condition Survey figures for 2006-7 which seemed very high.

Lifetime Cost per Tonne of CO_2- sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves. The CCC analysis gives this measure a negative lifetime cost per tonne of CO_2

Lead Delivery Agent – Private homeowners, or Council for Council homes.

Uptake Rates – For both Council homes and the private sector, these have been set at low 30%, medium 60%, and high 100% - a range chosen to represent a good spread of uptake rates.

Delivery Constraints – No major constraints.

9.2.1.5 Window Replacement

Technical Capacity – Based on the Private Sector Housing Condition Survey and Council rdSAP data which suggests that nearly 39,000 homes may have potential for double glazing.

In practice this may be an underestimate of potential as it will not take into account where double glazing has failed and needs replacing, or opportunities for further improvements to glazing. It is not fully clear in the data how homes with partial double and partial single glazing are dealt with. Such uncertainties – which are inherent to various degrees in all estimates in the study, which are all based upon a range of assumptions and data sources – can be mitigated against by taking a cautious approach to scenario development: for example, by assuming under 100% uptake of estimated capacity.

Carbon Saving Potential – Carbon savings for double glazing have been estimated using the Glass and Glazing Federation / EST's Energy Saving Calculator, assuming an improvement from a single glazed wood frame to a BFRC B rated window and assuming the tool's 'typical' window sizes for different property types.[63] **Should double glazing be installed to all properties identified with potetnial, this data**

[62] http://www.energysavingtrust.org.uk/In-your-home/Heating-and-hot-water/Replacing-your-boiler

[63] http://www.ggf.org.uk/energy-savings-calculator

suggests that around 16,100 tonnes of CO2 per year could be saved.

Costs – Capital costs based on AECOM assumptions, operational cost savings based on Glass and Glazing Federation / EST's Energy Saving Calculator.

Recent Installation Trends –Based on the Private Sector Housing Condition Survey data for 2006-7 which suggests that over this period around 3,750 homes per year have switched to double glazing.

Lifetime Cost per Tonne of CO_2- sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves. The CCC analysis gives this measure a negative lifetime cost per tonne of CO_2

Lead Delivery Agent - Private homeowners, or Council for Council homes.

Uptake Rates - For Council and private sector homes low 30%, medium 60%, high 100%.

Delivery Constraints – No major constraints though planning constraints particularly in relation to Listed Buildings and Conservation Areas where there are Article 4 Directions may mean high performing windows cannot be installed unless specific policy is developed by the Planning Authority on this issue.

9.2.1.6 Smart Meters

Technical Capacity – Based on total number of homes in Brighton and Hove.

Carbon Saving Potential – Based on DECC Smart Metering Impact Assessment figures: an average 2.8% for electricity, and 2% for gas credit meters and 0.5% for gas prepayment meters[64] - a conservative figure of 1% has been adopted here for all homes. The savings are based on an average over three consumer group types with varying engagement in demand side response.

Various more or less optimistic savings have been claimed for smart meters - this is a fairly conservative assumption compared to some. The savings made depend upon consumer behaviour – and benefits from behavioural change in the home are captured under this measure. There is potential to increase the savings should the response to smart metering from consumers be maximised. Using the assumptions outlined above, **should smart meters be installed in all homes in the city, an estimated 9,200 tonnes of CO2 per year could be saved**.

Costs – Capital cost based on DECC Smart Metering Impact Assessment: a total cost per

[64] DECC, *GB-wide smart meter roll out for the domestic sector: Impact Assessment*, 2010

household of £207 for a gas meter, electricity meter, in home display, and communications equipment. It should be noted that energy companies are expected to provide smart meters; financed through customers' energy bills.

Operational costs are based on DECC estimates of smart meter electricity consumption (which is minimal)[65] the percentage energy savings discussed above under 'carbon saving potential', and average UK domestic electricity and gas prices for 2011.[66] The operational costs do not include the cost to the supplier or the cost of operating associated communications equipment, or the savings which may be realised by energy supplier or the DNO, so overall savings on a system-wide basis may be greater than the figures in this report might suggest.

Recent Installation Trends – Assumed to be zero as current electricity monitors have not been widely rolled out and do not meet the same specification as those to be rolled out under the government's programme.

[65] Ofgem, *Domestic Metering Innovation Consultation and supporting documentation*, February and March 2006 (used in DECC, *GB-wide smart meter roll out for the domestic sector: Impact Assessment*, 2010)

[66] DECC qep551, qep591: http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/prices/prices.aspx#international

Lifetime Cost per Tonne of CO_2- Based on DECC's Smart Metering Impact Assessment (an approximate mid-figure from across the electricity and gas sectors has been taken). The DECC analysis gives this measure a negative lifetime cost per tonne of CO_2

Lead Delivery Agent – Private homeowners/energy companies (via government scheme).

Uptake Rates - For both Council and private sector homes: low 30%, medium 60%, high 100%. However it should be noted that the government plans to roll out smart meters to all homes by the end of 2019, so a 100% uptake rate is likely to be appropriate in scenario development, although this assumes that everyone with a smart meter changes their behaviour as a result, which may be over-optimistic.

Roll-out is assumed between 2014 and 2019 as this is when the majority of installations are currently expected by DECC. First savings are assumed to be realised in 2015.

Delivery Constraints – No major constraints, although delivery of higher savings will depend on financial incentives being put in place, for example through time of use tariffs, and upon consumer behaviour. Analysis undertaken by AECOM as part of the Energy Demand

Research Project (EDRP, a major research study funded jointly by industry and DECC and managed by Ofgem) found that existing literature does not provide direct evidence of the impact of installing a smart meter without any other scheduled interventions. However, two of the EDRP trials by E.ON and SSE provide the first evidence on this, showing that some aspect of the experience of just getting a smart meter can prompt a reduction in energy consumption, particularly gas consumption (savings of around 3%). The clearer effect for gas consumption makes sense in the context that simple one-off changes (e.g. reducing a thermostat setting) can have big effects on gas demand.

		CO2 Saving per Measure (kg/yr)						
				Loft Insulation				
Property Type	No. beds	Cavity Wall Insulation	Solid Wall Insulation	<60mm to 250mm	60-160mm to 250mm	Boiler Replacement	Window Replacement	Smart Meters
Flat	2	206	700	394	110	586	310	2.8% saving on electricity use and 1% saving on gas use
Terraced	3	243	815	247	71	707	580	
Bungalow	2	360	1233	422	130	935	770	
Semi-detached	3	448	1560	294	85	1023	770	
Detached	4	784	2663	403	121	1510	1070	
Source		CESP Carbon Scores[67]					Glass and Glazing Federation and EST[68]	Based on DECC Smart Metering IA[69]

Table 19: Carbon savings assumed per energy efficiency measure

[67] http://www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=19&refer=Sustainability/Environment/EnergyEff/cesp

[68] Energy Saving Calculator, http://www.ggf.org.uk/energy-savings-calculator

[69] DECC, *GB-wide smart meter roll out for the domestic sector: Impact Assessment*, 2012

9.2.2 Renewables

Technical Capacity – The maximum capacity for renewable energy is approximated based upon the assumptions used in the South East Renewable Energy Capacity Study.[70] The following technologies have been considered: PV, solar water heating (SWH), air source heat pumps (ASHP), ground source heat pumps (GSHP). The maximum capacities for are shown in the table below:

Technology	Max. Capacity	Unit
PV	13,418	no. of properties
SWH	13,418	
Heat Pumps	28,291	

Table 20: Maximum Capacities for Renewable Technologies in the Domestic Sector in Brighton and Hove based on DECC methodology

As discussed in section 6.5, the heat pump potential estimated by the DECC methodology appears high.

Carbon Saving Potential – Carbon saving potential has been calculated based on the assumed yearly output of different technologies. As heat pumps use electricity as well as generating heat, this has been taken into account when calculating carbon savings. The COP assumed for ASHP in 2.2, and 2.5 for GSHP, based on Energy Saving Trust heat pump trial findings.[71]

Costs – Costs of the technologies have been based on a range of sources: for heat pumps and SWH, AEA for DECC, *Review of Technical Information on Renewable Heat Technologies*, 2011 (mid-figure for capital cost); for PV, Parsons Brinkerhoff for DECC, *Solar PV Cost Update*, May 2012, as used by DECC in their Feed In Tariff Impact Assessments (for this study we have taken the medium 2012 cost for 4-10kW retrofit system). Operational costs are based on the same sources, plus DECC data on average domestic energy prices;[72] the standard solar PV FIT rate announced by DECC for installations from 1st August 2012 for a 4kW single installation meeting the energy efficiency requirement and exporting 50% of electricity to the grid[73]; and DECC's RHI consultation 2010 rates for solar thermal and

[70] SEPB, *Review of Renewable & Decentralised Energy Potential in South East England*, 2010. The DECC methodology does not separate solar technology potential into PV/SWH nor heat pump potential into ASHP/GSHP so these have been split 50/50 for illustrative purposes. The methodology makes fairly broad assumptions.

[71] EST, *Getting warmer: a field trial of heat pumps*, 2010

[72] DECC qep551, qep591: http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/prices/prices.aspx#international

[73] http://www.decc.gov.uk/en/content/cms/meeting_energy/Renewable_ener/feedin_tariff/feedin_tariff.aspx

heat pumps[74] (DECC advise that these rates will change when the scheme is introduced in 2013.) For heat pumps, electricity costs have been estimated based upon an assumed coefficient of performance taken from an EST study on installed performance of domestic heat pumps (2.2 for air source and 2.5 for ground source).[75]

Recent Installation Trends – Trends for PV are based on Ofgem data on Feed in Tariff installations 2010-12, which show that an average of around 680kWp of domestic PV was installed per year during this period. Solar water heating trends are based on BRE for CCC, *MAC Curves for the Domestic and Non-Domestic Building Sectors - Technical Documentation*, 2008 (although it is thought that this may provide an overestimate). It has been assumed that close to zero heat pumps have been installed to date in non-Council dwellings. Trends for Council housing are based on information provided by Brighton & Hove City Council.

Lifetime Cost per Tonne of CO_2- sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves. The CCC analysis gives renewables a high lifetime cost per tonne of CO_2however this is based on the cost to the UK as a whole and not the cost to the consumer, so does not reflect the benefits to consumers of government incentives such as FIT and RHI.

Lead Delivery Agent – Private homeowners with government support (such as the Feed in Tariff and Renewable Heat Incentive), plus the Council for Council homes.

Uptake Rates – A range of uptake rates have been set (zero/low/medium/high/higher) for each technology, expressed in terms of number of individual installations per year. These have been set separately for private homes and Council homes in order to allow different scenarios to be created. None of the uptake rates approach close to full technical capacity, recognising the significance of other barriers which make full uptake very unlikely in the period to 2030.

Delivery Constraints – Capital costs and consumer appetite are likely to be the main constraints.

[74] DECC, *Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme*, 2010

[75] EST, *Getting warmer: a field trial of heat pumps*, 2010

Non-Domestic Measures

9.2.3 Energy Efficiency

Limited data was available on the current composition, end energy uses and the status of equipment of the non-domestic building stock in Brighton and Hove, and it has therefore not been possible to break down energy efficiency savings into individual measures, the potential for which depends on a large number of variables. Instead, savings have been applied top-down based on an overall percentage reduction in energy use (low – 10%, medium – 20%, high – 30%). A similar approach has been taken for Council emissions from its non-domestic stock, with the range of uptake rates set at low – 10%, medium – 30%, high – 50%). However, should it be deemed useful it is recommended that further work is undertaken to understand the particular capacity for individual measures in non-domestic buildings in Brighton and Hove.

As energy efficiency in the non-domestic sector has not been broken down into individual measures, it has not been possible to assign costs to non-domestic energy efficiency. To give some indication of potential for cost-effective carbon reductions in the SME sector, a report by NERA has estimated that 15% of SME emissions can be reduced through measures with a positive NPV at a 15% discount rate, although they note the difficulties of lacking comprehensive statistics on the resource and energy efficiency of small businesses.

For information, a breakdown of typical electricity consumption by sector and end-use is also provided in Table 21 which could further help to identify where savings could be made in different sectors. VOA statistics[76] for Brighton and Hove show that retail is particularly significant in the city in terms of floor space – and it is likely to be a high energy user, with the majority of use likely to be electricity. The delivery matrix in section 11 also provides a qualitative assessment of some of the potential energy efficiency measures which could be adopted in the non-domestic sector. In very general terms, existing premises where a larger proportion of their energy use is heat tend to be able to make carbon reductions more easily and cheaply than premises where electricity use is the main energy use.

[76] ONS, Commercial and Industrial Floorspace and Rateable Value Statistics (2005 Revaluation), 2008

Business Type	% of total consumption by business type	2009 end-use share						
		Catering	Computing	Cooling & Ventilation	Hot Water	Heating	Lighting	Other
Commercial Offices	**9%**	3%	15%	21%	2%	20%	32%	6%
Communication and Transport	**5%**	8%	2%	7%	2%	14%	48%	20%
Education	**9%**	11%	12%	2%	7%	8%	51%	9%
Government	**7%**	11%	17%	7%	5%	19%	26%	15%
Health	**4%**	12%	4%	0%	0%	11%	63%	9%
Hotel and Catering	**11%**	34%	1%	11%	5%	7%	32%	10%
Other	**5%**	8%	4%	5%	11%	21%	35%	16%
Retail	**33%**	15%	4%	10%	3%	14%	43%	10%
Sport and Leisure	**5%**	9%	3%	10%	1%	22%	34%	23%
Warehouses	**12%**	6%	4%	5%	1%	14%	43%	26%

Table 21: Commercial and services sector electricity breakdown by end-use 2009. Source: DUKES 2009, updated July 2011, Table 5.6

9.2.4 Renewables

Technical Capacity – As for the domestic sector, the total technical capacity for non-domestic renewable energy installations has been based upon the DECC methodology assumptions used in the South East Renewable Energy Capacity Study. The maximum capacities are shown in the table below.

Technology	Max. Capacity	Unit
PV	1,467	No. of properties
SWH	1,467	
ASHP	367	
GSHP	367	

Table 22: Maximum Capacities for Renewable Technologies in the Non-Domestic Sector in Brighton and Hove based on DECC methodology

Carbon Saving Potential – As for the domestic sector, carbon saving potential has been

calculated based on the assumed yearly output of different technologies.

Costs – Capital costs of the technologies have been based on a range of sources: for heat pumps and SHW, AEA for DECC, *Review of Technical Information on Renewable Heat Technologies*, 2011 (mid-figure for capital cost for small non-domestic installations); for PV, Parsons Brinkerhoff for DECC, *Solar PV Cost Update*, May 2012, as used by DECC in their Feed In Tariff Impact Assessments (medium 2012 cost for 10-50kW retrofit system).

Operational costs have been based upon the same sources for fixed opex, plus DECC data on average non-domestic energy prices;[77] the standard solar PV FIT rate announced by DECC for installations from 1st August 2012 for a 10-15kW single installation exporting 50% of electricity to the grid[78]; and DECC's RHI current rates for solar thermal and large ground source heat pumps for 1st April 2012 onwards,[79] and DECC consultation rates for air source heat pumps assuming these may be brought into the RHI at a later stage – which may or may not happen. [80] For heat pumps, electricity costs have been estimated based upon an assumed coefficient of performance (3.5 for air source and 4 for ground source) taken from a report by NERA and AEA for DECC which forms part of the RHI evidence base.[81]

Recent Installation Trends – Non-domestic PV installation trends are based on Ofgem Feed in Tariff data for 2010-12, which shows that on average around 14kWp was installed per year in Brighton and Hove in the non-domestic sector in this period. It has not been possible to source installation trends for heat pump or solar water heating installations in non-domestic buildings.

Lifetime Cost per Tonne of CO_2- sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves.

Lead Delivery Agent – Commercial, public and industrial sector, including Council for Council buildings.

Uptake Rates – As for the domestic sector, a range of uptake rates have been set (zero/low/medium/high/higher) for each

[77] DECC qep551, qep591: http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/prices/prices.aspx#international

[78] http://www.decc.gov.uk/en/content/cms/meeting_energy/Renewable_ener/feedin_tariff/feedin_tariff.aspx

[79] http://www.decc.gov.uk/en/content/cms/meeting_energy/Renewable_ener/incentive/incentive.aspx

[80] DECC, *Renewable Heat Incentive: Consultation on the proposed RHI financial support scheme*, 2010

[81] NERA and AEA for DECC, The UK Supply Curve for Renewable Heat, 2009

technology, expressed in terms of number of individual installations or in total capacity installed per year. These have been set separately for Council buildings and other non-domestic buildings in order to allow different scenarios to be created. None of the uptake rates approach close to full technical capacity, recognising the significance of other barriers which make full uptake very unlikely in the period to 2030.

In the scenarios developed by AECOM the stated total capacity for schools has been based upon their number, although not all schools would be suitable for all technologies – therefore none of the uptake rates are set to 100%.

Delivery Constraints – Capital costs and consumer appetite are likely to be the main constraints. Conservation Areas may also constrain some technologies. Typical Brighton and Hove sites may make the application of GSHP difficult – tight urban sights where using borehole equipment is not feasible or sensitivity of trees mitigate against horizontal installations.

9.2.5 CHP

Technical Capacity – Due to the limited information available on non-domestic buildings a full analysis of the technical capacity for CHP has not been undertaken. Carbon savings are based on a bottom-up estimate of potential for CHP uptake.

Carbon Saving Potential – Carbon saving figures are AECOM estimates based on project experience.

Costs – cost figures are AECOM estimates based on project experience.

Recent Installation Trends – See section 6.1 for details of existing CHP plant.

Lifetime Cost per Tonne of CO_2- sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves.

Lead Delivery Agent - Commercial, public and industrial sector.

Uptake Rates – Uptake rates are based on a 60kWe installation:

- Low: 1 per year;
- Medium: 2 per year;
- High: 3 per year;
- Higher: 4 per year.

A single 60kWe installation is a small scale CHP which could serve a leisure centre, care home, school or a commercial building.

Delivery Constraints – Capital costs and competing financial priorities may be constraints for organisations seeking to install CHP.

9.2.6 Biomass Boilers

Technical Capacity – Due to the limited information available on non-domestic buildings a full analysis of the technical capacity for biomass boilers has not been undertaken. Carbon savings are based on a bottom-up estimate of potential for uptake.

Carbon Saving Potential – Carbon saving figures are AECOM estimates based on project experience.

Costs – Capital cost are based on AEA for DECC, *Review of Technical Information on Renewable Heat Technologies*, 2011 for capital and fixed operational costs, and the RHI current rate for technologies installed from 1st April 2012, plus a report by e4tech for DECC on commercial biomass chip prices.[82]

Recent Installation Trends – See section 6.1 for details of existing biomass installations.

Lifetime Cost per Tonne of CO_2- sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves. The CCC analysis gives biomass boilers a low lifetime

cost per tonne of CO_2.

Lead Delivery Agent - Commercial, public and industrial sector; private homeowners.

Uptake Rates –For the non-domestic sector, a typical installation might be 200-500kW and the following scenarios have been modelled

- Low: 1MW installed by 2030;
- Medium: 2MW by 2030;
- High: 5MW by 2030.

These uptake rates are based on AECOM assumptions rather than calculated capacity which specifically identifies potential buildings.

A single 200-500kW installation could serve a medium or large school or commercial building with a reasonable heat demand.

A typical installation for the domestic sector might be 15kW. Uptake rates for the domestic sector have been modelled as follows:

- Low: 2 15kW installations per year;

[82] e4tech for DECC, *Biomass Prices in the UK,* 2009. The central case 2009 price has been used.

- Medium: 5 15kW installations per year;
- High: 10 15kW installations per year.

Delivery Constraints – The Air Quality Management Area in the city centre is likely to constrain where biomass could be installed. Capital costs and competing financial priorities may also be constraints for organisations seeking to install biomass boilers. Boilers above 500kW are more likely to be suitable for the abatement technology which meets more stringent standards.

9.3 Cross-Sector Measures: Large Scale Energy Projects

9.3.1 District Heating

Technical Capacity – The potential for district heating has been assessed as described in section 7. The figures used in the scenario development described in the next section of this study are based upon the three shortlisted district heat network opportunity areas which have been assessed in more detail: centred on Eastern Road, Edward Street and London Road/New England Quarter.

Carbon Saving Potential – Carbon saving figures are AECOM estimates based on the analysis in section 7.

Costs – cost figures are AECOM estimates based on the analysis in section 7.

Recent Installation Trends – Total of 4 installed/on site (University of Sussex, University of Brighton (2), Royal Alexandra Quarter). 1 planned (Royal Sussex County Hospital).

Lifetime Cost per Tonne of CO_2- sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves, figure for city centre schemes. The CCC analysis gives heat networks a negative lifetime cost per tonne of CO_2

Lead Delivery Agent – Council / energy developers.

Uptake Rates – Options for the scenarios are:

- No heat networks;
- Eastern Rd network installed in 2016;
- Edward St network installed in 2016;
- London Rd network installed in 2016;
- Eastern Rd network installed in 2016 and Edward St in 2019;
- Eastern Rd network installed in 2016, Edward St in 2019 and London Rd in 2022.

Delivery Constraints – Setting up a delivery mechanism and sourcing finance for significant capital costs may be barriers.

9.3.2 Solar Farms

Technical Capacity – Total potential not quantified; bottom-up modelling of potential uptake scenarios is summarised below under 'uptake rates'.

Carbon Saving Potential – Carbon saving figures are AECOM estimates based on the assumed yearly output for well-sited panels.

Costs – cost figures are based on Parsons Brinkerhoff for DECC, *Solar PV Cost Update*, May 2012 (central cost for new build 250-5000kW / stand alone system).

Recent Installation Trends – Zero existing.

Lifetime Cost per Tonne of CO_2- sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves.

Lead Delivery Agent – Council / energy developers.

Uptake Rates – Options for the scenarios are:

- Zero;
- Low: 1MW by 2030;
- Medium: 5MW by 2030;
- High: 8MW by 2030;
- Higher: 12MW by 2030.

Delivery Constraints – Issues associated with situating solar farms near or within the South Downs National Park, and potential conflicts with use of land for other priorities such as food growing may be a barrier. Often solar farms are situated on land which is less productive to avoid this conflict. Existing examples of solar farms suggest that 1ha of land could provide space for up to 0.5MW of panels, however often this is not possible due to overshading issues. Panel layout would also need to be carefully designed to avoid shading and there is a balance between optimum land use and optimum design to avoid self-shading. Costs for grid connection can also be high.

9.3.3 Medium-Large Scale Wind

Technical Capacity – An estimate of 90MW maximum technical potential has been made based on the DECC methodology. However further consultation will be needed with the South Downs National Park Authority to see if any of this resource could be realised in practice.

Carbon Saving Potential – calculated based on an assumed average capacity factor.

Note: as explained in Section 4 above, the impact of local renewable energy installations on the overall decarbonisation of the national electricity grid is so minor that double-counting of carbon savings can be ignored.

Costs – Capital cost figures are AECOM estimates based on project experience. An indicative breakdown of these costs is shown in Figure 32. Operational costs are based on DECC's *Review of the generation costs and deployment potential of renewable electricity technologies in the UK*, 2011, the Renewable Obligation Certificate buy-out price for 2012-13, and the average UK wholesale electricity price for 2010.[83] Future changes in incentives have not been taken into account as sufficient information is not available at this stage – however the ROC scheme is due to be closed to new installations from 2017.

Recent Installation Trends – None.

Lifetime Cost per Tonne of CO_2- sourced from the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves.

Lead Delivery Agent – Council / energy developers – several of the potential sites are on Council-owned land.

Uptake Rates – Options for the scenarios are based on a 2.5MW turbine, as follows:

- Zero;
- Low: 2 turbines;
- Medium: 3 turbines;
- High: One turbine per year from 2015;
- Higher: Two turbines per year from 2015.

Delivery Constraints – Public perception and sourcing finance may be barriers, along with planning controls. The main constraint is that the potential areas are within the South Downs National Park. The South Downs National Park Authority is currently undertaking an energy opportunities study which may help to clarify their position. Also, whilst the DECC methodology approach identifies significant resource potential within the National Park area, it does not take into account constraints such as availability of grid connections.

[83] DECC, *Estimated impacts of energy and climate change policies on energy prices and bills*, 2011

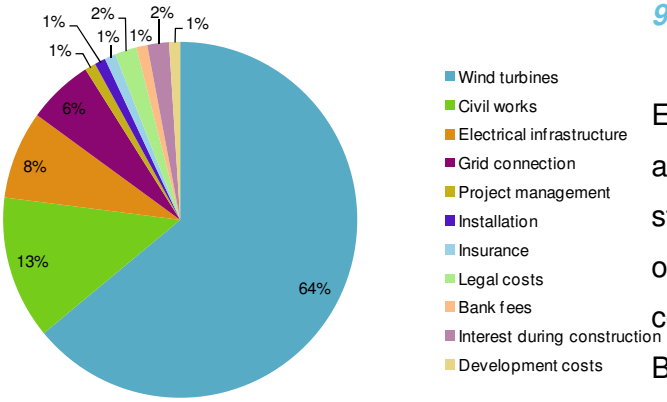


Figure 32: Capital cost breakdown of a typical 5MW onshore wind project. Source: BWEA, http://www.bwea.com, reproduced AECOM

9.4 Other Measures not Included in Scenarios

9.4.1 Biomass CHP

Biomass CHP has not been included as it is our understanding that it is difficult to secure finance for this technology at a sub-optimal scale. The whole of the borough is also an air quality management area which means that impacts on air quality impact would need to be considered.

9.4.2 Small-Scale Wind

Small-scale wind has been exluded as no potential was identified in the energy opportunities mapping undertaken as part of this study and described in section 6.3.2.

9.4.3 Energy from Waste

Energy from waste has not been included as although the South East renewable energy study identifies a technical potential of 126MW of installed energy capacity from MSW it concludes that this is unlikely to be used in Brighton and Hove due to cross-authority arrangements. No potential sites in Brighton and Hove have been identified for EfW so it is unlikely that any capacity would be installed pre-2030.

Anaerobic digestion (AD) has also been excluded from the scenarios. The main potential sources for AD are animal waste and food waste. Based on consultation with Brighton & Hove City Council, no farms of a suitable type and size to produce the amounts of animal manure required to make installation of AD feasible were identified. Municipal food waste is not currently collected separately in the city and there are currently no plans for this to be implemented. If it were to be collected it would have to be under the Council's existing contract with Veolia which runs to 2033. Veolia currently have an in-vessel composter outside Brighton and Hove, at Whitesmith, East Sussex. There may be some potential to use commercial food waste for a local scheme and the South East Seven local authorities are

exploring this opportunity. As there is a large catering sector in the city, Brighton and Hove could potentially benefit from this.

9.5 Note on Uptake Rates

For simplicity, and because the purpose of this study was not to run many different carbon reduction scenarios, it has been assumed that most measures have been taken up at a steady rate over the period 2012-2030, and savings are therefore spread out across the period, unless there is a significant reason to do otherwise (in which case this is specified above). In practice, this will not be the case: for example uptake rates of energy efficiency measures may tail off after the easier wins have been implemented. Action should be targeted as early as possible, in order to minimise total carbon emissions over the period - recognising the cumulative impact of carbon emissions in the atmosphere, and in line with the Stern report which concluded that the cost of mitigating emissions is less than the cost of combating their impact.

9.6 Note on Data Uncertainties

It should be noted that there are uncertainties in the estimates set out above and that further analysis will be needed on a project by project basis when projects are being implemented, in particular cost assumptions. Cost reductions over the period to 2030 have not been factored in to the analysis, and costs are based on near-current prices, so they may be overestimates as economies of scale and technological improvements bring costs of some measures down. They should be used mainly to understand the relative benefits of measures and scales of costs – more detailed assessment will be needed for business planning purposes. There are uncertainties inherent to various degrees in all estimates in the study, which are all based upon a range of assumptions and data sources. For example, the data used from Brighton's private sector housing stock condition survey is based on extrapolation from survey data which inevitably did not cover every home in the area.. However some of these uncertainties can be mitigated by taking a cautious approach to scenario development, for example by assuming under 100% uptake of estimated capacity. Section 9.2.1 suggests some sources of data for providing more detail and for cross-checking data sources used in this report.

Operational costs and savings should also be treated with caution. As with capital costs, these are based on near-current prices and do not take into account projected changes in costs over the period to 2030. Clearly, should

energy prices rise as they are expected to do, then the savings achieved from energy efficiency and renewable energy generation measures will increase in value. However there are risks with heat pumps - should electricity prices rise the operational costs of heat pumps will increase, although this may be partially mitigated by improvements in their performance as the technologies develop and installation practice improves. Similarly biomass prices may rise in line with gas prices and due to other factors such as competition for the resource. Income generated from government incentives will also change over the period, with current/proposed incentives likely to decrease in the future, though in theory this should be at least partly balanced out by technology capital cost reductions.

There is a potential issue of decline in the carbon saving effectiveness of some measures over time, for example through equipment wearing out. However it is not considered that this will be a significant issue over the timeframe of this strategy, this has therefore not been factored into the calculations in this study. In the medium-longer term when higher carbon saving targets will need to be met it will be sensible to review where measures may have reduced in effectiveness and could be replaced or serviced as well as where advances in technology have made further cost-effective upgrades available.

9.7 Note on Potential Savings Overlap

The savings from some measures may be less than estimated due to different measures overlapping leading to risks of double-counting. The main example of this would be gas smart meter estimates, which are based on current energy consumption levels before uptake of energy efficiency measures. To some degree this particular example is mitigated against by taking a conservative assumption for gas savings from smart meters. The estimates of CO_2 saved for insulation measures are based on CESP carbon scores, which provide a single figure by property type and size, but do not take into account the order in which different measures might be applied in a single property, nor what measures are already installed, which influences the savings made by each individual measure. Savings are not necessarily lower if a measure is applied later (e.g. if a loft is insulated and then a wall is insulated), as the heat losses through the later elements insulated will become more significant when other elements of a building are well insulated. These issues can be mitigated by taking a cautious approach to uptake rates.

10 Scenario Development

One of the main aims of this study is to provide an evidence-base to help support targeting carbon reduction measures in Brighton and Hove in the period to 2030. Using the measures identified in Section 9, a modelling tool has been developed for Brighton and Hove to allow the creation and assessment of different carbon reduction scenarios. The tool and examples of scenarios developed by AECOM and Brighton and Hove City Council are presented here. These are presented in the context of Brighton and Hove's existing carbon reduction targets.

10.1 Carbon Reduction Targets

In response to the national targets set in the UK Climate Change Act (as discussed in Section 2), many Local Authorities have set local CO_2 reduction targets in recognition of the need to take responsibility locally for delivering emissions savings. Many of these targets have been set using a top-down method – by applying the UK decarbonisation trajectory to 2050 to the local level and setting a target accordingly, sometimes without detailed analysis of how the target may be met. The targets which have been set in major cities in the UK are shown in Figure 33. Targets set for 2020 in this group of Local Authorities range from 20% to Brighton and Hove's target of 42%.

It should be recognised that various studies such as the Stern Report, and more recently DECC's Impact Assessment for the Fourth Carbon Budget, indicate that carbon reduction trajectories with earlier action (greater reductions in the earlier years) are more cost-effective over time than trajectories which delay action. Delaying action has high risks in terms of carbon emissions build-up, higher costs, lock-in to carbon-intensive technologies, pressure on supply chains in the future, and not meeting longer-term carbon targets, as well as greater exposure to increases in energy prices in the medium term.

Brighton and Hove City Council has therefore set ambitious targets for carbon reduction. Given that the majority of the city's emissions are from privately owned homes and the private sector, the Council itself has limited control and meeting any target will also rely strongly on the actions of other local stakeholders, as well as regional and national government. The scenario presented in this section shows one way of achieving carbon reduction targets.

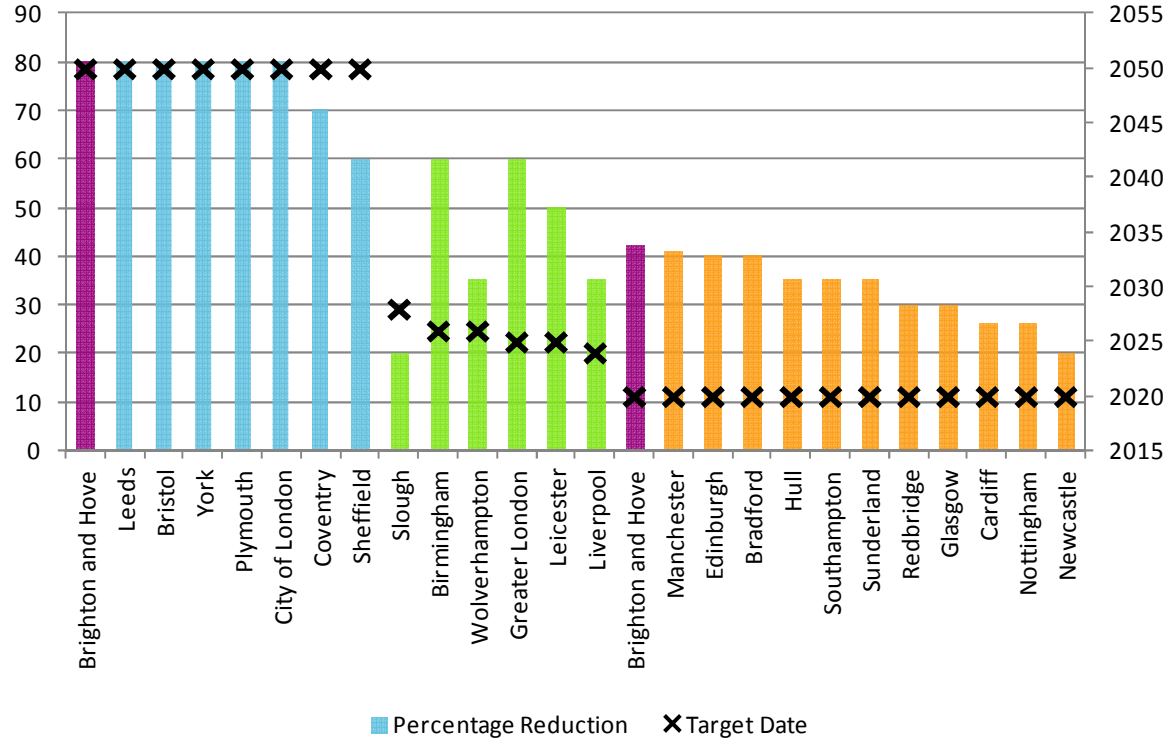


Figure 33: Local carbon reduction targets set by various UK cities including Brighton and Hove. The crosses show the target date, and the bars show the percentage reduction commitment made. The blue bars show other Local Authorities with 2050 targets, the orange bars show other Local Authorities with 2020 targets. Source: RICS, *Hotting Up? An Analysis of Low Carbon Plans and Strategies for UK Cities, Volume 1: Main Findings, 2011, reproduced AECOM.*

10.2 Scenario Development

Whilst recognising the importance of basing targets upon longer-term goals which reflect the emissions reductions which are required to avoid dangerous climate change, Brighton and Hove City Council also wanted to carry out more detailed local assessment to determine how targets could realistically be achieved in a cost-effective manner. The analysis of potential carbon reduction measures outlined in Sections 5 to 9 has therefore been built into a scenario modelling tool which allows the development and interactive assessment of different carbon reduction scenarios for the city. The scenario modelling tool is similar to the DECC UK 2050

Pathways Analysis tool[84] but operates at the Local Authority level.

There are countless possible scenarios for decarbonisation in Brighton and Hove, and the reality of delivery will always deviate from any proposed scenario. However the purpose of this study is to test scenarios to contribute towards the targets which Brighton and Hove is committed to, whilst recognising that over the next 18 years changes will need to be made to reflect new information, and adapt to new opportunities and barriers. It should be noted that whilst the modelling tool provides a powerful tool for comparing different scenarios, further work will be needed to fully assess projects, for example to take into account funding sources, packaging of measures into deliverable financial propositions, consideration of operational expenditure and market capacity for delivery. Some of these factors are considered in later sections of this report.

The scenario below is based on Brighton and Hove's existing carbon reduction targets for a 42% reduction by 2020 and 80% by 2050 based on a 2005 baseline. These targets have been used to estimate a 2030 target, based on the rough assumption of a steady trajectory from 2020-2050, giving a target for 2030 of just under 55%. They have also been applied to total carbon emissions rather than a per capita figure which may be slightly more challenging assuming that the population increases over the period to 2030. It sets out just one means of reaching such a target and there is some flexibility in how it is met. It is however important to recognise that targets are still reliant upon central government action through grid decarbonisation, as well as other factors highlighted throughout this report, and the city-wide target is highly dependent upon the outcome of measures to incentivise private sector retrofit such as the Green Deal.

It should also be recognised that in the medium to long term (i.e. post 2030) even more demanding carbon reductions will be needed and Brighton and Hove should also take into account the need to prepare for these – for example through setting in progress additional projects now, particularly those with longer lead-in times such as large-scale local energy generation schemes.

[84] 2050-calculator-tool.decc.gov.uk/

Carbon Reduction Scenario 1: High Energy Efficiency

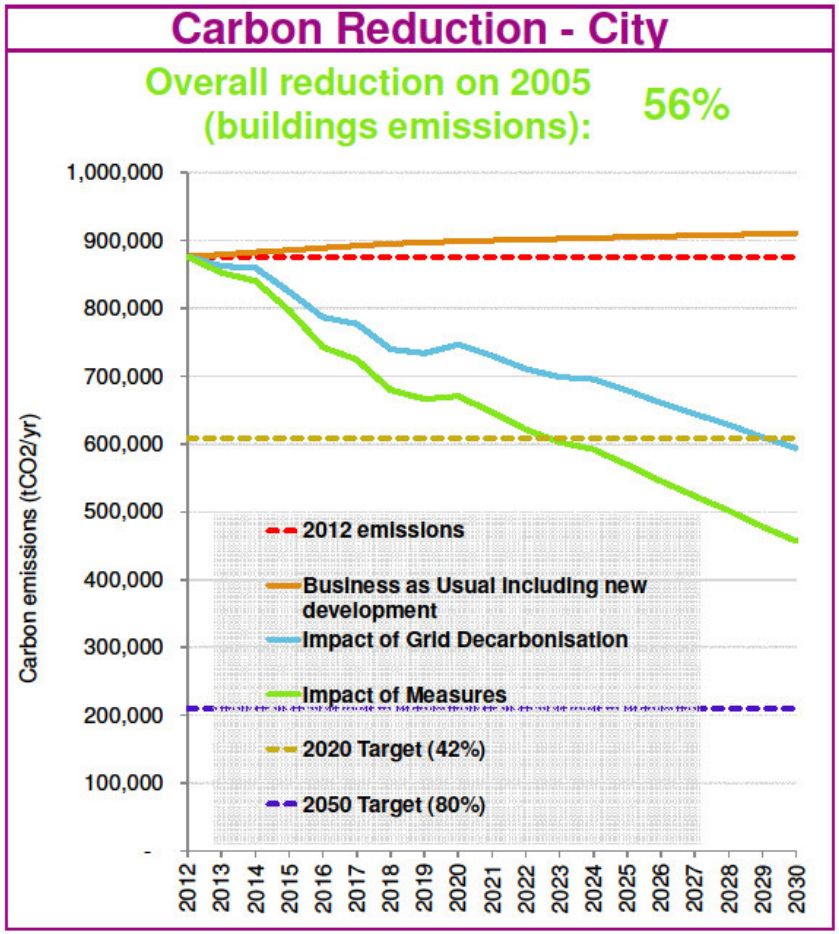
AECOM

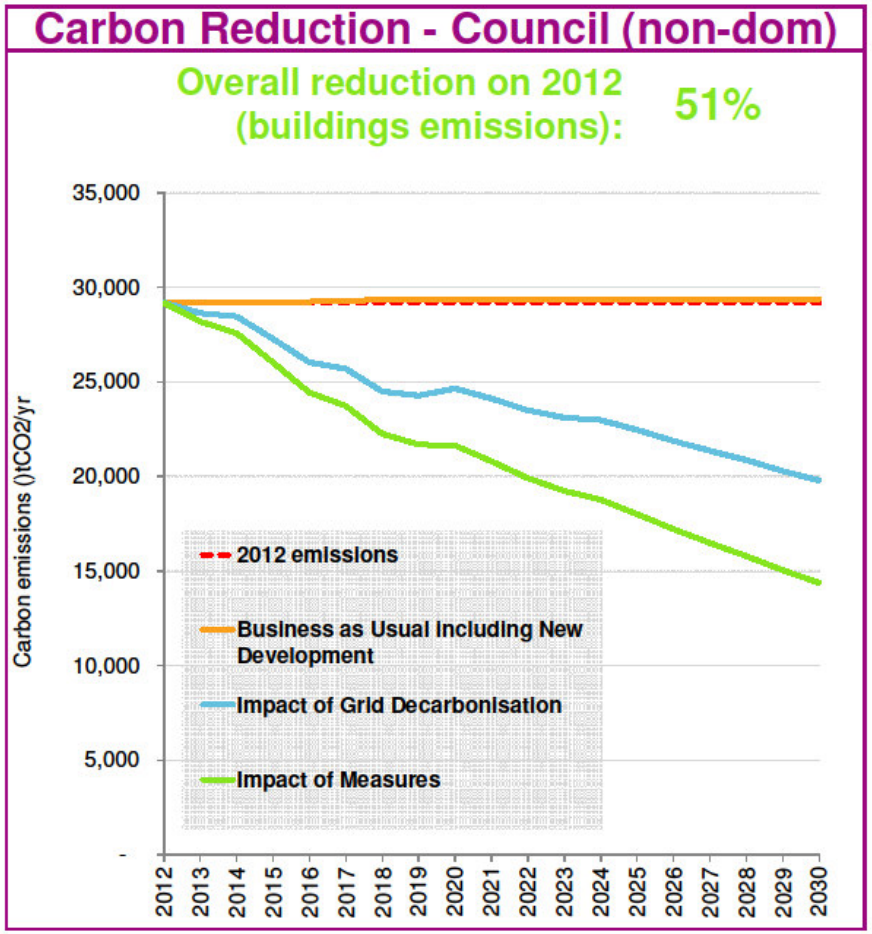
BRIGHTON AND HOVE ENERGY STUDY - SCENARIO MODELLING TOOL

Measures

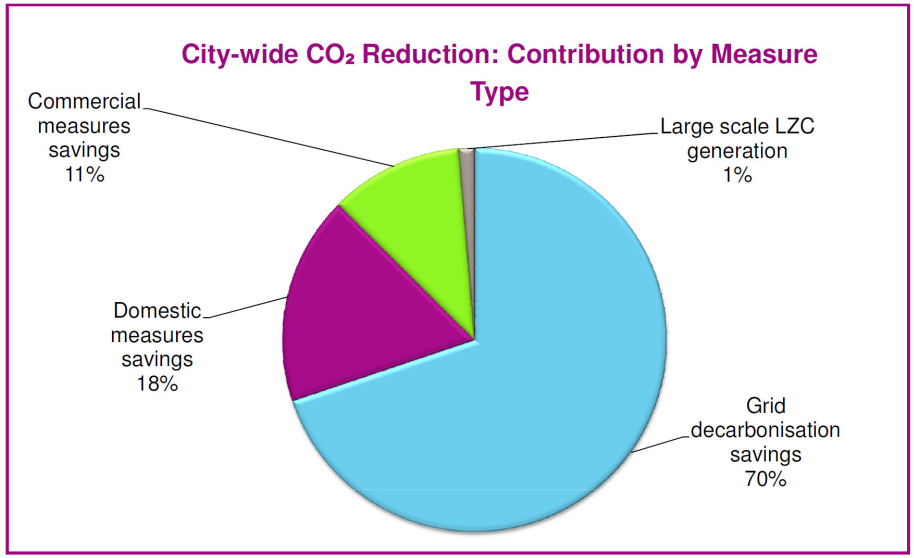
	Latest Revised Scenario	$ktCO_2$ Saved/yr by 2030 (rounded)	% Total CO_2 Savings Achieved by Measure	Indicative Capital Cost (£ 000s)	% of estimated Brighton and Hove capacity implemented by 2030	Target	Historic installation trend	Source for historic installation trend	Lead Delivery Agent
Domestic Building Measures (excl Council)									
Cavity wall insulation - Easy	High	5.6	1.2%	£6,000	100%	881 homes per year	2230 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Cavity wall insulation - Hard	Medium	2.3	0.5%	£10,400	22%	358 homes per year			Homeowners (government support)
Solid wall insulation	Medium	23.1	5.1%	£163,500	64%	1572 homes per year	250 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Loft insulation	High	7.6	1.7%	£4,300	76%	1257 homes per year	4220 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Loft top-up	High	2.3	0.5%	£4,700	76%	1392 homes per year			Homeowners (government support)
Boiler replacement	Medium	13.6	3.0%	£41,100	75%	906 homes per year	3870 homes per year	EHCS 2003-10	Homeowners (government support)
Window replacement	Medium	8.7	1.9%	£25,700	60%	1133 homes per year	3750 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Smart meters	High	4.6	1.0%	£21,600	100%	17891 homes per year	-	-	Homeowners / Energy companies
PV	Medium	1.1	0.2%	£16,300	13%	100 4kWp installations per year	170 4kWp installations per year	Ofgem FIT installations 2010-12	Homeowners (government support)
Solar Thermal	Medium	0.9	0.2%	£11,500	13%	100 4sqm installations per year	130 installations per year	BRE for CCC	Homeowners (government support)
Biomass	Low	0.1	0.0%	£400	-	2 15kWe installations per year	Near Zero	AECOM assumption	Homeowners (government support)
ASHP	Low	0.6	0.1%	£3,300	2%	25 7kW installations per year	Near Zero	AECOM assumption	Homeowners (government support)
GSHP	Low	1.9	0.4%	£12,500	3%	50 10kW installations per year	Near Zero	AECOM assumption	Homeowners (government support)
Non-domestic Building Measures (excl Council)									
Energy Efficiency	Medium	38.0	8.4%	Unknown	20%	20% reduction in emissions	Unknown (range of measures)		Commercial / Public sector
PV	Medium	0.3	0.1%	£3,600	12%	100kWp installed per year	14 kWp installed per year	Ofgem FIT installations 2010-12	Commercial / Public sector
Solar Thermal	Low	0.2	0.1%	£2,400	6%	100sqm installed per year	c300sqm total known	BHCC/AECOM	Commercial / Public sector
ASHP	Low	2.1	0.5%	£4,000	25%	5 100kW installations per year	Near Zero	AECOM assumption	Commercial / Public sector
GSHP	Low	2.2	0.5%	£8,800	25%	5 100kW installations per year	3 installations in total known	BHCC/AECOM	Commercial / Public sector
CHP	Medium	1.9	0.4%	£2,200	-	2 60kWe installations per year	c.1.78MW total existing (not per year)	BHCC/AECOM	Commercial / Public sector
Biomass Boilers	Low	0.7	0.2%	£400	-	1 MW by 2030	c.1MW total existing (not per year)	BHCC/AECOM	Commercial / Public sector
Council Building and Infrastructure Measures									
PV on Schools	High	0.2	0.0%	£2,200	83%	4 15kW installations per year	4 installations in total known	BHCC/AECOM	Council (own estate / housing)
PV on Council Buildings	Medium	0.1	0.0%	£700	35%	20kW installed per year	1 installation in total known	BHCC/AECOM	Council (own estate / housing)
Solar Thermal on schools	Medium	0.0	0.0%	£200	52%	25 7kW installations per year	8 installations in total known	BHCC/AECOM	Council
ASHP in Schools	Low	0.1	0.0%	£200	103%	0.25 100kW installations per year	4 ASHP installations in total existing	BHCC/AECOM	Council (own estate / housing)
GSHP in Schools	Low	0.1	0.0%	£400	103%	0.25 100kW installations per year	4 GSHP installations in total existing		Council (own estate / housing)
Energy Efficiency in non-domestic stock	Medium	4.9	1.1%	TBC	25%	25% reduction in emissions	-	-	Council (own estate / housing)
Council Housing Measures									
Cavity wall insulation - Easy	High	0.7	0.1%	£900	90%	124 homes per year	30 homes per year	ELASH 2012	Council (own estate / housing)
Cavity wall insulation - Hard	Medium	0.8	0.2%	£4,500	60%	153 homes per year			Council (own estate / housing)
Solid wall insulation	Medium	0.3	0.1%	£1,700	60%	18 homes per year	50 homes per year	ELASH 2012	Council (own estate / housing)
Loft insulation	High	0.4	0.1%	£200	90%	68 homes per year	200 homes per year	ELASH 2012	Council (own estate / housing)
Loft top-up	High	0.4	0.1%	£900	90%	248 homes per year			Council (own estate / housing)
Boiler replacement	High	2.6	0.6%	£8,500	100%	188 homes per year	920 homes per year	ELASH 2012	Council (own estate / housing)
Window replacement	Medium	1.0	0.2%	£3,000	60%	167 homes per year	190 homes per year	ELASH 2012	Council (own estate / housing)
Smart meters	High	0.6	0.1%	£2,900	100%	2366 homes per year	-	-	Council (own estate / housing)
PV	Medium	0.5	0.1%	£6,500	41%	40 4kWp installations per year	25 installations per year	ELASH 2012	Council (own estate / housing)
Solar Thermal	Medium	0.4	0.1%	£4,600	41%	40 4sqm installations per year	1 existing communal system	BHCC	Council (own estate / housing)
Large Scale Energy Projects									
District Heat Networks	Eastern Rd (2016)	6.1	1.3%	£13,400	-	Eastern Rd (2016)	4 installed/on site in total	BHCC/AECOM	Council / Energy developers
Large scale solar	Zero	0.0	-	£0	-	No action	Zero	BHCC/AECOM	Council / Energy developers
Large scale wind	Zero	0.0	-	£0	n/a	No action	Zero	BHCC/AECOM	Council / Energy developers
Emission Factors									
Electricity emission factors	DECC Central			Unknown					
TOTALS									
		$ktCO_2$ Saved/yr by 2030 (rounded)	% Total CO_2 Savings Achieved by Measure	Indicative Capital Cost (£000s)					
Grid Decarbonisation Savings		317	69.9%						
Local Measures Savings		137	30.1%	£393,429					
TOTAL SAVINGS		454							

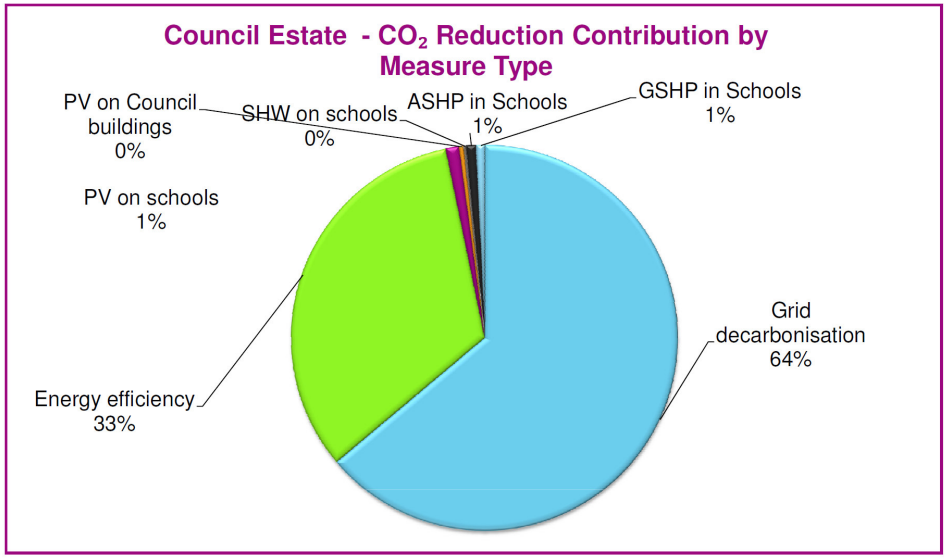
Carbon Reduction Scenario 1: High Energy Efficiency Outputs 2005 - 2030

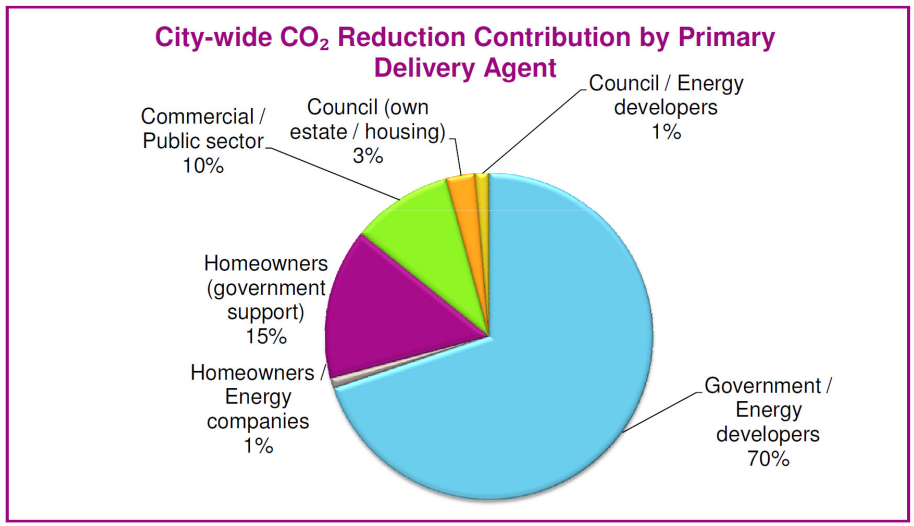




Carbon Reduction Scenario 1: High Energy Efficiency: Outputs Showing Relative Carbon Saving Contribution by Measure Type and Delivery Agent to Overall Target







Carbon Reduction Scenario 2: High Renewables/Low Carbon Energy

AECOM

BRIGHTON AND HOVE ENERGY STUDY - SCENARIO MODELLING TOOL

Measures

	Latest Revised Scenario	$ktCO_2$ Saved/yr by 2030 (rounded)	% Total CO_2 Savings Achieved by Measure	Indicative Capital Cost (£ 000s)	% of estimated Brighton and Hove capacity implemeneied by 2030	Target	Historic installation trend	Source for historic installation trend	Lead Delivery Agent
Domestic Building Measures (excl Council)									
Cavity wall insulation - Easy	High	5.6	1.2%	£8,000	100%	881 homes per year	2230 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Cavity wall insulation - Hard	Medium	2.3	0.5%	£10,400	22%	358 homes per year			Homeowners (government support)
Solid wall insulation	Low	20.7	4.6%	£148,700	58%	1412 homes per year	250 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Loft insulation	High	7.6	1.7%	£4,300	78%	1257 homes per year	4220 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Loft top-up	High	2.3	0.5%	£4,700	78%	1392 homes per year			Homeowners (government support)
Boiler replacement	Medium	13.8	3.0%	£41,100	75%	908 homes per year	3870 homes per year	EHCS 2003-10	Homeowners (government support)
Window replacement	Medium	8.7	1.9%	£25,700	60%	1133 homes per year	3750 homes per year	BHCC PSHCS 2007	Homeowners (government support)
Smart meters	High	4.6	1.0%	£21,800	100%	17991 homes per year	-	-	Homeowners / Energy companies
PV	Medium	1.1	0.2%	£16,300	13%	100 4kWp installations per year	170 4kWp installations per year	Ofgem FIT installations 2010-12	Homeowners (government support)
Solar Thermal	Medium	0.9	0.2%	£11,500	13%	100 4sqm installations per year	130 installations per year	BRE for CCC	Homeowners (government support)
Biomass	Low	0.1	0.0%	£400	-	2 15kWe installations per year	Near Zero	AECOM assumption	Homeowners (government support)
ASHP	Low	0.6	0.1%	£3,300	2%	25 7kW installations per year	Near Zero	AECOM assumption	Homeowners (government support)
GSHP	Low	1.9	0.4%	£12,500	3%	50 10kW installations per year	Near Zero	AECOM assumption	Homeowners (government support)
Non-domestic Building Measures (excl Council)									
Energy Efficiency	Low	19.0	4.2%	Unknown	10%	10% reduction in emissions	Unknown (range of measures)		Commercial / Public sector
PV	Medium	0.3	0.1%	£3,600	12%	100kWp installed per year	14 kWp installed per year	Ofgem FIT installations 2010-12	Commercial / Public sector
Solar Thermal	Low	0.2	0.1%	£2,400	6%	100sqm installed per year	c300sqm total known	BHCC/AECOM	Commercial / Public sector
ASHP	Low	2.1	0.5%	£4,000	25%	5 100kW installations per year	Near Zero	AECOM assumption	Commercial / Public sector
GSHP	Low	2.2	0.5%	£8,800	25%	5 100kW installations per year	3 installations in total known	BHCC/AECOM	Commercial / Public sector
CHP	Medium	1.9	0.4%	£2,200	-	2 60kWe installations per year	c.1.78MW total existing (not per year)	BHCC/AECOM	Commercial / Public sector
Biomass Boilers	Low	0.7	0.2%	£400	-	1 MW by 2030	c.1MW total existing (not per year)	BHCC/AECOM	Commercial / Public sector
Council Building and Infrastructure Measures									
PV on Schools	High	0.2	0.0%	£2,200	83%	4 15kW installations per year	4 installations in total known	BHCC/AECOM	Council (own estate / housing)
PV on Council Buildings	Medium	0.1	0.0%	£700	35%	20kW installed per year	1 installation in total known	BHCC/AECOM	Council (own estate / housing)
Solar Thermal on schools	Medium	0.0	0.0%	£200	52%	25 7kW installations per year	8 installations in total known	BHCC/AECOM	Council
ASHP in Schools	Low	0.1	0.0%	£200	103%	0.25 100kW installations per year	4 ASHP installations in total existing	BHCC/AECOM	Council (own estate / housing)
GSHP in Schools	Low	0.1	0.0%	£400	103%	0.25 100kW installations per year	4 GSHP installations in total existing		Council (own estate / housing)
Energy Efficiency in non-domestic stock	Medium	4.9	1.1%	TBC	25%	25% reduction in emissions	-	-	Council (own estate / housing)
Council Housing Measures									
Cavity wall insulation - Easy	High	0.7	0.1%	£800	90%	124 homes per year	30 homes per year	ELASH 2012	Council (own estate / housing)
Cavity wall insulation - Hard	Medium	0.8	0.2%	£4,500	60%	153 homes per year			Council (own estate / housing)
Solid wall insulation	Low	0.1	0.0%	£800	30%	9 homes per year	50 homes per year	ELASH 2012	Council (own estate / housing)
Loft insulation	High	0.4	0.1%	£200	90%	68 homes per year	200 homes per year	ELASH 2012	Council (own estate / housing)
Loft top-up	High	0.4	0.1%	£800	90%	248 homes per year			Council (own estate / housing)
Boiler replacement	High	2.6	0.6%	£9,500	100%	188 homes per year	920 homes per year	ELASH 2012	Council (own estate / housing)
Window replacement	Medium	1.0	0.2%	£3,000	60%	187 homes per year	190 homes per year	ELASH 2012	Council (own estate / housing)
Smart meters	High	0.6	0.1%	£2,900	100%	2386 homes per year	-	-	Council (own estate / housing)
PV	Medium	0.5	0.1%	£6,500	41%	40 4kWp installations per year	25 installations per year	ELASH 2012	Council (own estate / housing)
Solar Thermal	Medium	0.4	0.1%	£4,600	41%	40 4sqm installations per year	1 existing communal system	BHCC	Council (own estate / housing)
Large Scale Energy Projects									
District Heat Networks	Eastern Rd (2016) + Edward St (2019) + London Rd (2022)	9.7	2.1%	£25,300	-	Eastern Rd (2016) + Edward St (20	4 installed on site in total	BHCC/AECOM	Council / Energy developers
Large scale solar	Higher	1.9	0.4%	£15,800	-	12 MW installed by 2030	Zero	BHCC/AECOM	Council / Energy developers
Large scale wind	High	14.5	3.2%	£32,000	n/a	One turbine per year from 2015	Zero	BHCC/AECOM	Council / Energy developers
Emission Factors									
Electricity emission factors	DECC Central			Unknown					

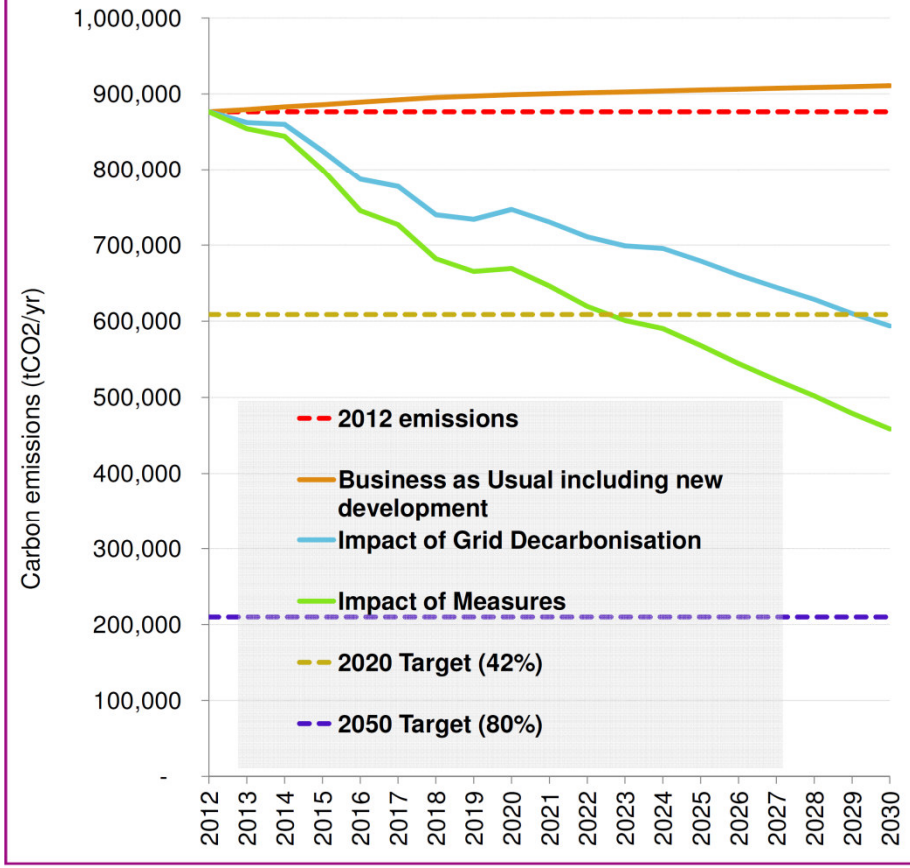
TOTALS

	$ktCO_2$ Saved/yr by 2030 (rounded)	% Total CO_2 Savings Achieved by Measure	Indicative Capital Cost (£000s)
Grid Decarbonisation Savings	317	70.1%	
Local Measures Savings	135	29.9%	£435,393
TOTAL SAVINGS	452		

Carbon Reduction Scenario 2: High Renewables/Low Carbon Energy: Outputs 2005 - 2030

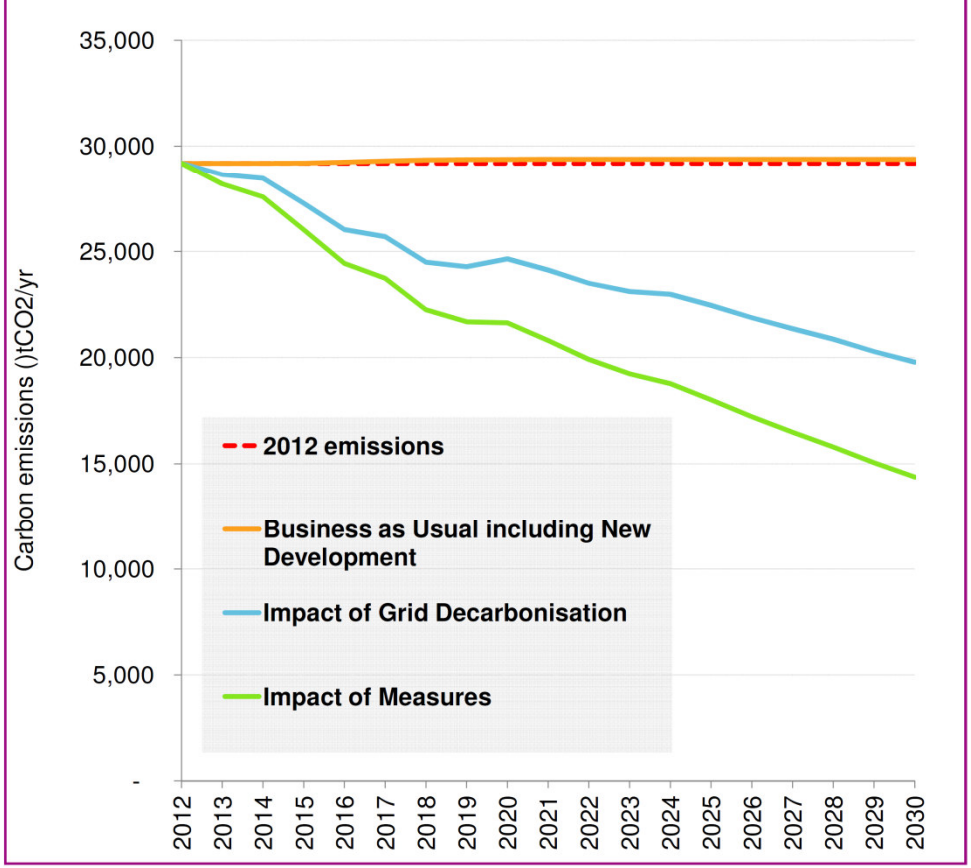
Carbon Reduction - City

Overall reduction on 2005 (buildings emissions): 56%

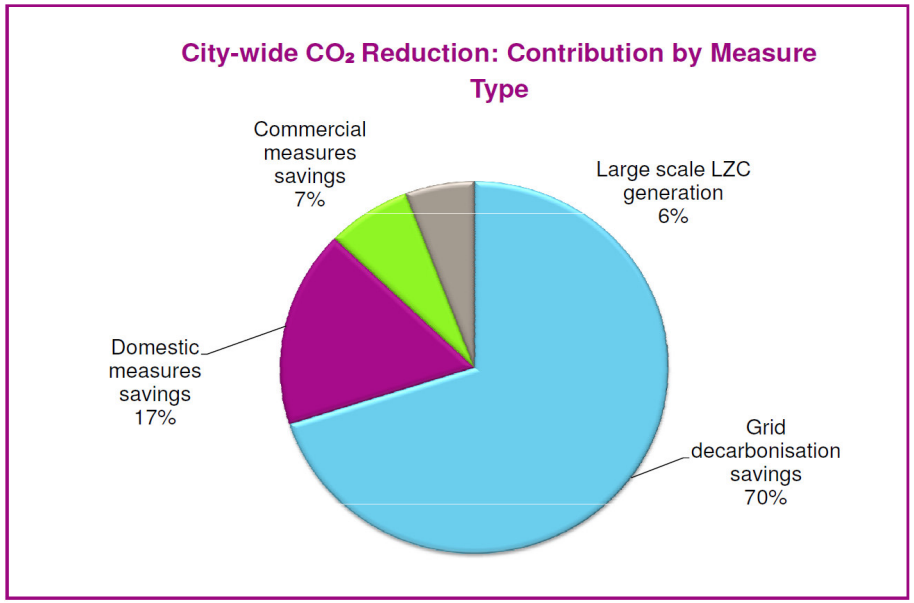


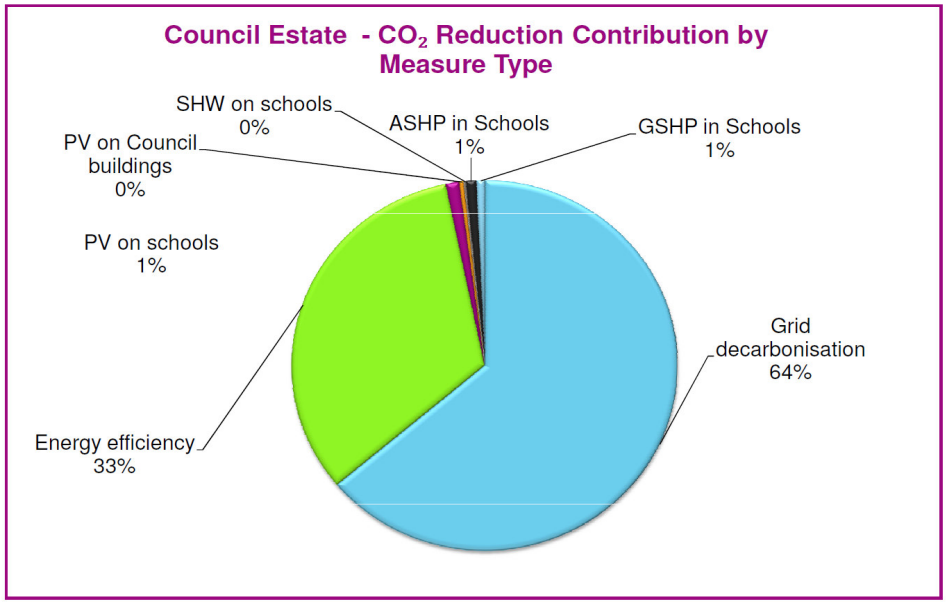
Carbon Reduction - Council (non-dom)

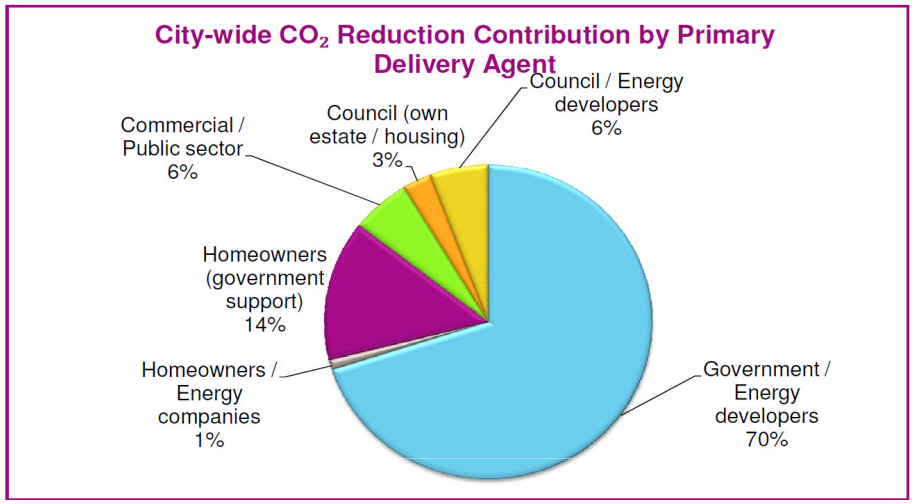
Overall reduction on 2012 (buildings emissions): 51%



Carbon Reduction Scenario 2: High Renewables/Low Carbon Energy: Outputs Showing Relative Carbon Saving Contribution by Measure Type and Delivery Agent to Overall Target







11 Funding and Delivery

This section sets out some of the opportunities for funding and delivering the opportunities identified in the previous sections. Realising any of the projects identified will require the financing and delivery mechanisms to be defined and in most cases making the financial case for the project will determine whether it is carried out.

11.1 Introduction

This section of the report covers delivery advice, an overview of funding options (general and project-specific), and also presents a delivery matrix to summarise some of the quantitative assessment of the measures identified in this study and to provide further qualitative assessment to help inform decision-making.

11.1.1 Making a case for spending

Many of the schemes could appear relatively unattractive on a simple cost benefit analysis that only takes capital cost into account. However widening the scope of the analysis could demonstrate the additional benefits measures can deliver:

- *Whole-lifecycle costing approach for new development and retrofit*

  It is important to consider both capital expenditure and operational expenditure through a whole lifecycle energy cost model so that the optimum approach can be taken when investing in new buildings and retrofits. Often capital expenditure and operational expenditure are separated so that the long term cost effectiveness of actions is not understood.

- *Identify and account for cross sector goals*

  Financial, social and environmental benefits need to be taken into account to understand the wider value of investment which delivers in areas other than simple returns. Investment in low carbon energy systems often helps either directly or indirectly in areas such as fuel poverty, health, air quality and biodiversity. These other benefits should be recognised and possible financial implications should be attached to them in order to deliver a more comprehensive assessment. Some of the additional benefits are summarised in the 'Economic and Social Benefits' insert on this page.

- *Consider the value of CO2 saving*

  The Council will need to tackle CO2 emissions and there will be a cost associated with this. Accounting for the value of the CO_2 saving, with reference to carbon price mechanisms such as the carbon floor price, CRC and Carbon Levy, should enable a saving to be allocated. For projects which make financial returns that are potentially

considered to be low and unattractive, the understanding that CO_2 savings are essentially being achieved for negative costs could change the view.

Economic and Social Benefits of Carbon Reduction Measures

The Committee on Climate Change report on opportunity areas for local government action notes that carbon reduction activities by local government can also provide a range of other economic and social benefits for local authorities and their communities. The text below is taken from the report and summarises some of the main additional benefits:

- **Reduction in fuel poverty and improved energy affordability** through energy efficiency improvements in the residential sector. CCC energy bill analysis suggests that the implementation of energy efficiency measures together with boiler replacement can offset the additional costs associated with renewable power generation, such that typical household energy bills in 2020 remain at around current levels.
- **Cost savings** through energy efficiency improvement in the non-residential sector.
- **Infrastructure improvements with economic benefits**
- Improved energy affordability can also deliver **health benefits** by reducing the risks of illness due to living in inadequately heated homes. There are also potential health and social benefits from promoting cycling and walking as alternative modes to car travel.
- **Development of local skills and job creation.** Energy efficiency retrofit programmes can provide opportunities for the creation of local jobs (e.g. local installers of insulation measures) and wider economic regeneration. For example, in Kirklees a programme to insulate 51,000 homes has been estimated to have created almost 250 jobs.

11.1.2 General roadmap for delivering energy projects

The following table sets out a simple roadmap of the stages required to implement the projects in this report.

Step	Requirement
1	Identify opportunities
2	Capacity building
3	Outline technical and financial assessment
4	Stakeholder engagement

5	Strategy, Policy and Budgets
6	Detailed feasibility for specific project(s)
7	Identify funding & prepare business model
8	Prepare & issue full tender specification
9	Select partner and agree terms
10	Monitor implementation and evaluate outcomes

Table 23: Simplified roadmap identifying the key stages leading to the implementation of the projects in this report

This study only provides high-level indications of costs and feasibility of projects and further work will be needed to confirm the opportunities it identifies and to work up business cases for specific projects. However it should help to provide evidence to demonstrate the potential of different measures and to support further work. Potential delivery steps are outlined in more detail below:

Step 1 - Identify opportunities

The first step in the process is the one that has been completed as part of this project, namely to assess the scale and type of opportunities within the city. This provides an evidence base for identifying the actions to be taken.

Step 2 – Capacity building

Following the identification of the specific opportunities to be developed, work will be required to build up the internal support necessary to secure the political will and financial support to fund the development and delivery of the project.

This work will require a few key members to be identified within the Council that can form a working group to present the case for further work to key personnel within the Authority and, if necessary, with other external stakeholders.

In regards to large scale projects such as district heating networks, the most commonly cited lesson from large local energy network projects in the UK has been the need for a high profile champion to secure the political will to drive the project forward, be a focal point for engagement with external stakeholders and obtain the support and funding required at each of the key decision points.

Step 3 – Outline technical and financial assessment

Technical and financial analysis will then be required to develop an outline business case for the scheme. This may require assistance

from a third party to provide the required technical and financial expertise and/or an independent assessment of the viability of a possible project. It may also be necessary to undertake more detailed assessment to confirm opportunities identified in this report for example where high-level national data or local survey data based has been proportioned to Brighton and Hove as data was not available at the ideal scale or level of detail.

Step 4 – Stakeholder engagement

If the technical and financial assessment identifies a viable opportunity then the results of the study will need to be presented to key stakeholders to seek their engagement and support. The key stakeholders for the various projects detailed in this report have been identified.

Step 5 – Strategy, Policy and Budgets

The existing Council policies, aims and objectives should be reviewed to determine whether the project will be able to help to deliver, thereby providing support for the scheme. This could include social and environmental goals, such as fuel poverty, air quality improvements and CO_2savings, as well as purely financial returns.

In addition any further strategic support that could be provided should be identified. This could include planning policies to safeguard key sites or stronger and more detailed requirements for specific developments to support low carbon energy infrastructure.

At the end of this stage a decision will need to be taken as to whether to proceed to the detailed design stage, which will require further resources

Steps 6 and 7 – Detailed Investigations (Detailed feasibility for specific project(s) and Identify funding & prepare business model)

Depending on the nature of the project further detailed investigations may be required to provide more detailed analysis of the technical and financial viability of a project before tendering the scheme.

Alongside this, for more complex projects such as a district heating scheme, the Council will need to identify an appropriate funding and delivery model for a project. This is likely to depend upon a number of factors but the most significant will be the level of financial investment and the allocation of risk. Examples of existing projects should be reviewed; there are a variety of different models for existing local energy projects in the UK.

Steps 8 and 9 – Procurement (Prepare & issue full tender specification and Select partner & agree terms)

A significant decision point will be reached at the end of the Detailed Investigations stage as to whether to proceed to tender for the project.

It is anticipated that the Council will be well accustomed to the procurement process and in many ways procuring a local energy network project will follow a well defined approach.

Step 10 – Monitoring and evaluation

Brighton and Hove already has proposals for monitoring progress in delivering carbon reduction measures across the city within its Climate Change Strategy. In addition to the national statistics produced by DECC on carbon emissions at the local authority level, it is proposed to monitor the Council's own carbon footprint through the Carbon Reduction Commitment and the Council's carbon management programme; data on kW renewable heat and electricity installed on new development through the planning system (Sustainability Checklist data);[85] number of new homes built to Code Levels 3 to 6 and non-domestic buildings built to BREEAM Very Good or above; average kg CO_2/sqm/yr performance of new homes; energy performance of Council housing; levels of PV on Council buildings (this could be extended to other renewable technologies); and the number of people living in fuel poverty.

Individual projects should also be monitored where possible and where this will aid future learning and roll-out of measures.

11.2 General overview of funding options

11.2.1 Green Deal

This is a government initiative, due to be fully launched in 2013, that will enable private firms to offer energy efficiency improvements to home and building-owners at no upfront cost, and to recoup payments through the savings in energy bills. For all Green Deal measures, the expected financial savings must be equal to or greater than the costs attached to the energy bill; this is known as "the golden rule". The government's Green Deal consultation response, June 2012, suggests that the Home Energy Conservation Act (HECA) will be revitalised to encourage Local Authorities to plan for CO_2 emission reductions on a borough wide basis, recognising the importance of intermediaries in particular Local Authorities,

[85] It was noted that the Sustainability Checklist data provided to AECOM as part of this study was often not in the correct units (kW – often kWh or technology sizes were provided instead) – this could potentially be improved.

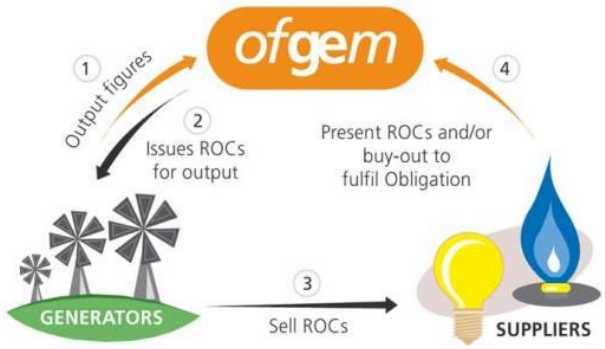
social housing providers and communities in building local partnerships to deliver the Green Deal.

11.2.2 Energy Company Obligation

The 2011 Energy Bill, which made provision for the Green Deal, also provided for an Energy Company Obligation (ECO) to replace the current CERT and CESP schemes which oblige energy companies to contribute to the costs of installing energy efficiency measures in homes. The ECO is expected to focus on subsidising measures which do not meet the Green Deal's golden rule - in particular solid wall insulation – and a proportion is expected to be targeted towards thermal energy efficiency measures in vulnerable homes.

11.2.3 Renewable Obligations Certificates

The Renewables Obligation requires licensed electricity suppliers to source a specific and annually increasing percentage of the electricity they supply from renewable sources thereby creating a market and premium for green energy.



The current level is 12.4% for 20011/12 rising year on year, which the scheme extended in April 2010 to operate till 2037. The types of technology and the number of ROCs achieved per MWh are outlined in the table below. The value of a ROC fluctuates as it is traded on the open market.

Technology	ROCs /MWh	Technology	ROCs /MWh
Hydro	1	Energy from Waste with CHP	1
Onshore wind	1	Gasification/Pyrolysis	2
Offshore wind	1.5	Anaerobic Digestion	2
Wave	2	Co-firing of Biomass	0.5
Tidal Stream	2	Co-firing of Energy crops	1
Tidal Barrage	2	Co-firing of Biomass with CHP	1

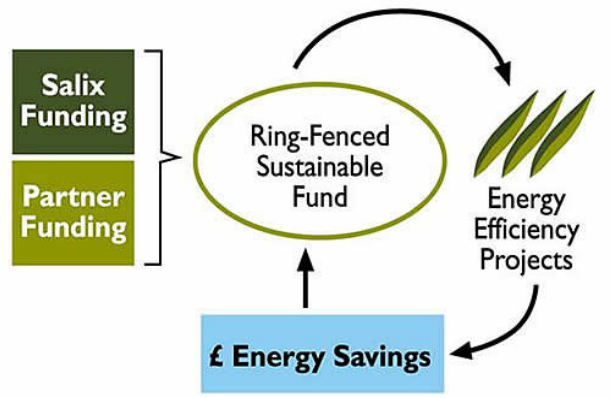
Tidal Lagoon	2	Co-firing of Energy crop with CHP	1.5
Solar PV	2	Dedicated Biomass	1.5
Geothermal	2	Dedicated energy crops	2
Geopressure	1	Dedicated Biomass with CHP	2
Landfill Gas	0.25	Dedicated Energy Crops with CHP	2 [86]
Sewage Gas	0.5		

11.2.4 Salix Finance

This is a publicly funded company designed to accelerate public sector investment in energy efficiency technologies through invest to save schemes. Funded by the Carbon Trust, Salix Finance works across the public sector including Central and Local Government, NHS Trusts and higher and further education institutions. It will provide £51.5 million in interest free loans, to be repaid over four years, to help public sector organisations take advantage of energy efficiency technologies.

[86] Renewable Obligation Certificate (ROC) Banding (DECC websites http://chp.defra.gov.uk/cms/roc-banding/, accessed August 2009)

Salix launched its Local Authority Energy Financing (LAEF) pilot scheme in 2004. The success of this programme has allowed the pilot to be rolled out into a fully fledged local authorities programme.



11.2.5 Prudential borrowing and bond financing

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

there is an equity stake, or indeed from other Council funds (e.g. other asset sales).

Currently the majority of a council's borrowing, will typically access funds via the 'Public Works Loan Board'. The Board's interest rates are determined by HM Treasury in accordance with section 5 of the National Loans Act 1968. In practice, rates are set by Debt Management Office on HM Treasury's behalf in accordance with agreed procedures and methodologies. Councils can usually easily and quickly access borrowing at less than 5%.

The most likely issue for local authorities will be whether or not to utilise Prudential Borrowing, which can be arranged at highly competitive rates, but remains 'on-balance sheet' or more expensive bond financing which is off-balance sheet and does not have recourse to the Council in the event of default.

11.2.6 Best Value

Local authorities have the right to apply conditions to sales of their own land, whereby a lower than market value sale price is agreed with the developer in return for a commitment to meet higher specified sustainability standards. Rules governing this are contained within the Treasury Green Book which governs disposal of assets and in within the Best Value - General Disposal Consent 2003 'for less than best consideration without consent'. It is our understanding that undervalues currently have a cap of £2 million without requiring consent from Secretary of State.

11.2.7 Local Asset-Backed Vehicles

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

The partnership may then use these assets as collateral to raise debt financing to develop and regenerate the portfolio. Assets will revert back to the public sector if the partnership does not progress in accordance with pre-agreed timescales through the use of options.

Control is shared 50/50 and the partnership typically runs for a period of ten years. The purpose and long term vision of the vehicle is enshrined in the legal documents which protect the wide economic and social aims of the public sector along with pre-agreed business plans based on the public sector's requirements.

Many local authorities are now investigating this approach, with the London Borough of

Croydon being the first LA to establish a LABV in November 2008. LABVs are still feasible if adapted to suit the current macro economy. The first generation of LABVs were largely predicated on a transfer of assets from the public sector to a 50/50 owned partnership vehicle in which a private sector developer/investor partner invested the equivalent equity usually in cash. The benefits were in some instances compelling.

This transfer of assets suited the public sector given yields and prices had never been stronger. There is now a need for a second generation of LABVs that deliver many of the recognised benefits of LABVs as set out above but protect the public sector from selling 'the family silver' at the bottom of the market.

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

11.2.8 Community Infrastructure Levy (CIL)

The CIL has previously been used to support the development of an area rather than to support the specific development for which planning permission is being sought. This made CIL a potentially good mechanism for operating a carbon fund, however new legislation proposed on the CIL will limit this potential, ruling that section 106 can only be used for onsite mitigation or where it is used offsite cannot be pooled for more than 5 contributions into an 'energy grant fund', for example, which makes the approach difficult. A further review of CIL is currently underway which is due to complete by early 2013.

11.2.9 Allowable Solutions

The revisions of Building Regulations proposed to take effect in 2016 (for dwellings) and 2019 (for non-domestic buildings) are expected to require a 'zero carbon' standard to be achieved.

The definition of the 'Zero Carbon' standard has changed a number of times since it was first proposed in 2007. The current proposed approach suggests that it should be achieved through three steps:

- Energy Efficiency – which will set minimum standard for the performance of the building fabric
- Carbon Compliance – which will set a minimum on-site CO_2reduction target
- Allowable Solutions – which will require the residual CO2 emissions from the development to be 'offset' through payment into a fund to be used for CO_2reductions elsewhere

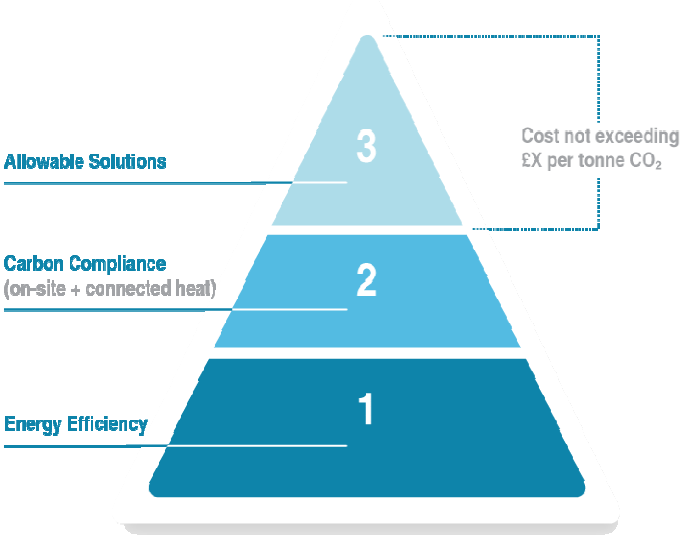


Figure 34: Proposed Zero Carbon Methodology

This concept behind Allowable Solutions reflects the understanding that there are diminishing returns for the money invested in reducing CO2 emissions on site and that this can be better spent at scale on projects such as retrofitting programmes for existing buildings or on large scale low and zero carbon energy projects.

Work is still underway to define the Allowable Solutions and to create a mechanism to operate it. The most recent work has been undertaken by the Zero Carbon Hub which has suggested that the most likely mechanism for allowable solutions will be a fund administered by the Green Investment Bank which will make funds available to the Council to spend on CO_2 mitigation measures. The current proposals suggest a cost of £46/tonne CO_2over 30 years. Indicative estimates by the Zero Carbon Hub indicate that this could represent around £1,000 - £1,600 per dwelling depending on dwelling type.[87]

11.2.10 SME Support

Lack of funding and advice are cited as major barriers to businesses investing in energy saving measures. Some potential sources of funding and advice are indicated below.

[87] Estimated Cost of Zero Carbon Homes (Zero Carbon Hub)

Organisations already providing support to commercial and public organisations include the Carbon Trust, and Business Link. The Carbon Trust is currently working with Siemens to provide an Energy Efficiency Financing Scheme which gives loans from £1000 for energy efficiency and renewable energy measures. The support is available to SMEs, large businesses, and public sector organisations.[88] The Carbon Trust also provides guidance including a free helpline, some free on-site surveys, and extensive online materials. They can also help businesses to identify opportunities to improve the business case for measures, for example through Enhanced Capital Allowances for energy saving technologies which provide tax relief for a year on qualifying capital expenditure.

11.3 General information on Delivery opportunities

11.3.1 Special Purpose Vehicles

Delivering large energy projects may require the creation of a Special Purpose Vehicle (SPV) that may include partners outside the authority.

Options for setting up an SPV should be explored at the earliest opportunity. Although the skills required for this are likely to need to be developed this does not need to be an insurmountable barrier and there are a growing number of local authorities engaging in similar activities both in energy and other areas. They key to success is likely to be leadership: from senior Council management or, at least initially, from committed individuals in planning or other departments.

SPV models range from fully public, through partnerships between public, private and community sectors to fully private. Broadly speaking, the greater the involvement of third parties the lower the risk to the authority but, importantly also, the less control the authority will have. Whichever route is chosen, the delivery vehicle should be put in place as early on in the development process as possible, so that its technical and financial requirements can be fed through into negotiations with potential customers.

Potential advantages and disadvantages associated with publicly led and privately led SPVs are shown in the following table:

[88] http://www.carbontrust.co.uk/cut-carbon-reduce-costs/products-services/financing/business-financing/Pages/finance-overview.aspx

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

Table 24: Advantages and disadvantages of SPV Models

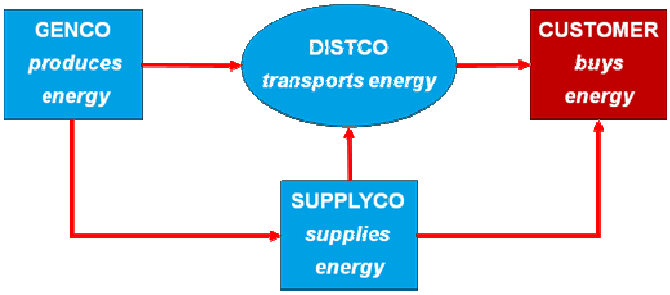
11.3.2 ESCo services

Energy Service Companies (ESCos) are commercial businesses that provide and manage energy solutions. A full ESCo service involves the following elements:

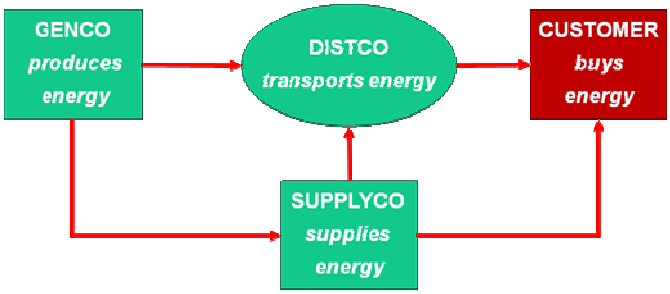
1. Finance
2. Design
3. Installation
4. Operation
5. Maintenance
6. Management

For example the following diagrams different ESCo models that are being used in a number of existing District Heating schemes across the country.

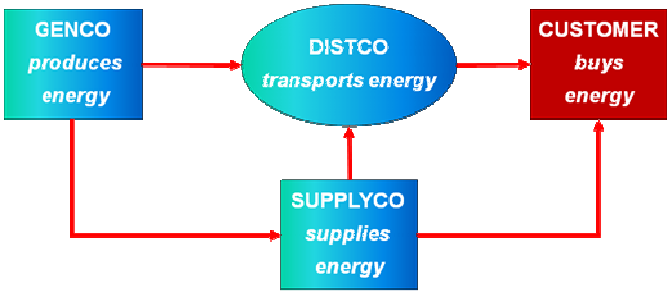
1. Private sector ownership e.g. Southampton, Citigen (London), Sheffield



2. LA Ownership e.g. Pimlico



3. Joint Ownership e.g. Birmingham



4. LA owns network and supply, private sector owns heat source, e.g. London Thames Gateway, Nottingham

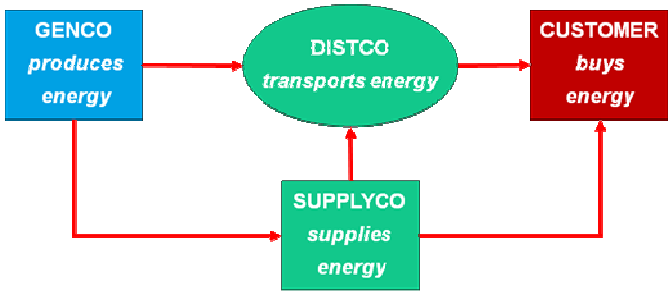


Figure 35: Four different ESCo Models

KEY

GENCO refers to the part of the organisation that owns and is responsible for the operation and maintenance of the generating plant and energy centre.

DISTCO refers to the part of the organisation that owns and is responsible for the distribution network.

SUPPLYCO refers to the part of the organisation that is the energy supplier i.e. the interface with the customer and responsible for billing, metering etc.

BLUE BOXES represent private ownership and GREEN BOXES represent public (Council) ownership.

Each of these models entails a different level of risk and commercial interest. In addition to this, a party will need to be responsible for metering and billing. In addition to the list of ESCOs above, there are a number of private companies who specialise in this part of the operation.

11.4 Project specific funding and delivery

11.4.1 Energy Efficiency – Private Domestic

Delivery

The key mechanism for delivering energy efficiency to the private domestic sector will be the Green Deal. As previously described in this report, the scale of the uptake of the Green Deal will have the most significant impact on the achievement of the Borough-wide carbon reduction target.

In theory the Council has three main options:

1. Become a Green Deal Provider – leveraging the finance and tendering the contract (as is being undertaken by Birmingham City Council)
2. Partner with Private Finance Providers – helping to manage and oversee the scheme as well as potentially acting as a guarantor to secure the finance.
3. Promote the scheme – take a more passive role but take all opportunities to promote the scheme to Brighton and Hove residents through marketing, community groups and providing support and guidance for people looking to take up the measure.

The private rented housing potentially presents a significant opportunity since the landlords will have less of a disincentive to undertake energy efficiency measures since the upfront cost will not sit with them.

Funding and Financing

The key financing tool for energy efficiency in the domestic sector will be the Green Deal.

This is growing consensus that the Green Deal may need to be supported by other finance to enable some measures such as solid wall insulation to pass the 'Golden Rule'. At the national level the Energy Company Obligation (ECO), which is the replacement for the CERT scheme, is being proposed, but potentially the Allowable Solutions could additionally be used at the local level.

Possible Partners and Stakeholders

Engaging with private households will be crucial to stimulate uptake of energy efficiency through the Green Deal or other mechanisms.

Potential routes to reaching this group could be sought through the following channels:

- Working with estate agents to provide information to people moving house;
- Working with local building contractors to provide information to people undertaking improvement works in their home;
- Creating links to community groups, particularly those with a sustainability/energy remit such as transition town groups.

11.4.2 Energy Efficiency – Public domestic

Delivery

As previously detailed there are more direct intervention options for energy efficiency measures and there are likely to be programmes underway and planned to deliver this.

Funding and Financing

For public sector housing financing can be achieved through capital expenditure, prudential borrowing or the Green Deal or ECO financing.

11.4.3 Energy Efficiency – Private non-domestic

Delivery

The Green Deal will also be open to private non-domestic building owners although in reality this group might be less attracted by the long-term repayment structure.

As an alternative approach, the Council could potentially consider product specific programmes using bulk buy contract and potentially subsidies to promote the uptake of one-off measures like better light fittings, control systems, variable speed drives, monitoring equipment. A similar approach was taken in the Islington Low Carbon Zone to drive the uptake of energy efficient lighting.

Funding and Financing

The Green Deal will be available for longer term measures while shorter-term measures (less than 3 years) should have their own business case, although awareness raising and support may be required to help businesses identify these. Many measures will also be eligible for incentives such as Enhanced Capital Allowances.

Possible Partners and Stakeholders

The Council will need to use its connections to local businesses through business forums and

similar platforms to promote and market the Green Deal as well as providing general guidance and support for the uptake of energy efficiency.

Measures on the Council's own stock should be promoted, both to set an example and demonstrate leadership in this area but also to share learning on the costs, technical issues and delivery process to better inform others on undertaking similar projects.

11.4.4 Energy Efficiency – Public non-domestic

Delivery

The Green Deal will also be open to public non-domestic building owners although in reality this group might be less attracted by the long-term repayment structure.

As an alternative approach, the Council could potentially consider product specific programmes using bulk buy contract and potentially subsidies to promote the uptake of one-off measures like better light fittings, control systems, variable speed drives, monitoring equipment. A similar approach was taken in the Islington Low Carbon Zone to drive the uptake of energy efficient lighting.

Funding and Financing

As above for private non-domestic.

Possible Partners and Stakeholders

The Council will again need to use its connection to local public sector organisations, through forums such as the City Sustainability Forum and similar platforms to promote and market the Green Deal as well as providing general guidance and support for the uptake of energy efficiency.

Measures on the Council's own stock should be promoted, both to set an example and demonstrate leadership in this area but also to share learning on the costs, technical issues and delivery process to better inform others on undertaking similar projects.

11.4.5 District Heating

Delivery

Delivering a District Heating Scheme is likely to require the input of an Energy Services Company (ESCo) to provide the necessary skills. A special Purpose Vehicle (SPV) could be created.

Funding and Financing

Depending on the scale of the opportunity an ESCo may be willing to fully fund a scheme, or alternatively the Council could provide the finance through capital investment or prudential borrowing.

The Council will play a key role in making district heating projects viable through long term commitments to purchase heat and power plus the provision of strong planning policy support.

11.4.6 Microgeneration

Funding and Financing

Microgeneration technologies are incentivised by the Feed-in-Tariff and Renewable Heat Incentive schemes. The tariff rates have been set (and amended numerous times) to offer a return of around 6-9% for most technologies.

Delivery

If the Council is able to use its own money, either through capital expenditure or borrowing at preferential rates then the long term financial benefit can be secured for the Council, with the potential to use this to start a recycling fund for future energy efficiency or generation projects.

The use of prudential borrowing (currently at around 4% interest) or Salix funding (if a scheme can achieve a payback rate less than 5 years) can provide low cost financing to invest in schemes that achieve better returns. Although the potential returns may be low the other benefits, particularly CO_2 savings and addressing fuel poverty (if installed on social housing) can effectively be achieved at no cost.

11.4.7 Large-scale generation

Funding and Financing

Large scale renewable generation technologies are incentivised by the Feed-in-Tariff and Renewable Heat Incentive schemes as well as Renewable Obligation Certificates.

The Council can effectively unlock the potential for many medium and large scale schemes that could be taken forward by private individuals, co-operatives or community groups, by agreeing the purchase the energy generated over long periods. These Power Purchase Agreements (PPAs) effective provide the security for a scheme to enable it to raise the funding required to deliver a project. This is a very effective way of encouraging schemes like wind turbines or anaerobic digestion to be delivered quickly, receive the CO_2 savings and avoid the upfront capital investment, although the Council does not receive the full financial benefits that it would if it provided the capital.

Delivery

The authority has a key role to play in providing clarity on the type of projects, scale and locations that are likely to be acceptable plus providing the planning policy support to encourage uptake.

11.5 Delivery Matrix

A ‘delivery matrix’ has been created to summarise some of the quantitative assessment of the measures identified in this study and to provide further qualitative assessment to help inform decision-making. ‘Measure CO_2 savings’ refers to the scale of savings of a typical installation of the measure relative to other measures and ‘potential CO_2 savings in Brighton and Hove’ refers to the estimated overall potential in the city – both are indications based on the results of the assessment above. The matrix also includes some measures which are not included in the scenarios. This matrix is shown below.

	Measure CO_2 savings	Potential of CO_2 savings from measure in Brighton and Hove	Level of LA intervention opportunity	LA role	Partners	Indicative Cost/ tonne in 2020 (capital)[89]	Indicative Cost/ tonne (lifetime)[90]	Sources of funding and support	Risks and issues
Domestic									
Private housing									
Cavity Wall Insulation	Medium	Medium	Low	Promoting Possible enabling / direct if active on Green Deal	• Homeowners • Community groups, • Private landlords • EST • GLA • Green Deal providers • Local installers	£1,200 to £5,100 (hard /easy to treat)	-£35	• Green Deal • ECO • Private homeowners • Carbon Fund	• Relies on private sector take-up • Lack of take-up of Green Deal, e.g. due to mistrust or aversion to taking out loans • Public reaction against consequential improvements policy • Reductions in FIT and RHI • Practical challenges of solid wall and hard to treat cavity wall insulation • Risks to Council in becoming a Green Deal provider
Solid Wall Insulation	High	High				£6,700	£5		
Loft Insulation	Low-Medium	Low				£700 to £2,300 (virgin / top-up)	-£80 to -£30		
Window replacement	Low-Medium	Low				£2,700	-£130		
Boiler replacement	High	Low				£3,100	-£45		
Smart meters	Low	Low-Medium				£1,700	-£275	• Energy Companies	
Photovoltaics	Medium	High				£7,800	£265	• FIT	
Solar Thermal	Medium	Medium				£7,600	£425	• RHI	
Heat pumps	Low	Low				£8,500 - £9,400 (ASHP /GSHP)	£190		
Council Housing									
Cavity Wall	Medium	Low/	Medium	Enabling	• RSLs	£1,500 to	-£35	• Green Deal	• Council housing

[89] Figures based on capital costs and carbon savings estimated in scenario spreadsheet. Note that the cost per tonne for certain measures will vary depending on the proportions of different unit types receiving the measures – this is why for example the private solid wall insulation and Council solid wall insulation cost per tonne figures differ in this matrix.

[90] Based on figures given in the Committee on Climate Change's *Building a Low Carbon Economy* MAC curves and supporting documentation, and DECC's *Smart metering Impact Assessment* – not including incentives such as FITs.

	Measure CO_2 savings	Potential of CO_2 savings from measure in Brighton and Hove	Level of LA intervention opportunity	LA role	Partners	Indicative Cost/ tonne in 2020 (capital)[89]	Indicative Cost/ tonne (lifetime)[90]	Sources of funding and support	Risks and issues
Insulation		Medium		– working with RSLs	• Green Deal providers • Local installers • Energy companies and ESCos • Renewable system providers	£6,500 (hard /easy to treat)		• ECO • LEEF • Carbon Fund • EIB • Green Investment Bank • Prudential borrowing	represents only around 10% of the housing stock and many measures are likely to have been already implemented. • Reductions in FIT and RHI • Practical challenges of solid wall and hard to treat cavity wall insulation
Solid Wall Insulation	High					£7,300	£5		
Loft Insulation	Medium					£700 - £2,300 (virgin / top-up)	-£80 to -£30		
Window replacement	Low					£3,400	-£130		
Boiler replacement	Low-Medium					£3,700	-£45		
Smart meters	High					£1,700	-£275	• Energy Companies	
Photovoltaics	Low					£7,800	£265	• FIT	
Solar Thermal	Medium					£7,600	£425		
Heat pumps	Medium					£8,500 - £9,400 (ASHP /GSHP)	£190	• RHI	
Commercial and Industrial									
Private commercial									
BMS	Medium	Low-Medium	Low	Promoting/ Enabling	• Private business and industry • Chamber of Commerce • Carbon Trust • Business	TBC	TBC	• Energy companies and ESCOs • Green Deal • Carbon Trust • 3rd party models • Energy Performanc	• Lack of Council control • Difficult to get hold of data
Boiler replacement	High	Medium				Varies TBC	-£100 to £200		
Energy efficient refrigeration	High	Low				TBC	-£150 to £450		
Voltage optimisation	Low	Low				TBC	TBC		
Small power energy use	Low-Medium	Medium				TBC	-£150 to -£50		

	Measure CO_2 savings	Potential of CO_2 savings from measure in Brighton and Hove	Level of LA intervention opportunity	LA role	Partners	Indicative Cost/ tonne in 2020 (capital)[89]	Indicative Cost/ tonne (lifetime)[90]	Sources of funding and support	Risks and issues
reduction					networking forums			e Contracting • FIT • RHI	
Microgeneration	High	High				£3,600 to £7,200	£15 to £290		
CHP	Medium	Medium				TBC	£220		
Council buildings and infrastructure (non-domestic)									
LED Street lighting	High	Low		Direct	• Schools • Building managers • Council staff • ESCOs or Energy Performance Contractors	TBC	TBC	• Carbon Trust • Council funding • 3rd party models • FIT • LEEF	• Financial pressures and competing priorities • Investing in measures on own estate can be used to set a leadership example to support take-up from other sectors
LED lighting roll-out	High	Medium		Direct/ Enabling		TBC	TBC		
Turn-off of unnecessary lighting	Medium	Medium		Direct		£0	-£150		
BMS	Medium	Low		Direct		TBC	TBC		
Boiler replacement	High	Medium		Direct/ Enabling		TBC	-£100 to £200		
Voltage optimisation	Low	Low	High	Direct		TBC	TBC		
Small power energy use reduction	Low-Medium	Medium		Direct		TBC	-£150 to -£50		
PV on council buildings	High	Low		Direct		£7,200	£290		
PV on schools	High	Low		Direct/ Enabling		£7,200	£290		
CHP	Medium	Medium		Direct/ Enabling		TBC	-£40		
Other public sector									
LED lighting roll-out	High	Medium	Medium	Promoting	• NHS • Police • Fire • Non-	TBC	TBC	• Carbon Trust • Own funding,	• Lack of Council control • Financial pressures and competing priorities
Turn-off of unnecessary lighting	Medium	Medium				£0	-£150		

	Measure CO_2 savings	Potential of CO_2 savings from measure in Brighton and Hove	Level of LA intervention opportunity	LA role	Partners	Indicative Cost/ tonne in 2020 (capital)[89]	Indicative Cost/ tonne (lifetime)[90]	Sources of funding and support	Risks and issues
BMS	Medium	Low			Council education • Courts • Universities	TBC	TBC	• 3rd party models • LEEF	
Boiler replacement	High	Medium				TBC	-£100 to £200		
Voltage optimisation	Low	Low				TBC	TBC		
Small power energy use reduction	Medium	Medium				TBC	-£150 to -£50		
Microgeneration	High	High				£3,600 to £7,200	£20 to £290		
CHP	Medium	Medium				TBC	£220		
Large Scale Energy Generation									
District Heat Networks	High	Medium/High	Medium-High	Direct /Enabling	• ESCOs • Energy Developers • Potential energy customers	£1,000	TBC	• EU funding • Private sector investment • ESCOs • Green Investment Bank • Low Carbon Network Fund • FIT • RHI	• Finance not secured • Public opposition • Planning constraints • Length of lead-in time required
Wind	High	Medium/High		Direct /Enabling		£1,100	£90 to £135		
Anaerobic digestion and Energy from Waste	Medium	Low		Direct /Enabling		TBC	TBC		

Appendix A: Glossary

Allowable Solutions – A proposed mechanism for reducing carbon emissions off site as part the Government's definition of Zero Carbon Policy.

BREEAM – The Building Regulations Establishment Environmental Assessment Method. It measures the environmental performance of a building.

Carbon Compliance – The minimum reduction in carbon emissions to be delivered on site as part of the Government's Zero Carbon Policy.

Carbon Emissions Reduction Target (CERT) and Community Energy Saving Programme (CESP) – Government schemes to promote the uptake of energy efficiency measures by requiring utility companies to promote and facilitate energy efficiency improvements. These programmes end in 2012.

The Carbon Reduction Commitment (CRC) – A mandatory carbon trading scheme which came into force in 2010, designed to encourage organisations with large property portfolios to manage energy consumption and emissions.

Code for Sustainable Homes – This is an environmental assessment method which attempts to rate the sustainability of residential dwellings by assessing them against nine key criteria including water, energy and CO2 emissions .

Combined Heat and Power (CHP) – This system works by generating electricity near or on-site, capturing the heat for space and water heating.

Community Heating – An alternative description for district heating, usually referring to smaller residential systems within blocks of flats or housing estates.

CHP – Combined Heat & Power.

CIL – Community Infrastructure Levy.

COP – Coefficient of Performance, i.e. ratio of output to input, a measure of efficiency.

CO_2 – Carbon Dioxide.

CP8 – Policy CP8 of the Council's draft City Plan 2012

DEC – Display Energy Certificate.

DECC – Department of Energy and Climate Change.

Distribution Network Operator (DNO) – Companies licensed to distribute electricity within a defined geographical area.

District Heating Network (DHN) – This term is generally given to a system where a centralised heat generating plant (using any one of a range of technologies) provides heat to surrounding

buildings in the area by means of a network of pipes carrying hot water or steam.

DPD – Development Plan Documents.

EPBD – Energy Performance of Buildings Directive (EU).

Energy Developer – company developing energy generation plant.

Energy Company – Used in the report to refer to the companies which contract with consumers to supply electricity or gas. In some cases may also be a developer.

Energy Supply Company (ESCo) – A commercial entity which typically operates and maintains the plant associated with a DHN (or potentially also other forms of generation). They would also normally bill any user of the DHN.

EPC – Energy Performance Certificate.

EST – Energy Saving Trust.

FEES – Fabric Energy Efficiency Standard proposed by Zero Carbon Hub as the minimum energy efficiency standard for Zero Carbon policy.

FITs – Feed in Tariffs. Government incentive paid for electricity generated from renewable sources.

Geographic Information System (GIS) – Visual representations in map form so that relationships of physical location can be observed.

Green Deal – The Government's programme to establish a framework to: enable private firms to offer consumers energy efficiency improvements to their homes, community spaces and businesses at no upfront cost; and recoup payments through a charge in instalments on the energy bill. Due to be introduced in October 2012.

Heat Density Mapping – A visual representation of the heat demand in a given area, shown as thermal energy demand per Km.

Home Energy Conservation Act (HECA) – The 1995 Act mandates all Local Authorities to carry out voluntary cost effective and practical measures that will reduce home energy consumption by 30% over 10 to 15 years.

KWh – Kilowatt hours, unit of energy.

LDF – Local Development Framework.

LLSOA – Lower Layer Super Output Area. Geography designed by the Office for National Statistics to improve the reporting of small area statistics. Minimum population 1,000; mean 1,500. Built from groups of Output Areas

(typically five) and constrained by the boundaries of the Standard Table (ST) wards used for 2001 Census outputs.

LZCs – Low and Zero Carbon energy generation technologies, such as biomass, wind, solar etc.

MLSOA – Middle Layer Super Output Area. Minimum population 5,000; mean 7,200. Built from groups of Lower Layer SOAs and constrained by the 2003 local authority boundaries used for 2001 Census outputs.

MWh – Megawatt hour, unit of energy consisting of 1000 kilowatt hours.

ONS – Office for National Statistics

On-site – In this context, on-site means any measures taken by a developer within the boundary of the building required to comply with Part L of the Building Regulations.

Part L 2010 / 2013 / 2016 / 2019 – Building Regulations for Conservation of heat and power, Approved Documents, in place from October 2010; and subsequent revisions which are due to take place.

PV – Solar Photovoltaic panels that convert sunlight to electricity.

Regulated Emissions – CO2 emissions resulting from energy uses currently regulated by Part L1a or L2a of Building Regulations, these include CO2 emissions resulting from space heating, space cooling, water heating, auxiliary energy for pumps and fans and some allowance for fixed lighting. They exclude energy use and emissions associated with domestic appliances, decorative lighting and equipment in non-domestic buildings.

Renewable energy – Energy derived from sources which are replenished within the lifecycle of their consumption and involve zero, or near zero, carbon emissions over this lifecycle.

ROCs – Renewable Obligation Certificates.

RHI – Renewable Heat Incentive. Government's proposed fiscal incentive for sale of heat from renewable sources.

Special Purpose Vehicle (SPV) – A subsidiary corporation designed for high risk investments.

SPD – Supplementary Planning Document.

Standard Assessment Procedure (SAP) – A method of providing an energy performance rating for dwellings. SAP ratings are on a scale of 1 to 100+ where 1 is the worst and 100 represents a dwelling with no energy costs for the energy components which are included in SAP (heating, hot water, cooling and internal lighting).

Unregulated Emissions – CO2 emissions resulting from energy uses not currently regulated by Part L1a or L2a of Building Regulations. These are principally the CO2 emissions resulting from domestic appliances, non fixed lighting, office equipment and process energy uses that are influenced by the occupier and which change with changing occupancy.

Zero Carbon Hub – Not for profit public/private partnership established to take day-to-day operational responsibility for co-ordinating delivery of low and zero carbon new homes on behalf of Government.

Zero Carbon Policy – Government policy that all new homes built from 2016 and all new non-domestic buildings built after 2019 will have zero net CO2 emissions . Work is still underway on this definition but it has been indicated that this will cover only regulated emissions.

Appendix B: Draft City Plan Part 1 Policy CP8 Testing Assumptions

The modeling undertaken to test the potential for meeting future carbon targets was based upon certain key building types modeled to achieve compliance with Building Regulations 2010. A selection of indicative domestic unit types were modelled using NHER (National Home Energy Rating) Version 5.4 which is software accredited to run SAP 2009 assessments to test compliance with Part L 2010. Four unit types have been modeled; a flat, a mid-terrace house, a semi-detached house and a detached house. The dwelling specification chosen would be expected to comply with Part L 2010 through energy efficiency measures only.The specifications assumed are detailed in Table 25 below. A case with improved door and window u-values, air permeability rates, and a mechanical extract ventilation system was also modeled to give an increased energy efficient case. Renewable and low carbon energy generation options were then modeled based on the energy efficiency case, using the same sources for assumptions on efficiencies and capital costs as outlined in section 9 the main report. A similar process was followed for non-domestic buildings. The non-domestic energy efficient cases were based on the specifications used in the government's *2012 Consultation on Changes to the Building Regulations in England* for non-domestic buildings achieving a 20% aggregate reduction over Part L 2010 (summarized in below).

	Flat	Mid-terrace house	Semi-detached house	Detached house
External Walls (W/m²K)	0.18	0.18	0.18	0.22
Party Walls (W/m²K)	0	0	0	n/a
Semi exposed walls (W/m²K)	0.17	n/a	n/a	n/a
Floor (W/m²K)	0.15	0.13	0.15	0.18
Roof (W/m²K)	0.13	0.13	0.13	0.15
Windows (W/m²K) whole window u-value	1.4 (double glazed)			
Doors (W/m²K)	1.2	1.2	1.2	1.2
Airtightness (m³/hr/m²)	5.4	5.5	5.9	5.9
Thermal bridging y-value (W/m²K) (ACD / ECD =Accredited / Enhanced Construction Details)	Half way ACD-ECD	Half way ACD-ECD	ACD	ACD
Ventilation type	Natural			
Low energy lighting	100%			
Boiler	Gas Combi 90% efficient			
Water store (fully insulated primary pipework)	n/a	150l	150l	200l

Table 25: 2010 compliant basecase used for domestic modeling.

Element	Unit	Side lit (where HVAC specification is heating only)	Sidelit (where HVAC specification includes cooling)	Toplit
Roof	U-value ($W/m^2.K$)	0.16	0.18	0.16
Wall	U-value ($W/m^2.K$)	0.20	0.26	0.20
Floor	U-value ($W/m^2.K$)	0.20	0.22	0.20
Window	U-value ($W/m^2.K$)	1.6 (10% FF)	1.8 (10% FF)	N/A
	G-Value	40%	40%	N/A
	Light transmittance	71%	71%	N/A
Roof-light	U-value ($W/m^2.K$)	N/A	N/A	1.6 (15% Frame Factor)
	G-Value	N/A	N/A	48%
	Light transmittance	N/A	N/A	53%
Air-permeability	m^3/m^2/hour	3	5	3
Lighting	Luminaire lm / circuit watt	65	65	65
Occupancy control	Yes (MAN ON/AUTO OFF) / No	Yes	Yes	Yes
Daylight control	Yes / No	Yes	Yes	Yes
Heating efficiency	Heating and hot water	91%	91%	91%
Central ventilation	SFP (W/l/s)	1.8	1.8	1.8
Terminal unit	SFP (W/l/s)	0.3	0.3	0.3
Cooling (air-conditioned)	SEER / SSEER	N/A	4.5 / 3.6	4.5 / 3.6
Cooling (mixed-mode)*	SSEER	N/A	2.7	2.7
Heat recovery efficiency	%	70%	70%	70%
Variable speed control of fans and pumps, controlled via multiple sensors	Yes / No	Yes	Yes	Yes
Demand control (mechanical ventilation only). Variable speed control fans via CO_2 sensors	Yes / No	Yes	Yes	Yes
Renewable energy contribution	Monocrystalline PV with an efficiency of 15%. Active area of south facing panels ($120kWh/m^2$/year output) equivalent to stated % of gross floor area but limited to 50% of roof area.	1.6%	1.6%	1.6%

* Mixed Mode assumed to be cooled by DX unit where SSEER includes indoor and outdoor units and fans, pumps and losses

Table 26: Basis of energy efficient specifications used for non-domestic modelling. Source: Part L (Conservation of fuel and power) Proposed changes to technical guidance Jan 2012

Appendix C: Summary of Assumptions in SEPB *Review of Renewable and Decentralised Energy Potential in South East England*

Outlined below are some of the key assumptions used in the South East Partnership Board report, *Review of Renewable and Decentralised Energy in South East England*, June 2010, as discussed in section 6.5 of this study. AECOM is not responsible for these assumptions or any errors in their reproduction – the original report should be seen for full details.

Technology	Technology Sub-Type	Inputs/Assumptions			Capacity Factor: (Installed capacity (MW) x 365 days x 24 hours x capacity factor = Generated Capacity MW/h)	
		Summary of Constraint / Opportunity	Assessment	Data Source	Factor	Source
Wind	**Onshore, commercial scale**	Infrastructure exclusion areas: roads, railways, inland waters, built up areas, airports	Excluded	Roads: OS Strategi (with topple distance buffer 150m); Railways and inland waters: OS meridian 2 (with topple distance buffer 150m); Built up areas: OS Meridian urban area boundaries (with 600m buffer); Airports: CAA aerodromes and airfields plus additional military airfields (internet search) (with 5km buffer)	**18%**	**Ofgem Renewables Register June 2010**
		Other exclusion areas: all ancient woodland (ancient, semi-natural, PAWS);	Excluded	Ancient woodland and nature conservation designations: Natural England; Heritage sites: English Heritage; MOD low fly zones and Met Office Weather Radar sites: MOD (via RESTATS website). MOD didn't provide any specific regional advice as requested.		

		Sites of historic interest; Civil Air Traffic Control constraints (highest priority MOD low fly zones - none in SE anyway); Met Office weather radar sites (2 innermost buffers)				
		Available Wind Speed	All areas with speed >5m/s at 45m above ground level	NOABL		
		Wind Turbine Size	Uniform turbine size of 2.5MW with dimensions: tip height 135m, rotor diameter 100m, hub height 85m	DECC methodology		
		Wind Turbine Density: Zone A: Areas within national and international landscape designations	0% turbine density	DECC methodology; Natural England Landscape Designations; RSPB/Natural England Bird Sensitivity Maps		
		Wind Turbine Density: Zone B: Areas within 2km buffer of landscape designations	0% turbine density			
		Wind Turbine Density: Zone C:	25% turbine density (1			

		Areas outside 2km buffer but with high bird sensitivity	turbine / km^2)			
		Wind Turbine Density: Zone D: Areas outside 2km buffer but with high bird sensitivity	50% turbine density (2 turbines / km^2)			
		Wind Turbine Density: Zone E: All other areas with no mapped bird or landscape sensitivity	100% turbine density (4 turbines / km^2)			
	Onshore, small scale: less than 100kW	Address Points Categorisation: Residential, Commercial, Industrial, Other	Other' buildings category excluded	OS MasterMap Address Layer 2 (Address Point not available)	**16%**	**SEE-STATS June 2010**
		Mean wind speed factor scaling factor: Urban Areas	56% scaling factor	DEFRA Rural-Definition (ward level); Wind scaling factor: DECC methodology		
		Mean wind speed factor scaling factor: Semi-Urban Areas	67% scaling factor			
		Mean wind speed factor scaling factor: Rural Areas	100% scaling factor			
		Available Wind Speed	All areas with speed >4.5m/s at 10m above ground level	NOABL		
		Wind Turbine Size	Uniform turbine size	DECC methodology		

			of 6kW per address point			
Biomass	**Managed Woodland**	Exclusion of woodfuel potential due to environmental and economic constraints	Excluded	Forestry Commission Research Tool http://www.eforestry.gov.uk/woodfuel/ automatically constrains wood arisings on economic/logistical & environmental grounds.	**86%**	**Ofgem Renewables Register June 2010**
		Exclusion of woodfuel potential due to competing demand (e.g. Paper, construction): FC woodland	10% availability factor applied	Forestry Commission Woodfuel in Britain: Main Report, p.75.	**20%**	**Carbon Trust Biomass Heating a Practical Guide for Potential Users 2009**
		Exclusion of woodfuel potential due to competing demand (e.g. Paper, construction): Private woodland; Arboricultural arisings	10% availability factor applied			

	Energy Crops (medium scenario chosen)	Exclusion areas: Mapped constraints: Common Land, Nature Conservation and Heritage designations, Permanent grassland, PRoW with buffers; Grades 1 and 2 Agricultural Land.	Excluded	Natural England: Common Land, SAC, SPA, Ramsar, SSSI, NNR, Ancient Woodland; English Heritage: Listed Buildings, Scheduled Monuments, World Heritage Sites, Registered Parks and Gardens, Battlefields. Data on PRoW and a 5m buffer was already excluded from the Rural Land Register data provided by Natural England. (The DECC methodology required two differing buffer widths to be considered (3m for miscanthus and 5m for SRC), but it was agreed that the 5m buffer would be sufficient for both Miscanthus and SRC.). DEFRA Agricultural Land. Classification.	**86%**	**Ofgem Renewables Register June 2010**
		Exclusion areas: Unmapped constraints: SPS Cross-compliance buffers alongside field boundaries	12% land area reduction applied			
		Environmental Impacts: Water Stressed Areas	Not excluded	Discussions with SEEPB and Natural England		
		Environmental Impacts: Biodiversity	Applied to High scenario only: All HLS or EA habitat creation option areas excluded Land areas reduced by 7% in	GIS data on HLS habitat creation options; Farmland Bird target areas, EA habitat creation areas.		

			reduced by 3% for all areas outside the above			
		Existing Resource Analysis	Collated data on extent of existing energy crops	Natural England Energy Crop Scheme GIS data 2009. Additional crops identified by TV Energy.		
		Available Land: DECC High Scenario	Assumed all available arable land and pasture will be planted with energy crops. Referring to Energy Crop Opportunity Maps for yield bands and benchmarks. Exclude all constrained areas as defined in exclusion area.	Rural Land Register database (data supplied by Natural England); DEFRA Energy Crop Opportunity Maps; DEFRA Agricultural and Horticultural Survey 2008 GAEC12 and (not available as mapped data); Natural England protected landscapes.	**20%**	**Carbon Trust Biomass Heating a Practical Guide for Potential Users 2009**
		Available Land: DECC Medium Scenario	Assumed that energy crops are planted only on land no longer needed for food production (all abandoned land and pasture).	DEFRA Agricultural and Horticultural Survey 2008 GAEC12 land (not available as mapped data)		

		Available Land: DECC Low Scenario	Assumed new crops will only be planted to the extent of submitted applications to the Energy Crop Scheme (ECS) for 2010.	Natural England ECS (tranche 1 and 2) 2009 data		
		Yield	10odt/ha for SRC 15odt/ha for Miscanthus 10% increase for 2020 Further 10% increase for 2031	DECC Methodology and estimate for 2031		
		Fuel Requirement	Electricity: 6000 odt/year/MW Heat: 17GJ/odt Miscanthus 18GJ/odt SRC (plant availability 80% and plant conversion efficiency 20% for heat)	DECC methodology. Energy values for miscanthus taken instead from Natural England: Planting and Growing miscanthus Best Practice Guidelines July 2007 - thought DECC value incorrect. DECC methodology stated that a plant conversion category of 80% should be applied. This was not considered to be realistic. 20% used instead, as this better reflects the regional experience e.g. SEE-STATS data.		

	Waste Wood	Existing and Potential Feedstock: Amount of construction, demolition and sawmill arisings	Extimated from data at regional level, and allocated to county level using housing allocations and sawmill numbers per county.Assumed increase of 1% year on year.	Construction & demolition: WRAP Wood waste markets in the UK (2009), 2009 data. Sawmills: Forestry Commission Sawmills in South East England 2002-2008 unpublished spreadsheet), 2002-8 data. Forestry Commission Woodfuel Resource main report, Table 12, 2003 data.	**86%**	**Ofgem Renewables Register June 2010**
		Fuel Requirement - electricity (tonne biomass/MW capacity)	6,000 odt per MWe	Inferred from DECC Methodology		
		Fuel Requirement - heat	20% plant capacity factor	deviates from suggested 80% in DECC methodology. Source: Carbon Trust Biomass heating a practical guide for potential users (2009), pg 43	**20%**	**Carbon Trust Biomass Heating a Practical Guide for Potential Users 2009**
		Available Feedstock due to competing uses	50% assumed available	DECC methodology		
	Agricultural Arisings	Existing and Potential Feedstock: amount of wheat and oilseed rape straw available in region	Estimated	Defra Agricultural and Horticultural Survey 2007 & 2008.	**86%**	**Ofgem Renewables Register June 2010**
		Fuel Requirement	6000tonnes per Mwe. Assumes would be for electricity.	Inferred from DECC Methodology		

		Available Feedstock (as competing with bedding demand for cattle)	Bedding demand subtracted from available resource potential	DECC methodology. Defra Agricultural and Horticultural Survey 2007 & 2008. (1.5t/yr/head of cattle)		
	Poultry Litter	Existing and Potential Feedstock: amount of poultry manure supply	Estimated. Assumed all of resource could be made available for energy generation.	Defra Agricultural and Horticultural Survey (2007 & 2008). Defra Guidance for Farmers in Nitrate Vulnerable Zones Leaflet 3 (2009). DECC method and own assumptions. Table chicken only, mid-range manure factors selected & averaged: 2.12 kg/bird/mth (=1.8 kg/mth per place divided by 85% place occupancy)	**59%**	**DECC Energy Trends June 2010**
		Fuel Requirement	11,000 tonnes of poultry litter for 1 MW of electricity per annum	DECC methodology		
		Availability	100%	DECC methodology		
	Co-Firing (Biomass with Coal)	Available Plant: total coal and oil fired plant capacity (MW) in 2015	Estimated	DECC methodology. DECC Digest of UK Energy Statistics (2009), 2008 data. Ofgem, Renewables & CHP Register: RO certificates (Public View) (June 2010), 2005-9 data. TV Energy SEE-STATS (unpublished, June 2010), 2009 data. Applied DUKES listed capacities, plus UKwide load factors of 40.5% ('conventional thermal and other stations') to oil/light oil/gas oil-fired stations and 6.7% to coalfired stations. For regional capacity this averages at 48.3%.	**48%**	**Ofgem Renewables Register June 2010**
		Co-firing Threshold	10% of total combusted fuel = biomass	DECC methodology		
		Policy Framework	Assumed that co-firing	DECC methodology, extended to 2031		

			of biomass will continue until at least 2027			
Waste	**Municipal Solid Waste**	Existing and potential new feedstock (Amount of MSW generated in the region in tonnes)	Annual growth rate of 0.3% over 2010	Collated forecasts of MSW arisings for WPAs or individual local authorities: http://www.defra.gov.uk/evidence/statistics/environment/wastats/bulletin09.htm. http://www.separtnershipboard.org.uk/page/5/view/163/sub/77/waste	**44%**	**DECC Energy Trends June 2010**
		Feedstock Requirement (amount of MSW / MW capacity)	10 kilo tonnes of MSW for 1 MW capacity per annum			
	Commercial and Industrial Waste	Existing and potential new feedstock (Amount of C&I waste generated in the region in tonnes)	Annual growth rate of 0.64% over 2010	Not covered in DECC methodology, so treated same as MSW. Collated forecasts of C&I arisings for WPAs or individual local authorities http://www.separtnershipboard.org.uk/page/5/view/163/sub/77/waste National ADAS study estimated growth rates for the regions.	**44%**	**DECC Energy Trends June 2010**
		Feedstock requirement (Required amount of C&I waste per MW capacity)	10 kilo tonnes of C&I waste for 1 MW capacity per annum.			

Biogas	**Wet Organic Waste**	Existing and Potential Feedstock: amount of cattle and pig manure and commercial/ MSW food waste available.	Estimated	Defra Agricultural and Horticultural Survey (2007 & 2008). Defra Guidance for Farmers in Nitrate Vulnerable Zones Leaflets 3 & 4 (2009). Food: Pathways to Zero Waste Defining landfill diversion Targets for food waste in the South East (2009, unpublished), 2008 data, data courtesy of Beyond Waste. Manure: Total cattle and total pigs; mid-range manure factors selected. Food: C&I plus MSW food waste output estimates (pro-rated by county using one county's data).	**59%**	**DECC Energy Trends June 2010**
		Fuel Requirement	37,000 tonnes of wet organic waste for 1MW capacity per annum	DECC methodology		
		Limits to Extraction: amount that can be collected with H&S considerations	80%	DECC methodology		
		Availability for energy due to competing Uses: Manure and Slurry	100%	DECC methodology		
		Availability for energy due to competing Uses: Food and Drink	50%	DECC methodology		

	Landfill Gas	Available Resource; Lifetime of Resource (amount of bio-gas generated in region)	Estimated	Data needed for DECC Method not available. Used decline curves from UK landfill gas generators' published projections. Various authors Landfill Gas Generators' Response to the Reform of the RO(2007) www.berr.gov.uk/files/file43157.pdf. Ofgem Renewables & CHP Register: RO certificates (Public View) (June 2010), 2005-9 data. TV Energy SEE-STATS (unpublished, June 2010), 2009 data. Applied mean values of 'Oxera Curve' and 'Consolidated Industry Estimate' at points 2020 & 2031 in relation to 2010. Assumed every current landfill site equally affected pro-rata.	**65%**	**Ofgem Renewables Register June 2010**
	Sewage Gas	Available Resource	Sewage output per person: 180l/day. Volatile/organic solids: mean of 250-380mg/litre sewage. Biogas content: mean of 250-350cu.m/tonne organic solids. Methane content: mean of 68-72 % of biogas. Energy content: 11.04 kWh/cu.m methane.	Data needed for DECC Method not available. Estimated amount of sewage gas generated using population figures plus assumptions on sewage outputs, biogas production and energy output. Sewage output per person: Environment Agency private communication (2010). Volatile solids content: APHA/AWWA/WEF standard Methods for the Examination of Water and Wastewater 20th ed. (1998) quoted in Elango et al Production of biogas from municipal solid waste with domestic sewage (2006), Table 3, p.3. Biogas content: IEA Bioenergy Task 37 Potential of Co-digestion (2003), table p.6. Energy outputs: adapted from DECC Methodology for wet organic waste using methane content from: Elango et al (2006), p.3. International & regional figures applied uniformly at LA & county level.	**43%**	**SEE-STATS June 2010**

			Plant availability: 90% of time. Calculated output factor was 1,020,000cu. m biogas required per MWe.			
Hydropower		Disaggregated hydropower opportunities as defined by the EA hydropower study by County and Local Authority.	Win-wins identified: defined in the EA report as sites which have the potential to provide a good hydropower opportunity (ie power potential >10kW) as well as increasing the status of the associated fish	GIS data for win-win barriers from EA study 'Mapping Hydropower Opportunities in England and Wales' (2009). No further reduction due to designated areas: assumed hydro-power unlikely to compromise their purposes.	**59%**	**SEE-STATS June 2010**

		population (e.g.by improving fish passage). All of the 'win-win' sites lie within areas designated as heavily modified under the Water Framework Directive.			
Solar Energy: PV and Solar Thermal	Existing Roof Space (% of properties to include): Domestic	25%	Addresses classified as 'other' were excluded. OS MasterMap Address Layer 2.	**9%**	**SEE-STATS June 2010**
	Existing Roof Space (% of properties to include): Commercial	40%			
	Existing Roof Space (% of properties to include): Industrial	80%			
	Potential New Roof Space: Domestic	50%	South East Plan Housing Provision annual figures for 2006-2026		
	System Capacity: Domestic	2kW (thermal or electric)	DECC methodology and advice from SQW Energy regarding Industrial system capacity	**5%**	**NERA/AEA UK Supply Curve for Renewable Heat**
	System Capacity: Commercial	5kW (electric only)			
	System Capacity: Industrial	10kW			

Heat Pumps	Existing Building Stock: Domestic off-grid	100%	OS MasterMap Address Layer 2; ONS 2001 census statistics KS16 (Household Spaces and Accommodation Type); Off-gas grid data source: Centre for Sustainable energy (Identifying and Quantifying the Prevalence of Hard to Treat Homes, 2006)	**26%**	**NERA/AEA UK Supply Curve for Renewable Heat**
	Existing Building Stock: Domestic detached and semi-	75%			
	Existing Building Stock: Domestic flats	25%			
	Existing Building Stock: Commercial	10%			
	Suitable New Buildings: Domestic	50%	South East Plan Housing Provision annual figures for 2006-2026		
	System Capacity: Domestic	5kW	DECC methodology		
	System Capacity: Commercial	10kW			