Promoting Zero Carbon Development Phase 2

Prepared by: .... Tom Williams, Senior Consultant, AECOM

Prepared by: .... Angela Lai, Senior Consultant, Davis Langdon

Checked by: .... Kirsten Elder, Principal Consultant, AECOM

Checked by: .... Tom Williams, Senior Consultant, AECOM

Approved by: .... Andrew Cripps, Regional Director, AECOM

Approved by: .... John Davies, Associate, Davis Langdon

Promoting Zero Carbon Development Phase

Rev No	Comments	Checked by	Approved by	Date
1c	Draft report for client comment	KE	AC	06/09/2010
2c	Final report- work in progress	KE	AC	25/10/2010
3b	Final report (without appendices)	KE	AC	27/10/2010
4c	Final report (with appendices)	KE	AC	04/11/2010

AECOM House, 63-77 Victoria Street, St Albans, Hertfordshire, AL1 3ER
Telephone: 01727 535000 Website: http://www.aecom.com

Job No: 60157680 Reference: Promoting Zero Carbon Development Phase 2 Date Created: November 2010

p:\uksta1-be-services\projects\sdg - promoting zero carbon development phase 2 islington bc\04 working files\05 report\final report\100615-promoting zero carbon development phase 2-v4c final issued.doc

Table of Contents

Executive Summary

Introduction

The London Borough of Islington (LBI) has commissioned AECOM and Davis Langdon to carry out work to investigate the feasibility of developing policies for a carbon reduction target for minor schemes, to support implementation of the carbon offset policy within the Core Strategy, and to review the evidence base for the Borough-wide Code for Sustainable Homes and BREEAM targets.

The Council's zero carbon policy (within the Core Strategy Sustainable Design policy) was informed and supported by an evidence base study carried out by Fulcrum Consulting, which examined the feasibility of a range of carbon reduction targets as well as a requirement for developments to offset remaining emissions. This work generally focussed on major schemes, rather than minor developments.

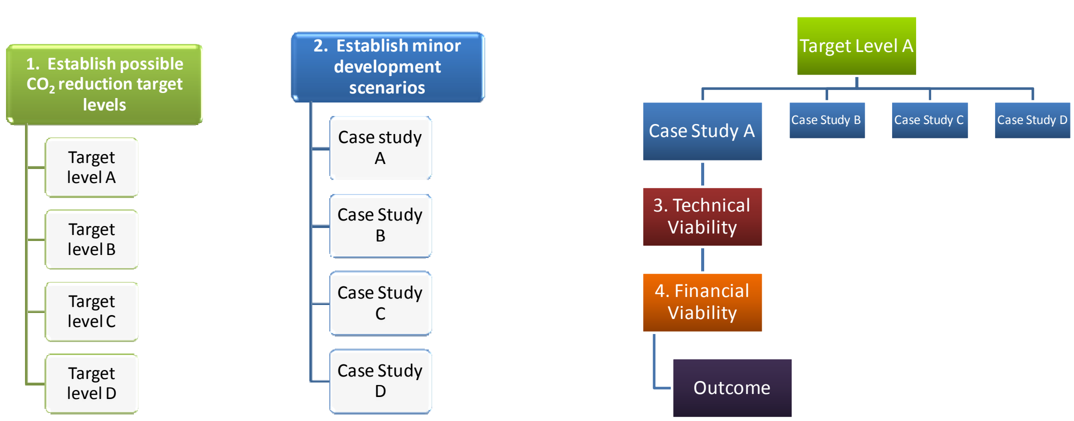
The key issues identified which have been investigated as part of this Phase 2 study are:

- the need for further testing to establish a carbon reduction target for minor developments, as the targets proposed for major schemes were deemed to be unviable for minors, both in terms of cost and potentially the practicalities involved in implementation
- the need for further work to identify an appropriate cost per tonne of carbon, building on the initial research which suggested a range of £250-£1000/tonne
- the need for an evidence base to be established to support the proposed borough-wide Code for Sustainable Homes and BREEAM target within Development Management Policies, drawing on the analysis which has already been carried out

Setting an onsite reduction target for minors

The Government has set out an ambitious trajectory for the achievement of net zero carbon new buildings through Part L of the building regulations. The recently introduced Part L 2010 requires a 25% reduction in carbon dioxide emissions from both domestic and non-domestic buildings, relative to carbon emissions allowed under the previous Part L 2006. There will be a further revision to Part L in 2013, which will introduce a further 25% reduction relative to Part L 2010 for both domestic and non-domestic buildings. Achievement of zero carbon new build is anticipated from 2016 for dwellings and from 2019 in non-domestic buildings. Therefore, in many cases in the next few years, planning requirements relating to carbon reduction from new developments will be superceded by the increasing requirements imposed by the Building Regulations.

Our approach for establishing and testing viability of CO_2 reduction target levels has been based on a four-step process. In summary, the following methodology has been applied



Step 1: Establishing the carbon reduction targets to be tested

Given the extra burdens on both developers and the Local Planning Authority that would be involved in implementing a target relating to total emissions, the form of target adopted for analysis in this study is based on regulated emissions only.

The range of regulated emission reduction targets investigated for minor domestic developments is set out in the table below. The upper bound of 47% over Part L 2010 is broadly in line with the maximum investigated in the Phase 1 study for major developments (under the assumption that a reduction target based on total emissions would reduce regulated and unregulated emissions by the same proportion). For a domestic regulated only emissions target, it is also possible to specify an equivalent number of credits under the new version of the Code for Sustainable Homes, and these set the intermediate targets.

Regulated emission reduction targets for minor developments investigated

Percentage reduction in regulated emissions over Part L 2010 compliant building	**Anticipated number of Code for Sustainable Homes 2010 Ene 1 credits**
0%	0
8%	1
16%	2
25%	3
47%	4

Step 2: Establishing the case studies to be tested

To test the range of emission reduction targets selected, a number of case studies were selected based on actual planning application for minor developments in the London Borough of Islington. The case studies aimed to be representative of the Islington context by covering an appropriate range of use types and scales. They comprise 5 new build schemes and one residential conversion and are summarised in the following table:

Case study description	**Planning application number**	**Uses**
1 detached house (new build)	P100300	1 residential unit
7 flats (new build)	P092717	7 residential units
Small B1 (new build)	P100806	B1 543 m^2 A3 522 m^2
B1 plus 8 flats (new build)	P100915	8 residential units B1 96 m^2
A1/A2/A3 plus 8 flats (new build)	P100915	8 residential units A1/A2 38 m^2 A3 58 m^2
Conversion of house to 4 flats (change of use)	P091383	4 residential units

Step 3: Technical viability modelling

For the domestic elements of the case studies, three fabric specifications were tested, and are Specifications A, B and C developed by the Zero Carbon Hub. These represent increasingly high levels of best practice energy efficiency, with Specification A comprising U-values corresponding to a Part L 2006 compliant building and an air-tightness of 5 m^3/m^2/hour, and Specification C comprising advanced practice U-values and an air tightness of 1 m^3/m^2/hour.

For the non-domestic cases, two energy efficiency packages were tested, a Base Case and an Improved Case. The Base Case comprised a fabric and plant efficiencies which enabled the building to just comply with Part L 2010 without the need for LZC technologies. The Improved Case comprised fabric improvements and improved plant efficiencies for boilers and electric chillers.

A number of possible technology packages potentially suitable for minor development in Islington were identified and are as follows:

- gas boilers plus PV
- gas boilers plus solar thermal plus PV
- Ground Source Heat Pump (GSHP) plus PV
- Air Source Heat Pump (ASHP) plus PV
- District heating (DH) plus PV

When applying the measures in order to reach a given carbon reduction target, the choice of energy efficiency option was applied first. For the technology options, the choice of main heating system was then applied (gas boiler, GSHP, ASHP or DH), followed by solar thermal water heating in the case of the gas boiler plus solar thermal option. If there was still a shortfall in reaching a target, then for all options the minimum amount of PV required to meet the target was applied.

Step 4: Cost viability modelling

The aim of testing cost viability was to determine what level of CO_2 reduction target would be possible to implement without having a significant negative impact on viability from the developer's perspective in the form of reduced profit levels. What a developer considers viable depends on his/her desired return or reward on risk. A method related to the residual land valuation, the residual profit valuation, was used. This has developer's profit as the residual figure. It was assessed and agreed with Islington that developer profit would be favourable for a developer if within the range of 17% to 20% of building costs. However, development strategies vary and it may be the case that a developer would base their profit margins on a percentage of gross development value, hence, this was also shown in the model.

The residual profit valuation is a valuation method that requires a number of assumptions to be made (these assumptions are detailed in Appendix 3).

A developer's strategy in terms of whether to let or sell had to be assumed. A sensible set of assumptions was made on each of the schemes, however, it must be noted that a developer's strategy would vary greatly depending on whether they are speculative developers or long term investors/owner/occupiers. However, in order that the study reflects a mix of strategies, the following strategies were assumed:

- 2 storey office – let
- Detached house – sell
- 7 flats – sell
- B1 plus 8 flats – let office, let flats
- A1/A2/A3 plus 8 flats – let retail office, let flats
- House conversion into 4 flats –sell

For costing, a baseline scheme was established for each of the case studies, which were as follows:

- 2 storey office
- detached house
- 7 flats
- B1 plus 8 flats
- A1/A2/A3 plus 8 flats
- house conversion into 4 flats

With the exception of the detached house and 7 flats, full detailed cost plans were produced for all archetypes - these were based on design and specification information from existing/past projects supplied by AECOM. However, where little design information was available, assumptions were made on specifications and scope. With regard to the detached house and 7 flats, costs were estimated based on a rate/m² sourced from the Zero Carbon Hub Fabric Efficiency Standard study, updated to reflect Part L 2010 Regulations. The reason for this was that the Zero Carbon Hub study base scheme was based on Part L 2006 compliance (the study was undertaken in 2008), and therefore, it was necessary that additional costs were included for enhanced fabric and low and zero carbon technology specifications.

Once the baseline scheme cost plan was established, the enhancements in terms of the fabric and low carbon technologies were costed. Hence, costs were produced for a standard scheme that reflected compliance with Part L 2010 and a scheme that met the carbon targets assessed in the technical modelling.

Other costs used in the study were the potential cost of offsetting an annual tonne of carbon dioxide emissions from new developments (identified in the work relating to the carbon offset fund), and the extra over costs that would be associated with achieving the non-energy credits for Ecohomes Excellent or Code Level 4 (in the case of the residential components of the case studies) and BREEAM Excellent (in the case of the non-domestic components of the case studies).

The costing output was used to feed into the residual profit valuation (as part of overall development costs). For a detailed list of information used, and the assumptions and exclusions from the cost plans, please refer to Appendix 3.

Viability modelling is subject to many uncertainties, therefore the margin for deviation between costs reported in this report and the costs that may be realised in practice is significant. It is important to stress that this is an exploratory exercise using reasonable judgement and the focus should be on the general level of profit increase/decrease rather than on the absolute figures presented. In addition, there are number of other variables not considered in this study that may add further uncertainties to the results, such as the effect of financial incentives such as the Feed-in Tariff and the Renewable Heat Incentive, and the effect of technology price volatility.

Results

A summary of the technical viability results is as follows:

- for new build minor residential schemes, it is generally technically possible to achieve a 25% reduction over Part L 2010, with energy efficiency Specifications B and C allowing this to be achieved with all LZC technology options examined
- 47% reductions over Part L 2010 are also achievable for small scale residential developments, although this is dependent on energy efficiency Specifications B and C, and either heat pumps or district heating
- for new build non-domestic schemes the challenges are greater, with a 16% reduction over Part L 2010 possible for the stand-alone office development and only 8% for the small office and retail units forming part mixed use developments
- in all cases, DH is an enabler for the highest carbon savings to be achieved. Non-domestic buildings do not achieve the highest targets even with DH due to their relatively small heat loads

A summary of the cost viability results is as follows:

- for purely residential new build schemes, an onsite reduction target of 25% over Part L 2010 and an offset policy for residual emissions at a carbon price of £920 per annual tonne of CO_2 emitted is viable, becoming marginally viable in some cases where DH and ASHPs are not available
- for purely residential new build schemes, an onsite reduction target of 25% over Part L 2010, an offset policy and Code for Sustainable Homes Level 4 is viable, becoming marginally viable in some cases where DH and ASHPs are not available
- compared to residential only schemes, the viability of the mixed use schemes containing a small element of non-domestic space is significantly reduced
- for purely non-domestic schemes, an onsite reduction target 16% over Part L 2010 is viable, but any further policy appears not to be
- in the case of the residential conversion of a house into 4 flats, the maximum additional cost for energy efficiency and LZCs supportable before viability becomes marginal is £33,000, and before viability becomes unviable is £53,000

In light of these results, the mixed use schemes were re-examined assuming no policy requirements for the small non-domestic elements, but with no changes to the policy requirements for the domestic element. This showed significantly improved viability for both the mixed-use schemes assessed.

Conclusions

As a result of the analysis above, the following set of policies could be considered by Islington as representing the most ambitious policies which would not have a significant adverse impact on the viability of minor developments in Islington:

- for minor new build domestic developments: an onsite reduction target of 25% relative to Part L 2010, an offset policy and Code for Sustainable Homes Level 4. For some schemes, the availability of ASHP or DH may prove important in achieving all these requirements together viably.
- for minor new build non-domestic developments: an onsite reduction target of 16% relative to Part L 2010
- for the residential component of residential led mixed use developments: an onsite reduction target of 25% relative to Part L 2010, an offset policy and Code for Sustainable Homes Level 4. The analysis in this report indicates that this combination of policies may be close to the limits of viability even when DH and ASHPs are available technology options. It is therefore recommended that, particularly for residential elements of mixed use schemes, LBI adopt a case by case approach during the planning approval process.
- in the case of a conversion of a house into 4 flats, the analysis in this report indicates that a total additional cost of approximately £30,000-£50,000 (or c. £10,000 per flat) for energy efficiency and LZCs could be borne before cost viability was seriously adversely affected.

In judging the policy to be adopted the following factors should be borne in mind:

- the theoretical nature of the residual profit appraisal process used in this study
- the limited scope of this study in terms of the number of case studies assessed
- the many uncertainties associated with developer appetite for risk
- the many uncertainties associated with technology costs and the use of FITs and RHIs (excluded from the scope of this study)
- greater uncertainty in the results for non-domestic developments given the much greater variability in non-domestic buildings compared with dwellings

The potential for a carbon offset fund

In aiming for net zero carbon development in Islington, LBI is proposing to use an offsetting mechanism for dealing with CO_2 reduction which cannot be obtained onsite. The use of offsetting in this way is expected to form part of 'Allowable Solutions', a planned element of the national zero carbon policy and Building Regulations Part L.

This report has assessed the number of potential retrofit opportunities within Islington in both the domestic and non-domestic stock, examined the effect of policy interventions such as CERT and the CRC on the availability of retrofit measures in the existing stock to both 2013 and 2020, and estimated the total requirement for carbon offset from new development in Islington over the same time periods.

As a result of this analysis, the following conclusions can be drawn:

- even allowing for the fact that there will be significant retrofit within the existing stock within Islington as the result of national policies such as CERT, there are sufficient offset opportunities available within Islington to support a developer offset fund for all new development to 2020 and beyond. This assumes a 40% reduction in total emissions from onsite measures relative to a Part L 2006 compliant baseline (or 20% relative to a Part L 2010 compliant baseline) from 2010, and the successful realisation of the Government's target for zero carbon new homes from 2016 (requiring at least a 70% reduction in total carbon emissions from onsite measures relative to a Part L 2006 baseline)

- assuming that nearly all retrofit activity as the result of a developer offset fund would occur in the residential sector in the period to 2020, and given the anticipated effect of national policies in addressing many of the remaining opportunities for cost effective retrofit measures, by 2013 the carbon offset price set would need to be sufficiently high to enable carbon offset through retrofit of solid wall insulation

- taking the cost per annual tonne of carbon dioxide saved of c.£800 for the most cost effective form of solid wall insulation (external solid wall insulation installed as part of a solid wall retrofit), and adding a s.106 management fee of 5% and a project management fee of 10% (following the example of Reigate and Banstead) results in a carbon offset price of £920 per annual tonne emitted
- funds raised as a result of a developer offset fund with a carbon price of £920 per annual tonne emitted do not have to be spent solid wall retrofits, and in the earlier stages of the operation of the offset fund are likely to be spent on more cost effective measures, which could include some measures in the non-domestic sector. Equally, as the price has been set by solid wall insulation as part of a wider wall refurbishment, it is insufficient to offset residual emissions from new development through more expensive forms of solid wall insulation, such as internal solid wall insulation. However, by the time solid wall insulation becomes the most cost-effective option for offsetting, prices for these more expensive forms of solid wall insulation may have fallen
- the emissions reductions available from cost-effective retrofits in the non-domestic sector are uncertain but potentially very significant. It is recommended that LBI investigate these further for the non-domestic stock in Islington

- given the large potential for cost effective emission reductions from retrofit of solid wall insulation within the existing stock and the use of the s.106 process to implement retrofit measures in other schemes, the s.106 process is likely to be the best implementation mechanism within Islington. However, it should be worded sufficiently flexibly to accommodate the as yet uncertain allowable solutions. Non-monetary requirements could be considered but may form only part of the approach

- Dover's Core Strategy shows how this could be done in a way already considered 'sound' by an Inspector

- detail should be set out in a supplementary planning document which can be updated as necessary

- if it were desired to fund the roll-out of community wide energy infrastructure though an offset fund then CIL would be a more suitable mechanism through which to operate the fund, given the constraints on the use of s.106 payments

The proposed Borough-wide Code for Sustainable Homes and BREEAM targets

An assessment of the evidence base potentially supporting the viability of the proposed Borough-wide Code for Sustainable Homes Level 4 and BREEAM Excellent targets has resulted in the following conclusions:

- for minor residential developments, a Code for Sustainable Homes Level 4 target (in addition to a 25% onsite reduction target and a requirement to offset remaining emissions) is estimated to be viable, including in cases where DH and ASHP are unavailable as technology options. For residential-led mixed use schemes, scheme viability becomes more marginal when this additional requirement is imposed on the residential component. Achieving this marginal viability was dependent on the absence of any planning policy requirements on the non-domestic component, and, for the case studies assessed, was also dependent on the use of DH or ASHPs
- for minor non-domestic developments, a BREEAM Excellent target is unlikely to be viable
- for major residential developments, the evidence base suggests that a Code for Sustainable Homes Level 4 target is likely to be viable
- for major non-domestic developments, the evidence base is more limited in the support it lends to the proposed Borough-wide BREEAM Excellent target

1 Introduction

1.1 Introduction and background to the Phase 2 Study

1.1.1 Background

The London Borough of Islington (LBI) has commissioned AECOM and Davis Langdon to carry out work to investigate the feasibility of developing policies for a carbon reduction target for minor schemes, to support implementation of the carbon offset policy within the Core Strategy, and to review the evidence base for the Borough-wide Code for Sustainable Homes and BREEAM targets.

This is in line with the requirement under the supplement to Planning Policy Statement 1 (PPS1) that "any policy relating to local requirements for...sustainable buildings should....in the case of housing development and when setting development area or site specific expectations, demonstrate that the proposed approach is consistent with securing the expected supply and pace of housing development shown in the housing trajectory required by PPS3, and does not inhibit the provision of affordable housing".

The work will support the development of guidance within the Sustainable Design Supplementary Planning Document (SPD) to enable implementation of the Council's zero carbon policy and will provide the evidence base for the emerging sustainable design policies within the Development Management Policies.

The Council's zero carbon policy (within the Core Strategy Sustainable Design policy) was informed and supported by an evidence base study carried out by Fulcrum Consulting, which examined the feasibility of a range of carbon reduction targets as well as a requirement for developments to offset remaining emissions. This work generally focussed on major schemes, rather than minor developments.

The Sustainable Design policy sets out requirements for major developments to:

- achieve a reduction in total CO_2 emissions of 40% (compared to total emissions from a building which complies with Building Regulations 2006);
- achieve a reduction in total CO_2 emissions of 50% where connection to a decentralised energy network is possible.
- offset their remaining CO_2 emissions locally, for example through energy efficiency improvements to the existing housing stock.

The policy also promotes decentralised energy networks more widely, based on work undertaken by the council to identify the locations across the borough where decentralised energy is most likely to be feasible.

The zero carbon policy was finalised and underwent public consultation between September and November 2009 within the Core Strategy Publication Draft. It is expected that the Core Strategy will be submitted to the Secretary of State shortly. At the same time as developing the Core Strategy, the Council has also been working on the Development Management Policies which also form part of the LDF. Options proposed within the document included a carbon reduction target for minor schemes, and a Borough-wide BREEAM and Code target.

1.2 Scope of the study

The evidence base developed in previous work for the Council focussed on major developments. However, the Council has since recognised the need for further work to provide robust and defensible evidence to support the implementation of the zero carbon policy, as well as Development Management Policies, for minor[1] schemes.

[1] A 'minor' development is defined as <10 dwellings (or a site area <0.5ha) for residential developments, and <1000m^2 (or site area <1ha) for non-residential by the Local Government (Best Value) Performance Indicators and Performance Standards (England) Order 2005 representing Minor Developments

The key issues identified which have been investigated as part of this Phase 2 study are:

- the need for further testing to establish a carbon reduction target for minor developments, as the targets proposed for major schemes were deemed to be unviable for minors, both in terms of cost and potentially the practicalities involved in implementation
- the need for further work to identify an appropriate cost per tonne of carbon, building on the initial research which suggested a range of £250-£1000/tonne
- the need for an evidence base to be established to support the proposed borough-wide Code for Sustainable Homes and BREEAM target within Development Management Policies, drawing on the analysis which has already been carried out

2 Establishing a CO_2 reduction target for minor schemes

2.1 Introduction

The Government has set out an ambitious trajectory for the achievement of net zero carbon new buildings through Part L of the building regulations. The recently introduced Part L 2010 requires a 25% reduction in carbon dioxide emissions from both domestic and non-domestic buildings, relative to carbon emissions allowed under the previous Part L 2006. There will be a further revision to Part L in 2013, which will introduce a further 25% reduction relative to Part L 2010 for both domestic and non-domestic buildings, with achievement of zero carbon new build in dwellings from 2016 and in non-domestic buildings from 2019. In many cases, therefore, carbon reduction requirements imposed by Local Authorities for new developments will be superceded by the requirements imposed by Building Regulations over the next few years.

It is evident that there are opportunities for onsite carbon reduction available to major projects that may not be afforded by minor projects. In particular these relate to centralised CHP plants where the scheme's heat demand will not make this strategy viable, but could also apply to ground source energy systems where insufficient space is available, or even PV where over-shadowing is a problem.

Even where these technologies may be possible, for smaller scale projects the cost effectiveness of options will usually decrease as the scale of the project reduces. A good example is with inter-seasonal heat storage in aquifers, where the cost is dependent on tests and drilling costs and almost independent of size.

For these reasons it may not be appropriate to set the same policy standards or targets for all scales of projects. This is also supported by the Fulcrum study which concluded that the 40% CO_2 target proposed in the Core Strategy was unlikely to be viable on minor schemes.

Therefore the aim of this section of the study is to establish a CO_2 reduction target for minor schemes, which is easily implementable, technically feasible and financially viable. The target would be included within the Development Management Policies.

2.2 Methodology

Our approach for establishing and testing viability of CO_2 reduction target levels has been based on a four-step process. In summary, the methodology shown in Figure 1 has been applied (further detail for each step is provided below):

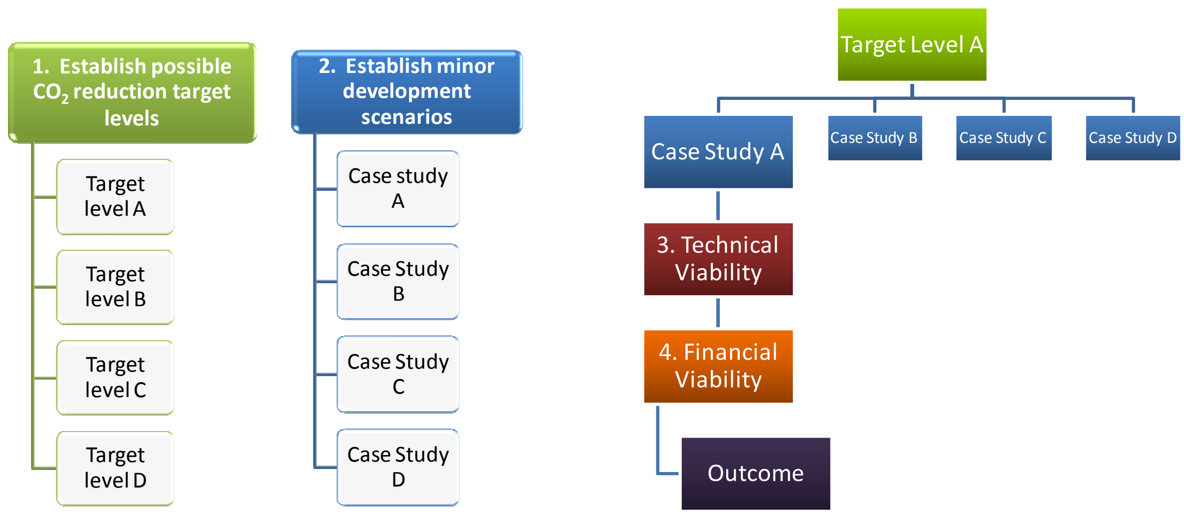


Figure 1 Summary of methodology for establishing and testing viability of CO_2 reduction target levels

Step 1: Establishing target levels

In respect of setting a carbon reduction target for minors, LBI have indicated that any targets selected would need to be easily implemented by planning officers in the minors teams, ideally in a less resource intensive way than the system for major schemes, and that targets would need to be established both for residential and non-residential minor schemes.

A range of possible low carbon reduction targets for small scale developments in Islington was therefore considered based on the following steps:

- an analysis of the type of low carbon target that would be desirable
- a discussion of targets based on total emissions
- a discussion of targets based on regulated emissions
- an assessment of the possible enforcement options against a range of criteria
- selection of a range of carbon reduction targets for analysis

Throughout this report, smaller developments are defined as 9 or fewer dwellings, and/or a non-domestic floor space of less than $1000m^2$. “Baseline emissions” mean emissions from a Part L compliant development.

A desirable low carbon target for small scale developments in Islington

Emissions of carbon dioxide are the leading cause of global warming. In order to limit the environmental impact from carbon dioxide emissions, it is logical that a carbon reduction target should relate to carbon dioxide emissions (and not to a less direct proxy such as energy use) and that the emissions covered by the target should be as comprehensive as possible (i.e. cover all the emissions from a development, not a fraction such as regulated emissions only). This would imply a carbon target relating to total carbon dioxide emissions. The recommendations of the previous PPS1a evidence base for the Core Strategy (focusing on larger developments) were in agreement with this approach, although did not consider enforcement options in detail[2].

The baseline for a development’s carbon emissions recommended in the PPS1a evidence base was a Part L 2006 compliant building. In the current Phase 2 study it is desired that targets developed relate to both a Part L 2006 compliant baseline and a Part L 2010 compliant baseline.

[2] Core Strategy PPS1a Evidence Base. Fulcrum Consulting, September 2009, p.39-40

However, although desirable in principle, a carbon reduction target covering both regulated and unregulated emissions would introduce extra complexities in enforcement which may prove too onerous for small developments, and it may therefore be preferred to base a carbon reduction target for this kind of development on regulated emissions only.

Options for an approach to an emissions reduction target for small developments in Islington therefore include:

- basing a target on regulated emissions only, disregarding unregulated emissions
- basing a target on regulated and unregulated emissions for the main types of development in Islington, but only on regulated emissions for less common types
- basing a target on regulated and unregulated emissions for all small scale developments

The pros and cons of each of these approaches is summarised in Table 1:

Table 1 Advantages and disadvantages of different types of carbon reduction targets for minor developments

Type of target	Advantages	Disadvantages
Regulated emissions only	• simple to administer • smallest impact on viability	• smallest impact on carbon reduction • no information collected on unregulated emissions
Total emissions target for some developments, regulated only for others	• captures most unregulated emissions for some additional complexity in administration	• arguably unfair
Total emissions	• achieves the largest carbon reductions	• complex to administer • complex compliance for developers

Targets based on total emissions

A general difficulty with defining a target which covers total emissions is the fact this comprises both regulated emissions (covered by Part L) and unregulated emissions (which comprise electrical appliances and cooking for domestic buildings and electrical appliances for non-domestic buildings). Baseline domestic unregulated emissions can be calculated relatively easily using formulae dependent on floor area. Baseline non-domestic unregulated energy use is currently calculated as part of the SBEM methodology, however this excludes loads considered to be industrial process loads (which currently include fridges and freezers used in supermarkets and energy used for hotel swimming pools).

However for both domestic and non-domestic buildings an assessment of the effect of energy efficiency and zero and low carbon technologies on reducing unregulated emissions is an analysis that would need to take place outside of the Part L process. Possible enforcement options for monitoring reductions in unregulated emissions include:

- an energy statement, setting out the energy strategy for ensuring that total carbon dioxide emissions from the development will not exceed a given target.

- a software tool provided by the Council which calculates the estimated carbon dioxide emissions from a development when certain information is entered.

Unfortunately, there is unavoidable complexity involved in introducing either of these compliance tools. This is because there is no simple relationship between regulated and unregulated emissions. Energy efficiency and low and zero carbon technologies reduce the two types of emission by different amounts. In addition, the split between baseline regulated and unregulated emissions also varies by building type for both domestic and non-domestic buildings. An indication of the relative proportions for both domestic and non-domestic buildings is provided in Table 2 and Table 3:

Table 2 Unregulated emissions from domestic buildings

Building type	NIA/m^2	Unregulated emissions as a percentage of Part L 2006 compliant total	Unregulated emissions as a percentage of Part L 2010 compliant total
Flat (gas heating)	61	40%	52%
Flat (electric heating)	61	32%	39%
Mid terrace (gas heating)	73	40%	52%
Semi-detached (gas heating)	88	37%	49%
Detached (gas heating)	118	34%	47%

Source: AECOM

Table 3 Unregulated emissions from non-domestic buildings

Building type	Unregulated emissions as a percentage of Part L 2006 compliant total
City Centre HQ	37
5* hotel	24
Shopping Centre	7
Mini-supermarket	7
Speculative office	37
Distribution warehouse	15
Retail warehouse	5
Large supermarket	7
3* hotel	24
2* hotel	24
Small office	67

Source: Impact Assessment for Zero Carbon for New Non-domestic Buildings (Department for Communities and Local Government, November 2009)

There is some variation in the fraction of domestic emissions which are unregulated dependent on built form, and the relative proportion increases under Part L 2010. For non-domestic, under the current SBEM methodology, the fraction of baseline total emissions due to unregulated emissions varies widely between the mini-supermarket and the small office (taking the two non-domestic buildings that may be the most likely to appear as small developments in Islington). Under the current consultation on options for zero carbon non-domestic buildings it is also possible that the Government will decide that unregulated emissions should be treated as a fixed proportion of regulated emissions (20% is currently proposed).

Carbon reduction targets based on regulated emissions only

To avoid the additional compliance complexities introduced by an emissions reduction target based on total emissions, it may be desirable to instead base a target on regulated emissions only for small developments.

For a target based on regulated emissions, a lower limit is set by Part L of the Building Regulations, although the change from Part L 2006 to Part L 2010 significantly increases the level of effort required from developers. The extent to which a possible target can be easily related to both Part L 2006 and Part L 2010 also differs significantly between domestic and non-domestic buildings.

In the case of dwellings, the Government has chosen to adopt a flat 25% reduction in the carbon dioxide emissions permitted from a Part L compliant building. This broadly means that the same percentage reduction of 25% over Part L 2006 is required for Part L 2010 compliance for every dwelling type, although other changes to the underlying SAP methodology (primarily the increased carbon dioxide emission factor for electricity) mean that this is not exactly the case. Table 4 shows the conversion factors between the minimum standards under Part L 2006 and Part L 2010.

Table 4 The percentage reduction in Target Emission Rates under Part L 2010 for a range of domestic buildings

Building type	NIA/m^2	Part L 2006 TER (kg CO_2/m^2/year)	Part L 2010 TER (kg CO_2/m^2/year)	Percentage reduction in TER under Part L 2010
Flat (gas heating)	61	23.36	19.09	18%
Flat (electric heating)	61	33.13	31.86	4%
Mid terrace (gas heating)	73	22.43	18.3	18%
Semi-detached (gas heating)	88	23.4	19	19%
Detached (gas heating)	118	22.11	17.76	20%

Source: AECOM

However, overall the reduction may be consistent enough to allow a broadly accurate simple conversion between Part L 2006 and Part L 2010 (at least for dwellings of the same fuel type). This assists greatly with defining policy targets against both baselines.

In contrast, for non-domestic buildings, the Government has chosen to adopt an aggregate 25% reduction. This means that although all new build non-domestic buildings as a whole will achieve a 25% reduction in carbon emissions relative to Part L 2006 (subject to certain assumptions about build rates for different types of buildings), the carbon reductions allocated to different types of non-domestic buildings differ according to the costs of abatement for each type of building. Table 5 summarises the carbon reductions introduced by Part L 2010 by non-domestic building type:

Table 5 The percentage reduction in Target Emission Rates under Part L 2010 for a range of non-domestic buildings

Building type	Percentage reduction in TER under Part L 2010
Shallow plan (heated)	22%
Shallow plan (air con)	40%
Deep plan (air con)	26%
Warehouse	34%
Hotel	16%
School	27%
Retail	21%
Supermarket	26%

Source: Implementation Stage Impact Assessment of the Revision to Parts L and F of the Building Regulations from 2010

The relationship between reductions relative to Part L 2006 and Part L 2010 is therefore only possible to define at the level of individual building types, and not for non-domestic buildings generically. Therefore, if policy targets are to be defined against both Part L 2006 and Part L 2010 this would involve a high degree of resolution to distinguish individual non-domestic building types.

Possible compliance and enforcement options

Table 6 summarises the advantages and disadvantages of possible compliance and enforcement options for a car carbon reduction target for minor developments.

Table 6 The advantages and disadvantages of possible compliance and enforcement routes for small development carbon reduction targets

Compliance process	Advantages	Disadvantages
SAP/SBEM certificates	• no extra burden on developers- have to be submitted for Building Control purposes anyway • should be easy for Local Authority to administer	• relate to regulated emissions only
Council provided software tool to support a carbon reduction target	• captures unregulated emissions as part of a total emissions target	• local Authority would need to invest some time in developing a form • some extra burdens in terms of local Authority administration • some extra burden for developers
Energy Performance Certificates	• no extra burden on developers- have to be submitted for Building Control purposes anyway • should be easy for Local Authority to administer	• for non-domestic buildings, EPC ratings bear little relationship to regulated or unregulated emissions.
BREEAM	• should be easy for Local Authority to administer	• BREEAM Ene 1 credits based on EPC ratings. EPC ratings bear no relationship to regulated or unregulated emissions • carrying out assessment a significant extra burden for developers of small scale developments
Code for Sustainable Homes	• should be easy for Local Authority to administer	• Ene 1 credits relate to regulated emissions only • Carrying out assessment a significant extra burden for developers of small scale developments
Energy statement	• flexible in terms of the forms of carbon reduction target that can be enforced • would relate to total emissions • allows developer scope to explain practicalities associated with particular site	• producing an Energy Statement a significant extra burden for developers of small scale developments • some guidance needed from LA if consistency of approach to be achieved

Selection of form of target and percentage reductions to be investigated

The two possible approaches to carbon reduction targets for small scale developments in Islington can be summarised as:

- a target relating to total emissions, with an energy statement or software tool compliance route

- a target relating to regulated emissions only, with a compliance route based on the building control process for Part L

Given the extra burdens on both developers and the Local Planning Authority that would be involved in implementing a target relating to total emissions, the form of target adopted for analysis in this study is based on regulated emissions only.

The range of regulated emission reduction targets investigated for minor domestic developments is set out in Table 7. The upper bound of 47% is broadly in line with the maximum investigated in the Phase 1 study for major developments (under the assumption that a reduction target based on total emissions would reduce regulated and unregulated emissions by the same proportion). For a domestic regulated only emissions target, it is also possible to specify an equivalent number of credits under the new version of the Code for Sustainable Homes, and these set the intermediate targets. The Government is still deciding the exact form of the new version, and the credits below are based on the consultation document. The new version of the Code for Sustainable Homes is expected to be released in October 2010.

Table 7 Regulated emission reduction targets for small scale domestic developments proposed for investigation

Percentage reduction in regulated emissions over Part L 2006 compliant building	Percentage reduction in regulated emissions over Part L 2010 compliant building	Anticipated number of Code for Sustainable Homes 2010 Ene 1 credits
20%	0%	0
26%	8%	1
33%	16%	2
40%	25%	3
58%	47%	4

For non-domestic buildings, the same set of targets relating to percentage reductions over Part L 2010 has been investigated. This has been done for the two main small scale non-domestic building types in Islington, which are assumed to be small office and retail developments. The figures in are based on the amendments to Part L as they relate to small shallow plan non-air conditioned offices, but it will be seen from Table 8 that the same targets could potentially be applied to small retail developments.

Table 8 Emission reduction targets for small scale non-domestic developments proposed for investigation (total and regulated only emission reduction targets using these percentages considered separately)

Percentage reduction in regulated emissions over Part L 2006 compliant building	Percentage reduction in regulated emissions over Part L 2010 compliant building
22%	0%
28%	8%
34%	16%
41%	25%
62%	47%

Step 2: Establishing minor development scenarios

To test the range of emission reduction targets selected, a number of case studies were selected based on actual planning application for minor developments in the London Borough of Islington. The case studies aimed to be representative of the Islington context by covering an appropriate range of use types and scales. They comprise 5 new build schemes and one residential conversion and are summarised in Table 9.

Table 9 Summary of case studies

Case study description	Planning application number	Uses
1 detached house (new build)	P100300	1 residential unit
7 flats (new build)	P092717	7 residential units
Small B1 (new build)	P100806	B1 543 m^2 A3 522 m^2
B1 plus 8 flats (new build)	P100915	8 residential units B1 96 m^2
A1/A2/A3 plus 8 flats (new build)	P100915	8 residential units A1/A2 38 m^2 A3 58 m^2
Conversion of house to 4 flats (change of use)	P091383	4 residential units

Step 3: Testing technical viability

The technical viability testing assessed whether each of the case studies selected in Step 2 could meet each of the carbon reduction targets selected for analysis in Step 1. This was done by testing different combinations of energy efficiency measures and Low or Zero Carbon (LZC) technologies within the physical and technical constraints imposed by the case studies.

Energy efficiency measures and LZC technology options

For the domestic elements of the case studies, three fabric specifications were tested, and are Specifications A, B and C developed by the Zero Carbon Hub. These represent increasingly high levels of best practice energy efficiency, with Specification A comprising U-values corresponding to a Part L 2006 compliant building and an air-tightness of 5 m^3/m^2/hour, and Specification C comprising advanced practice U-values and an air tightness of 1 m^3/m^2/hour. Full details of the Zero Carbon Hub fabric efficiency standards are provided in Appendix 1.

For the non-domestic cases, two energy efficiency packages were tested, a Base Case and an Improved Case. The Base Case comprised a fabric and plant efficiencies which enabled the building to just comply with Part L 2010 without the need for LZC technologies. The Improved Case comprised fabric improvements and improved plant efficiencies for boilers and electric chillers. Full details of the non-domestic Base and Improved fabric efficiency are provided in Appendix 1.

A number of possible technology packages potentially suitable for minor development in Islington were identified and are as follows:

- gas boilers plus PV
- gas boilers plus solar thermal plus PV
- Ground Source Heat Pump (GSHP) plus PV
- Air Source Heat Pump (ASHP) plus PV
- District heating (DH) plus PV

When applying the measures in order to reach a given carbon reduction target, the choice of energy efficiency option was applied first. For the technology options, the choice of main heating system was then applied (gas boiler, GSHP, ASHP or DH), followed by solar thermal water heating in the case of the gas boiler plus solar thermal option. If there was still a shortfall in reaching a target, then for all options the minimum amount of PV required to meet the target was applied. Technical assumptions on technologies are set out in Appendix 2.

Biomass technologies were excluded from consideration, as the use of biomass within small developments is unlikely to be consistent with LBI's objectives on air quality, given the difficulty of cost effectively abating emissions of particulates and nitrous oxides from small biomass combustion units. As all the fabric efficiency standards modelled for the domestic cases achieved an airtightness of $5m^3/m^2$/hour or less, Mechanical Ventilation with Heat Recovery (MVHR) could potentially be applied, and this has been assumed in the case of the ASHP. Placing the primary loop of the ASHP within the warm air flow of the MVHR system would assist with achieving improved Coefficient of Performance (CoP). The CoP assumed for an ASHP providing domestic space heating alone (with hot water provided by an electric immersion heater) is however the SAP default of 250%. This is close to the mid-range of actual ASHP CoPs of 2.2 measured in a recent field trial of installed heat pumps in the UK[3] (the range being 1.2 to 3.3).

The 5 new build case studies were assessed for the range of onsite carbon reduction targets identified in Step 1. For each of these case studies, the reductions in emissions resulting from different permutations of energy efficiency measures and LZC technologies were quantified by modelling within Part L 2010 software compliance tools. In the case of the non-domestic buildings, this was the IES software package using anticipated National Calculation Methodology (NCM) templates for office and retail developments, and for domestic buildings this was the trial version of the Part L 2010 software implementing SAP2009. This enables a precise assessment of the technical viability of carbon reduction strategies against a Part L 2010 baseline to be undertaken.

For the residential conversion of a house into 4 flats, the modelling was undertaken within the trial version of the Part L 2010 software for new build domestic buildings, however the baseline against which the carbon reduction targets were assessed was the existing building fabric with no LZCs. Clearly, this is a much worse baseline than for the other case studies, and the carbon emissions that must be saved to achieve a given percentage reduction target are therefore much larger in absolute terms. The results of the viability modelling and supporting cost data are set out in Appendix 12. The conversion is very different in nature to the new build case studies, and there is limited scope for assessing whether a carbon reduction target for conversions is being met as residential conversions do not fall within the Part L requirements relating carbon dioxide emissions. It is therefore considered that the most useful assessment of viability for the conversion comes from determining the maximum additional costs which would still allow viability. This was assessed at two levels, reflecting the uncertainty associated with judging when a development becomes unviable. The sums derived give an indication of the amount that a developer could be required to spend on energy efficiency and low and zero carbon technology measures.

The carbon savings from all technology options were assessed against a gas boiler baseline. In the case of dwellings, Part L 2010 calculates the Target Emission Rate (TER) required for compliance on the basis of a gas boiler heating system, so for the residential cases the modelled baseline is the same as that used for Part L 2010 compliance. However, this is not true for non-domestic buildings using an electric heating technology such as heat pumps, because in these cases the TER is calculated on the basis of an oil fired heating system. The gas baseline modelling carried out in this study will therefore show a more modest improvement over Part L 2010 for non-domestic electric heating options than would actually be achieved under the Part L 2010 compliance process with an oil baseline.

The case studies in the form of real planning applications were used to quantify the site constraints on the deployment of LZC technologies. The most significant of these are the available ground area for ground source heat pumps and the available roof area for solar technologies. However, the Part L compliance process is separate for the domestic and non-domestic elements if both elements are present within a scheme, and must also be carried out at the individual dwelling level in the case of the domestic element. It is therefore necessary in the case of mixed used schemes to apportion the available ground and roof areas between the domestic and non-domestic elements, and this was done on the basis of floor area. Where more than one dwelling was present, the domestic portion was then divided between the number of dwellings present to give an average per dwelling.

As a result of previous work for the Zero Carbon Hub, Davis Langdon had a full set of cost models for the Zero Carbon Hub archetypes (a detached house, semi-detached house, large flat and small flat) which included the costs associated with the energy efficient fabric Specifications A, B and C used in this study. A further step was therefore to relate the dwellings and their associated ground and roof areas in the case studies to the relevant Zero Carbon Hub archetype. This was done by selecting the closest matching archetype to the average dwelling in the case study (the detached house archetype in the case of the detached house and the large flat archetype for all others), and then scaling the available ground or floor area per dwelling within the case study up or down to reflect the larger or smaller floor area of the Zero Carbon Hub archetype. The technical modelling was therefore carried out on the basis of Zero Carbon Hub archetypes, but with available roof and floor areas reflective of the site constraints found on minor developments within Islington.

[3] Getting Warmer: a field trial of heat pumps, p.16. The Energy Saving Trust, September 2010.

Step 4: Testing financial viability

The aim of testing cost viability was to determine what level of CO_2 reduction target would be possible to implement without having a significant negative impact on viability from the developer's perspective in the form of reduced profit levels. What a developer considers viable depends on his/her desired return or reward on risk. A method related to the residual land valuation, the residual profit valuation, was used. This has developer's profit as the residual figure. It was assessed and agreed with Islington that developer profit would be favourable for a developer if within the range of 17% to 20% of building costs. However, development strategies vary and it may be the case that a developer would base their profit margins on a percentage of gross development value, hence, this was also shown in the model.

The residual profit valuation is a valuation method that requires a number of assumptions to be made (these assumptions are detailed in Appendix 3).

A developer's strategy in terms of whether to let or sell had to be assumed. A sensible set of assumptions was made on each of the schemes, however, it must be noted that a developer's strategy would vary greatly depending on whether they are speculative developers or long term investors/owner/occupiers. However, in order that the study reflects a mix of strategies, the following strategies were assumed:

- 2 storey office – let
- Detached house – sell
- 7 flats – sell
- B1 plus 8 flats – let office, let flats
- A1/A2/A3 plus 8 flats – let retail office, let flats
- House conversion into 4 flats –sell

For costing, a baseline scheme was established for each of the case studies, which were as follows:

- 2 storey office
- detached house
- 7 flats
- B1 plus 8 flats
- A1/A2/A3 plus 8 flats
- house conversion into 4 flats

With the exception of the detached house and 7 flats, full detailed cost plans were produced for all archetypes - these were based on design and specification information from existing/past projects supplied by AECOM. However, where little design information was available, assumptions were made on specifications and scope. With regard to the detached house and 7 flats, costs were estimated based on a rate/m² sourced from the Zero Carbon Hub Fabric Efficiency Standard study, updated to reflect Part L 2010 Regulations. The reason for this was that the Zero Carbon Hub study base scheme was based on Part L 2006 compliance (the study was undertaken in 2008), and therefore, it was necessary that additional costs were included for enhanced fabric and low and zero carbon technology specifications.

Once the baseline scheme cost plan was established, the enhancements in terms of the fabric and low carbon technologies were costed. Hence, costs were produced for a standard scheme that reflected compliance with Part L 2010 and a scheme that met the carbon targets assessed in the technical modelling.

Other costs used in the study were the potential cost of offsetting an annual tonne of carbon dioxide emissions from new developments (identified in the work relating to the carbon offset fund), and the extra over costs that would be associated with achieving the non-energy credits for Ecohomes Excellent or Code Level 4 (in the case of the residential components of the case studies) and BREEAM Excellent (in the case of the non-domestic components of the case studies). These costs were provided by AECOM.

The costing output was used to feed into the residual profit valuation (as part of overall development costs). For a detailed list of information used, and the assumptions and exclusions from the cost plans, please refer to Appendix 3.

Viability modelling is subject to many uncertainties, therefore the margin for deviation between costs reported in this report and the costs that may be realised in practice is significant. It is important to stress that this is an exploratory exercise using reasonable judgement and the focus should be on the general level of profit increase/decrease rather than on the absolute figures presented. In addition, there are number of other variables not considered in this study that may add further uncertainties to the results, such as the effect of financial incentives such as the Feed-in Tariff and the Renewable Heat Incentive, and the effect of technology price volatility.

FITs and the RHI

Consideration of the impact of Feed-In Tariff (FITs) and the Renewable Heat Incentive (RHI) is outside the scope of this study. However, we would suggest that this be explored as a further study to consider the impact of these revenue generating schemes on developer's profit viability. Clearly, the prospect of a revenue stream would change the financial picture, however it is not a static model. RHI is a new scheme (due to be implemented in 2011) and currently it appears that it has been not been considered and is not familiar to developers. FITs, introduced in April 2010, are more familiar, although different developers are currently choosing to exploit the FITs in different ways. At one extreme many developers are simply ignoring this opportunity and waiting for regulation to force them to focus on t. At the other extreme we are seeing the emergence of exciting, innovative procurement models that allow developers to benefit from, say, a solar PV installation through collaboration. An Energy Service Company (ESCO) in partnership with a developer will design and install an energy efficient solution, and maintain the system during the payback period. The savings in energy costs are used to pay back the capital investment or reinvested if the ESCO is community owned. This changes the economics dramatically as the developer sees zero capital cost (other than roof strengthening in the case of PV installation), but obtains a benefit from the PV installation.

The use of FITs in this way is however dependent on the development strategy and other drivers for developers. In terms of a speculative developer the main driver is to derive profit from a development, hence, FITs would be of little benefit unless it makes the development more attractive to purchasers and increases market value. A developer who intends to own and occupy premises for his/her own use would be interested in the incoming revenue and energy cost reduction benefits of FITs. Developers constructing affordable housing for Registered Social Landlords (RSLs) are only likely to consider FITs if this is part of the criteria to be met in developing affordable homes.

Cost volatility of LZC technologies

Present day LZC costs can be estimated with a high level of accuracy, but projecting costs forward (especially in the context of a 'depressed' market) introduces uncertainty. Low and zero carbon technologies are a carbon sensitive variation, reflecting changing costs in the context of the growing need for and focus on delivering low carbon solutions. Our view is that these costs will decrease in real terms over time as the industry finds more efficient (i.e. low cost) ways to meet the low carbon challenge. However, this may need to be balanced against a general lack of skilled labour that can adapt quickly to the need to install and maintain these systems, allowing the limited labour with the required skills to charge higher fees. With greater provision of labour in these areas, more of these technologies could be installed, resulting in greater take-up by homebuilders and hence potentially greater economies of scale. This illustrates the need for caution in projection of technology costs.

The PPS1a Evidence Base prepared by Fulcrum Consulting also considered the question of future costs for low and zero carbon technologies[4]. Although predications are clearly uncertain and changes in future costs will vary significantly between different technologies, Fulcrum anticipate a general trend in cost reduction for many LZC technologies, particularly in costs attributable to risk, contingency and first-time adoption. Costs of renewable technologies such as PV and heat pumps are likely to also drop due to the ramping up of the manufacturing base to meet increasing international demand.

2.3 Results from technical viability testing

The tables below summarise for each case study the technical feasibility of meeting the various carbon reduction targets analysed. The technical viability modelling carried out in respect of the residential conversion can be found in Appendix 6.

[4] Core Strategy PPS1a Evidence Base. Fulcrum Consulting, September 2009, p.72

Table 10 Technical viability results for detached house

Energy efficiency level	Technology scenario	Percentage reduction over Part L 2010				
		0%	8%	16%	25%	47%
Spec A	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					
Spec B	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					
Spec C	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					

Table 11 Technical viability results for 7 new flats

Energy efficiency level	Technology scenario	Percentage reduction over Part L 2010				
		0%	8%	16%	25%	47%
Spec A	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					
Spec B	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					
Spec C	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					

Table 12 Technical viability results for small office

Energy efficiency level	Technology scenario	Percentage reduction over Part L 2010				
		0%	8%	16%	25%	47%
Base case	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					
Improved case	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					

Table 13 Technical viability results for mixed use scheme: small office and 8 flats, residential component

Energy efficiency level	Technology scenario	Percentage reduction over Part L 2010				
		0%	8%	16%	25%	47%
Spec A	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					
Spec B	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					
Spec C	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					

Table 14 Technical viability results for mixed use scheme: small office and 8 flats, small office component

Energy efficiency level	Technology scenario	Percentage reduction over Part L 2010				
		0%	8%	16%	25%	47%
Base case	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					
Improved case	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
	DH + PV					

For the mixed use scheme small retail plus 8 flats, the results of the technical viability modelling of the residential component is as for the small office and 8 flats (Table 13).

Table 15 Technical viability results for mixed use scheme: small A1/A2/A3 and 8 flats, retail component:

Energy efficiency level	Technology scenario	Percentage reduction over Part L 2010				
		0%	8%	16%	25%	47%
	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
Base case	DH + PV					
	Gas boiler+PV					
	Gas boiler+solar thermal+PV					
	GSHP + PV					
	ASHP + PV					
Improved case	DH + PV					

Summary of technical viability results

A consideration of the technical viability results leads to the following conclusions:

- for new build minor residential schemes, it is generally technically possible to achieve a 25% reduction over Part L 2010, with energy efficiency Specifications B and C allowing this to be achieved with all LZC technology options examined
- 47% reductions over Part L 2010 are also achievable for small scale residential developments, although this is dependent on energy efficiency Specifications B and C, and either heat pumps or district heating
- for new build non-domestic schemes the challenges are greater, with a 16% reduction over Part L 2010 possible for the stand-alone office development and only 8% for the small office and retail units forming part mixed use developments
- in all cases, DH is an enabler for the highest carbon savings to be achieved. Non-domestic buildings do not achieve the highest targets even with DH due to their relatively small heat loads

2.4 Results from cost viability modelling

Appendices 8-11 (and Appendix 12 in the case of the residential conversion) provide the detailed residual profit appraisals for each of the case studies showing the effect of the different carbon reduction targets on scheme profitability.

Three types of policy scenario have been examined:

- an onsite reduction target for regulated emissions only
- an onsite reduction target plus offset of all remaining regulated and unregulated emissions
- an onsite reduction target, offset of all remaining regulated and unregulated emissions, and Code for Sustainable Homes Level 4 and/or BREEAM Excellent

These residual profit appraisals are based on the lowest cost method of achieving the requirements of the given policy scenarios.

In addition, owing to the necessarily limited potential for connection to DH and LBIs concerns over real-world performance of air source heat pumps, the same three policy scenarios were examined assuming that DH and ASHP were not available as options in a low carbon development. This results in 6 residual profit appraisals for each of the case studies examined.

The calculation of offset costs is based on an offset price of £920 per annual tonne of carbon emitted.

In the case of mixed use schemes, where the residential emission reduction target being achieved is higher than that possible to achieve for the non-domestic element (e.g. 25% or 47%), the percentage reduction achieved by the non-domestic component is assumed to be the maximum achievable, and the technology choice and cost reflect this.

With these assumptions, Table 16 to Table 21 summarise the best case profit on development costs for each scheme under each carbon reduction target. The colour coding reflects different levels of estimated cost viability under each policy scenario as follows:

Green Estimated to be viable (residual profit on development costs 17% or greater)

Yellow Estimated to be marginally viable (residual profit on development costs greater than 15% but less than 17%)

Red Estimated to be unviable (residual profit on development costs less than 15%)

All viability results presented in this report are estimates based on researched assumptions. They should not be taken as definitive of the level of profit that will be achieved for the schemes examined under the different policy scenarios, and may be subject to significant deviation even between similar schemes. Developer attitudes to risk vary and a scheme that may not be viable for one developer could be an opportunity for another. There are also numerous uncertainties associated with many of the factors that affect low carbon scheme viability, including cost volatility of LZC technologies, the extent to which land value can absorb increasing build costs, and the impact of FITs and RHIs as potential revenue streams.

The value of the results in Table 16 to Table 21 is in showing the relative impact of progressively more demanding policy scenarios, enabling a more informed judgement of their impact on scheme viability to be made.

Table 16 Best case profit on development costs by scheme and carbon reduction target (onsite reduction target only, all technology options available)

Case study description	Carbon reduction target (over Part L 2010)				
	0%	8%	16%	25%	47%
1 detached house (new build)	20%	20%	20%	20%	20%
7 flats (new build)	20%	20%	20%	20%	20%
Small B1 (new build)	20%	20%	18%	15%	Not acheivable
B1 plus 8 flats (new build)	19%	19%	18%	18%	18%
A1/A2/A3 plus 8 flats (new build)	19%	18%	18%	17%	17%

Table 17 Best case profit on development costs by scheme and carbon reduction target (onsite reduction target only, DH and ASHP not available)

Case study description	Carbon reduction target (over Part L 2010)				
	0%	8%	16%	25%	47%
1 detached house (new build)	20%	20%	19%	19%	17%
7 flats (new build)	20%	19%	18%	17%	15%
Small B1 (new build)	20%	18%	17%	Not acheivable	Not acheivable
B1 plus 8 flats (new build)	18%	17%	16%	15%	13%
A1/A2/A3 plus 8 flats (new build)	18%	17%	16%	14%	12%

Table 18 Best case profit on development costs by scheme and carbon reduction target (onsite reduction target and offset, all technologies available)

Case study description	Carbon reduction target (over Part L 2010)				
	0%	8%	16%	25%	47%
1 detached house (new build)	20%	20%	20%	20%	19%
7 flats (new build)	19%	19%	20%	19%	19%
Small B1 (new build)	14%	14%	13%	10%	Not acheivable
B1 plus 8 flats (new build)	17%	17%	17%	16%	16%
A1/A2/A3 plus 8 flats (new build)	17%	17%	17%	16%	16%

Table 19 Best case profit on development costs by scheme and carbon reduction target (onsite reduction target and offset, DH and ASHP not available)

Case study description	Carbon reduction target (over Part L 2010)				
	0%	8%	16%	25%	47%
1 detached house (new build)	19%	19%	19%	18%	17%
7 flats (new build)	19%	18%	17%	16%	15%
Small B1 (new build)	14%	13%	11%	Not acheivable	Not acheivable
B1 plus 8 flats (new build)	16%	15%	15%	13%	11%
A1/A2/A3 plus 8 flats (new build)	16%	15%	14%	13%	11%

Table 20 Best case profit on development costs by scheme and carbon reduction target (onsite reduction target, offset, and Code Level 4 and/or BREEAM Excellent)

Case study description	Carbon reduction target (over Part L 2010)				
	0%	8%	16%	25%	47%
1 detached house (new build)	18%	18%	18%	18%	18%
7 flats (new build)	17%	17%	17%	17%	17%
Small B1 (new build)	6%	6%	6%	3%	Not acheivable
B1 plus 8 flats (new build)	5%	5%	5%	5%	5%
A1/A2/A3 plus 8 flats (new build)	6%	6%	6%	6%	6%

Table 21 Best case profit on development costs by scheme and carbon reduction target (onsite reduction target, offset, and Code Level 4 and/or BREEAM Excellent- DH and ASHP not available)

Case study description	Carbon reduction target (over Part L 2010)				
	0%	8%	16%	25%	47%
1 detached house (new build)	17%	17%	17%	17%	15%
7 flats (new build)	15%	15%	15%	15%	13%
Small B1 (new build)	5%	5%	5%	Not acheivable	Not acheivable
B1 plus 8 flats (new build)	3%	3%	3%	3%	1%
A1/A2/A3 plus 8 flats (new build)	4%	4%	4%	4%	2%

Table 22 Additional building cost limits for the conversion of an existing house into 4 flats

Case study description	**Additional building cost limit for conversion**	
	17%	**15%**
Conversion of an existing house into 4 flats	£33,000	£53,000

The results in Table 16 to Table 21 indicate that:

- for purely residential new build schemes, an onsite reduction target of 25% over Part L 2010 and an offset policy for residual emissions at a carbon price of £920 per annual tonne of CO_2 emitted is viable, becoming marginally viable in some cases where DH and ASHPs are not available
- for purely residential new build schemes, an onsite reduction target of 25% over Part L 2010, an offset policy and Code for Sustainable Homes Level 4 is viable, becoming marginally viable in some cases where DH and ASHPs are not available
- compared to residential only schemes, the viability of the mixed use schemes containing a small element of non-domestic space is significantly reduced
- for purely non-domestic schemes, an onsite reduction target 16% over Part L 2010 is viable, but any further policy appears not to be
- in the case of the residential conversion of a house into 4 flats, the maximum additional cost for energy efficiency and LZCs supportable before viability becomes marginal is £33,000, and before viability becomes unviable is £53,000

In light of these results, the mixed use schemes were re-examined assuming no policy requirements for the small non-domestic elements, but with no changes to the policy requirements for the domestic element.

Table 23 Best case profit on development costs for the 8 flats plus office scheme assuming no non-domestic policy requirements

Case study description	**Carbon reduction target (over Part L 2010)**				
	0%	**8%**	**16%**	**25%**	**47%**
Onsite target only	19%	19%	19%	18%	18%
Onsite target only (no DH and ASHP)	18%	17%	16%	15%	13%
Onsite target and offset	18%	18%	18%	17%	17%
Onsite target and offset (no DH and ASHP)	17%	16%	15%	14%	12%
Onsite target, offset, Code Level 4	15%	15%	15%	15%	15%
Onsite target, offset, Code Level 4 (no DH and ASHP)	12%	12%	12%	12%	9%

Table 24 Best case profit on development costs for 8 flats plus retail scheme assuming no non-domestic policy requirements

Case study description	Carbon reduction target (over Part L 2010)				
	0%	8%	16%	25%	47%
Onsite target only	19%	19%	19%	18%	18%
Onsite target only (no DH and ASHP)	18%	17%	16%	15%	12%
Onsite target and offset	18%	18%	18%	17%	17%
Onsite target and offset (no DH and ASHP)	17%	16%	15%	14%	11%
Onsite target, offset, Code Level 4	15%	15%	15%	15%	15%
Onsite target, offset, Code Level 4 (no DH and ASHP)	12%	12%	12%	12%	9%

Table 23 and Table 24 illustrate that when there no policy requirements are imposed on the small non-domestic component of residential led mixed used schemes:

- an onsite reduction target for the residential component of up to 47% over Part L 2010 is potentially viable for both mixed used schemes, including in cases where DH and ASHP are unavailable as technology options
- an onsite reduction target of up to 47% together with an offset requirement for the residential component is viable when DH or ASHPs are available, but when DH and ASHPs are not available viability is lower, particularly for the higher onsite reduction targets
- adding a Code Level 4 requirement for the residential component to the onsite and offset requirements means that viability becomes more marginal for all onsite reduction targets when all technology options are available, and mixed-use schemes are estimated to become non-viable under these requirements when DH and ASHP are unavailable

2.5 Conclusions

As a result of the analysis above, the following set of policies could be considered by Islington as representing the most ambitious policies which would not have a significant adverse impact on the viability of minor developments in Islington:

- for minor new build domestic developments: an onsite reduction target of 25% relative to Part L 2010, an offset policy and Code for Sustainable Homes Level 4. For some schemes, the availability of ASHP or DH may prove important in achieving all these requirements together viably
- for minor new build non-domestic developments: an onsite reduction target of 16% relative to Part L 2010
- for the residential component of residential led mixed use developments: an onsite reduction target of 25% relative to Part L 2010, an offset policy and Code for Sustainable Homes Level 4. The analysis in this report indicates that this combination of policies may be close to the limits of viability even when DH and ASHPs are available technology options. It is therefore recommended that, particularly for residential elements of mixed use schemes, LBI adopt a case by case approach during the planning approval process
- in the case of a conversion of a house into 4 flats, the analysis in this report indicates that a total additional cost of approximately £30,000-£40,000 (or c. £10,000 per flat) for energy efficiency and LZCs could be borne before cost viability was seriously adversely affected.

In judging the policy to be adopted the following factors should be borne in mind:

- the theoretical nature of the residual profit appraisal process used in this study
- the limited scope of this study in terms of the number of case studies assessed
- the many uncertainties associated with developer appetite for risk
- the many uncertainties associated with technology costs and the use of FITs and RHIs (excluded from the scope of this study)
- greater uncertainty in the results for non-domestic developments given the much greater variability in non-domestic buildings compared with dwellings

3 Potential for carbon offsetting

3.1 Introduction

In aiming for net zero carbon development in Islington, LBI is proposing to use an offsetting mechanism for dealing with CO_2 reduction which cannot be obtained onsite. The use of offsetting in this way is expected to form part of 'Allowable Solutions', a planned element of the national zero carbon policy and Building Regulations Part L.

The basic concept of offsetting is for a new development to go as far as possible to reduce CO_2 on its own site with an opportunity to offset the remaining CO_2 through measures implemented on a different site, thereby enabling a 100% CO_2 reduction requirement to be met. An example could be to make improvements in an existing building by installing insulation, or to invest in low carbon infrastructure. This approach could provide a more technically and financially effective option to reducing CO_2 in the borough than trying to achieve 100% CO_2 abatement on site.

However it may too complex to insist that a project finds the recipient of the intervention themselves, and more practical simply to collect a levy to develop a fund to carry out the works across the Borough.

This section of the study aims to provide evidence on the cost of carbon that could be used for an offset fund, how this might develop over time, and how the offset fund might be implemented. It contains:

- a review of other similar offset schemes in operation to examine the method they use to set the price of a tonne of CO_2
- an assessment of the principal opportunities and constraints for reducing emissions from the existing building stock in Islington
- an assessment of the likely costs of offsetting a tonne of CO_2 using techniques suited to Islington's built environment
- recommendations on how the offset mechanism should be implemented

3.2 Review of existing carbon offset schemes

In this subsection of the report, background on some examples of offsetting schemes that have been established by some local authorities is provided.

3.2.1 Milton Keynes

Milton Keynes Council introduced a 'Carbon Offset Fund' in 2005 which raises money by taxing new development which emits carbon dioxide. The money raised is spent on upgrading the energy efficiency of existing homes.

Under the initiative, developers pay into a fund according to the carbon emissions generated by their buildings. Developers pay a one-off tax at a rate of £200 per tonne of carbon dioxide generated by the scheme each year. This works out at £400 for a typical new home but if a scheme is carbon neutral, developers do not pay anything. The money is collected using a section 106 agreement and is payable on completion of the scheme. The price per tonne of carbon increases annually based on building cost inflation (the Building Cost Information Service (BCIS) Index).

The scheme was introduced in December 2005 with payment required when the development is completed. The council has set up a not-for-profit company to administer the scheme, which offers cavity wall and loft insulation at the subsidised price of £95 per item.

3.2.2 Reigate and Banstead

Reigate and Banstead Borough Council intend to introduce a net zero carbon policy for new developments within its new Core Strategy. Policy CS10 within the draft core strategy requires new development to meet a) a Code for Sustainable Homes and/or BREEAM target b) an onsite contribution to renewable energy of 10% and c) net carbon neutrality through paying a price per tonne for residual emissions.

The scope of the carbon dioxide emissions covered by the definition of net carbon neutral used is all regulated and unregulated emissions from the operation of the development.

The process for payment of developers residual emission monies is an amendment to the existing s.106 process, with the online contribution calculator used by developers to assess their s.106 contributions to be amended to also calculate the residual carbon costs.

The proposed price for offsetting a tonne of carbon is based on the average Shadow Price of Carbon (SPC) over 20 years (the justification being that the Local Development Framework is a 20 year document), but with this average price applied to the emissions of the building over its expected lifetime of 60 years. The 20-year forward average from 2009 was £32.82/ tonne CO_2. However, a 50% discount factor is then applied to this total lifetime sum, the rationale being that there are additional build costs to developers as a result of the other sustainable construction requirements, and also that the electricity grid is expected to decarbonise over time so that electricity use in the future will have less carbon impact than it does today. A 5% administration fee is then applied in order to cover the costs of administering the s.106 process. A further 10% project management fee is then also applied to cover the costs under the Council's current contract with the Greater London Energy Efficiency Network for heating and insulation retrofit work (the capital works currently being grant funded by the Government Office of the South East). This project management fee excludes the costs of the Council staff in managing this work. The overall result for the proposed price of carbon is £1,137/ tonne CO_2 (based on 2009 prices).

This price will rise in line with the Baxter Index, used to adjust civil and specialist engineering contracts to allow for changes in the cost of labour, material and plant. The project management fee is to be kept under review on an annual basis to ensure a realistic link to the Council's actual spend on project management.

Unlike Milton Keynes and Ashford (discussed below), Reigate and Banstead propose to operate the fund in a flexible way which is not confined to spend on measures achieving a tonne for tonne reduction in residual emissions through retrofit measures elsewhere in the Borough (a true "offset" fund), to enable funding of other projects which may not have directly auditable carbon emission reductions but which provide wider benefits to the community as measured under a set of KPIs e.g. funding of feasibility studies.

3.2.3 Ashford Borough Council

Ashford Borough Council adopted its Local Development Framework Core Strategy in July 2008. Policy CS10 requires major developments to achieve a Code for Sustainable Homes and/or BREEAM rating; secure a significant proportion of total energy requirements through sustainable energy technologies; and to offset all residual regulated and unregulated emissions into a carbon fund (the "Ashford Carbon Fund") to enable funding of carbon saving measures elsewhere in the Borough. The use of offset payments is considered the last resort for reducing carbon emissions.

The cost per tonne of carbon is based on the Shadow Price of Carbon, which rises at 2% per annum. Although the building lifetime is recognised to be around 60 years, the carbon emissions from the first ten years only are required to be offset as "the Council feels that in the current social, environmental and economic conditions the SPC should be quantified over a ten year period". A project management fee or s.106 administration fee has not been included in the price per tonne of carbon.

The fund will be used to pay for retrofit energy efficiency measures within the Borough, and also tree planting as part of Ashford's Blue and Green grid. It will be managed by Ashford Borough Council, and reviewed annually through the Annual Monitoring Report.

3.2.4 Brighton and Hove City Council

The operation of the carbon offset fund within Brighton and Hove is set out in the Annex to the SPD on Sustainable Building Design.

In the first instance, developers are required to implement measures within existing buildings near the development in order to achieve carbon neutrality post energy efficiency and onsite LZC technologies. Strictly, therefore, this does not involve the operation of an offset fund. The measures the developer is required to implement are selected from the list below:

- loft insulation to 300 mm;
- cavity wall insulation
- draughtproofing;
- condensing boilers (including boiler itself);
- improved heating controls; and/or
- solar water heating.

The Council will monitor progress on agreed retrofit measures and only allow occupation of the new development once these have been implemented.

The requirement for developers to undertake retrofitting measure themselves within the existing stock on a development by development basis could be relatively non-cost effective due to the lack of economies and scale. However, if a developer is able to undertake the retrofitting measures more cheaply per tonne of carbon saved than contributing to the carbon offset fund, then it could be seen as giving more flexibility.

Should the developer not undertake retrofit measures, as an alternative a contribution may be made into a s.106 fund in order that the Council can implement measures via its portfolio of home energy efficiency and renewable grant/discount schemes.

Implementation of the contributions is overseen by the Housing Operations and Sustainable Housing team within the Council, together with the s.106 officer.

3.2.5 Dover Borough Council

The climate change evidence base study[5] for Dover's Local Development Framework made the following recommendation for policy:

> *"For new developments that cannot meet the carbon and water reduction targets in DM3 onsite and for new non-residential developments of less than 1000m^2 gross, applicants must achieve commensurate energy and water savings elsewhere in Dover District.*
>
> *The actions or sums paid must achieve the difference between the onsite performance of the development and the immediate, 2013 and 2016 energy and water standards expected for developments. Dover District will publish updates concerning details of the energy and water efficiency schemes that will be eligible and the cost per tonne of CO_2 and per m^3 of water saved.*
>
> *Applicants must prove they cannot meet requirements onsite through an open book accounting approach to show the development would not go ahead.*
>
> *Funding Model*
>
> *Funding levels will need to be set to reflect District needs and priorities to reduce energy and water use. This will be informed by Regional renewable energy targets; the Government definition of zero carbon and related list of allowable solutions; and local initiatives to improve existing residential and non-residential buildings."*

[5] Source: Dover Core Strategy Evidence Base - Sustainable Construction and Renewable Energy, AECOM (2009)

The draft Dover Core Strategy has recently been through Examination in Public where the proposed development contributions were not queried.

3.2.6 Summary

Table 25 summarises the key elements of the existing Local Authority offset schemes reviewed above.

Table 25 Summary of existing Local Authority carbon offset schemes

Local Authority	**Development scope**	**Price per annual tonne of carbon £/ tonne CO_2**	**Price inflation**	**Implementation mechanism**
Milton Keynes	Residential: > 5 dwellings Commercial: >1000 m^2	£200	In line with building cost inflation (BCIS index)	Developer payment into a central offset fund (s.106 process)
Reigate and Banstead	Residential: > 1 dwelling Commercial: >500 m^2	£1173	In line with the Baxter Index	Developer payment into a central offset fund (s.106 process)
Ashford	Within growth areas: Residential: > 10 dwellings Commercial: >1000 m^2	£290 (in 2008)	In line with Shadow Price of Carbon at 2% per annum	Developer payment into a central offset fund (process unclear)
Brighton and Hove	Residential: > 3 dwellings (includes extensions, conversions and changes of use) Retail: > 151 m^2 Other commercial: >236 m^2	£1006- £2525	Dependent on cost of measures implemented	Developer implements retrofit measures in the local existing stock; alternatively pays into a s.106 fund.

3.3 Principal opportunities and constraints for reducing emissions from existing stock in Islington

3.3.1 Introduction

This sub-section of the report provides an analysis of the principal opportunities for carbon offset measures within Islington's existing built environment. This involved the following steps:

- identifying the potential measures to implement in Islington
- assessing the likely suitability of different parts of the existing stock for different forms of retrofit measure
- identifying the number of retrofit opportunities in Islington, with total carbon saving potential associated with each measure
- assessing the effect of other policy interventions on the number of retrofit opportunities available to an offset fund

3.3.2 Potential retrofit measures for existing buildings in Islington

In advance of considering the suitability of different retrofit measures within Islington, retrofit measures for which emission reductions and costs are known were identified. In the case of domestic buildings, these comprise the measures shown in Table 26. In the case of the connection to the Cluster B Core and Extended district heating schemes, cost and emission reduction data were derived from detailed feasibility studies commissioned by LBI[6]. For all other measures, cost and emissions savings data was provided by the Energy Savings Trust (EST) under its programme of advice to Local Authorities. The EST data is based on the following approach:

- cost of measures reflect installed costs
- carbon factors for different fuels based on those used in CERT 2008-2011 for evaluation and planning
- insulation savings from CERT 2008-2011, using national weighted average mixes for property and heating fuel
- heating savings based on BREDEM, using national weighted average mixes for property and heating fuel
- savings are net of comfort taking and the heat replacement effect

Table 26 Potential retrofit measures for the domestic stock

Domestic retrofit measure	Annual carbon savings/ tonnes CO_2 per annum	Cost of carbon £/annual tonne CO_2 saved
Loft 0mm insulation	0.936	307
Connection to cluster B district heating (Extended scheme)	2.902	591
Cavity wall insulation	0.566	663
Draught-proofing (DIY)	0.121	741
Connection to cluster B district heating (Core scheme)	3.423	749
External solid wall insulation (when refurbishing existing wall)	1.934	776

[6] Although there are several further district heating clusters that have potential for development as part of a Borough-wide strategy for decentralised energy, currently there is less information on costs of carbon abatement available for these, although work carried out internally within LBI suggests this will be around £1000 per annual tonne saved in most cases.

Loft 1-50mm	0.268	1025
Internal solid wall insulation	1.829	1203
Electric heating replaced with gas central heating	2.921	1421
Loft 51-75mm	0.176	1508
Condensing boiler from stock average	0.710	1549
Draught-proofing (Professional installation)	0.121	1648
Loft 76-100mm	0.141	1662
External solid wall insulation	1.934	4136
Air Source Heat Pump (space heating only)	0.989	5561
Double glazing (single to double)	0.424	7071
Solar water heating	0.260	11521
PV (2.5kWp)	0.916	17476

Potential non-domestic measures for which cost and savings data are available are shown in Table 27.

Table 27 Potential retrofit measures for the non-domestic stock

Non-domestic retrofit measure	Annual carbon savings/ tonnes CO_2 per annum	Cost of carbon £/annual tonne CO_2 saved
Increase roof insulation	6.4	315
Insulating pipework	15.5	315
T8 to T5 adapters (lighting)	7.5	350
Fit draft stripping to external windows and doors	16.0	420
Cavity wall insulation	2.6	420
Install weather compensation and optimum start controls	32.0	525
Building Energy Management System (BEMS)	16.0	3800

For these measures, carbon saving and capital cost data were provided by LBI's Estates Management Programme[7].

[7] E-mail attachment from Graeme Low dated 15th October 2010.

3.3.3 Suitability of the stock for different types of retrofit measures

Total numbers of buildings

The primary classes of buildings within Islington which would be suitable for retrofitting of energy efficiency measures are broadly assumed to comprise dwellings, offices and retail units. The total numbers of these types of building within Islington have been identified.

A stock condition survey of residential dwellings within Islington was carried out in 2008. The survey was primarily concerned with the private sector, excluding registered social landlords. The total number of private dwellings in Islington by age as of 2008 is shown in Table 28.

Table 28 Private sector dwellings in Islington in 2008[8]

	Pre-1919	1919-1944	1945-1964	1965-1980	Post-1980	TOTAL
Detached/semi-detached	1358	49	42	257	176	1882
Terraced	9241	0	89	1024	1109	11463
Purpose built flat	1626	2427	2810	6520	4466	17849
Converted flat	18812	248	63	55	88	19266
Flat plus commercial	1760	192	38	46	174	2210
TOTAL	32797	2916	3042	7902	6013	**52670**

In addition to 52,670 private dwellings, there are also approximately 51,100 social sector dwellings, giving a total of approximately 81,000 dwellings in Islington in all.

In terms of commercial buildings, as of 2008, there were within Islington 1,810,000 m^2 of office space and 1778 B1 class hereditments, giving an average floorspace per hereditment of 1081 m^2[9]. As of 2010, there were approximately 1630 A-use class buildings in Islington, based on Land Use UK data on the 32 largest high street shopping centres (supplied by LBI).

Suitability of existing buildings within Islington for retrofit measures

In the case of domestic buildings, the most recent Private Sector Stock Condition Survey gives a reasonably detailed breakdown of the state of the private stock with respect to the presence of solid walls, cavity wall insulation, loft insulation, double glazing and the type of fuel used for heating. There is much less detail reported for the Registered Social Landlord (RSL) stock, although the average SAP rating is higher at 66 than the average for the private sector of 59, implying a higher level of installed insulation measures, other factors being equal.

The following assumptions have been made in respect of the private residential sector within Islington

- none of the solid walls have solid wall insulation
- no dwellings built prior to 1980, and all built post 1980, have draughtproofing
- half of dwellings with gas boilers have a boiler at or below the average efficiency for the national stock
- 80% of dwellings are suitable for an air source heat pump (to allow for restrictions in conservation areas)
- half of the houses within the Borough, and none of the flats, are suitable for solar water heating
- half of the houses within the Borough, and none of the flats, are suitable for photovoltaic panels

8 Based on Table A2.2, 2008 Private Sector Stock Condition Survey by the London Borough of Islington and Fordham Research.
9 Islington Employment Study- 2008 Update, p.60.

The following assumptions have been made in respect of the social housing stock within Islington (comprising 49% of the total residential stock):

- the age profile and built-form profile is the same as for the private residential stock (an approximation, as in reality the social housing stock has a higher pre-dominance of flats built post-1950 than the private sector)
- the proportion of dwellings with insulation measures is the same as the private sector, except (to reflect the anticipated higher level of fabric performance for the social stock):
    - half of all social dwellings have double glazing
    - 70% of social dwellings with cavity walls have cavity wall insulation
    - all social dwellings have 100mm of loft insulation, but none have more than this
- the same assumptions as listed for the private residential sector apply, with the following exceptions
    - 25% of social sector dwellings with gas boilers have a boiler at or below the average efficiency for the national stock
    - 25% of social sector flats are be suitable for solar water heating (due to greater communal ownership and the higher penetration of communal boiler systems compared to the private sector)
    - 25% of social sector flats are be suitable for photovoltaic panels

Based on the actual numbers of installed measures in the private residential sector and the assumptions above, the total number of retrofit opportunities on a 2008 baseline (and the total potential emission reductions by measure) would be as summarised in Table 29.

The number of retrofit opportunities identified for district heating is based on Cluster B, for which detailed feasibility studies have been carried out. Cluster B would mainly serve LBI owned social housing, hence the allocation of all retrofit opportunities to the social sector. However, Cluster B is anticipated to be the first of a number of heat load clusters which will eventually be served by district heating networks as part of LBI's plans for a borough wide decentralised energy network. The total number of opportunities for retrofit if all Clusters were developed might be of the order of 5 times the number for Cluster B (a crude estimate based on total annual heat loads and assuming a similar mix of buildings in each Cluster), and it is anticipated that later Clusters would result in private sector connections.

In the case of measures that would compete with each other for the same retrofit opportunities, the number of potential opportunities has been split equally among the competing measures (Table 29). For example, the potential for solid wall retrofit opportunities have been split equally between solid wall insulation as part of external wall refurbishment, solid wall insulation not part of a refurbishment, and internal solid wall insulation. Although external solid wall insulation (ESWI) provides slightly greater energy savings and carbon emission reductions compared to internal solid wall insulation (ISWI), in cases where the external appearance of a building cannot be modified, ISWI may be the preferred retrofit option for solid walls. This could occur within conservation areas for example, of which there are a number in Islington.

The number of retrofit opportunities identified for district heating is based on Cluster B, for which detailed feasibility studies have been carried out[10]. Cluster B would mainly serve LBI owned social housing, hence the allocation of all retrofit opportunities to the social sector. However, Cluster B is anticipated to be the first of a number of heat load clusters which will eventually be served by district heating networks as part of LBI's plans for a borough wide decentralised energy network. The total number of opportunities for retrofit if all Clusters were developed might be of the order of 5 times the number for Cluster B (a crude estimate based on total annual heat loads[11] and assuming a similar mix of buildings in each Cluster), and it is anticipated that later Clusters would result in private sector connections.

[10] Old Street (Cluster B) District Heating Detailed Feasibility Study, Revision B, p.10. PB Power, November 2009.
[11] Decentralised Energy Project- Stage 3. Borough Wide DE Strategy, p.26. PB Power, April 2010.

Table 29 Retrofit opportunities by measure for the residential sector in Islington (2008 baseline)

Domestic retrofit measure	Private housing sector opportunities (excluding RSLs) (Dwellings in Islington without measure in 2008)	Estimated social housing sector opportunities	Total potential emission reduction/ tonnes CO_2 per annum
Loft 0mm insulation	4,591	0	4,295
Connection to cluster B district heating (Extended scheme)	0	1,465	4,252
Cavity wall insulation	5,323	4,263	5,423
Draught-proofing (DIY)	23,329	22,633	5,579
Connection to cluster B district heating (Core scheme)	0	710	2,430
External solid wall insulation (when refurbishing existing wall)	12,674	12,297	48,295
Loft 1-50mm	5,124	0	1,375
Internal solid wall insulation	12,674	12,297	45,663
Electric heating replaced with gas central heating	4,154	4,030	23,906
Loft 51-75mm	3,201	0	563
Condensing boiler from stock average	23,705	11,499	25,005
Draught-proofing (Professional installation)	23,329	22,633	5,579
Loft 76-100mm	3,107	0	439
External solid wall insulation	12,674	12,297	48,295
ASHP (space heating only)	42,136	40,880	82,102
Double glazing (single to double)	26,093	25,550	21,909
Solar water heating	6,673	16,012	5,907
PV (2.5kWp)	6,673	16,012	20,768

In the case of non-domestic buildings there is much less data available on the state of the existing stock, both nationally and within Islington. The following broad assumptions have therefore been made:

- all of the measures can be installed in either retail units or offices and the emissions savings achieved in both cases are the same
- half of all non-domestic buildings have the measures listed already, except in the case of voltage optimisation, weather compensation and optimum start times and Building Energy Management Systems which are assumed not to be present in any of the non-domestic buildings considered

Based on these assumptions, the total number of non-domestic retrofit opportunities and total potential emission reductions by measure would be as summarised in Table 30.

Table 30 Retrofit opportunities by measure for the non-domestic sector in Islington

Non-domestic retrofit measure	Non-domestic sector opportunities (Non-domestic buildings without measure)	Total potential emission reduction/ tonnes CO_2 per annum
Increase roof insulation	1,704	10,981
Insulating pipework	1,704	26,489
T8 to T5 adapters (lighting)	1,704	12,780
Fit draft stripping to external windows and doors	1,704	27,264
Cavity wall insulation	1,704	4,430
Install weather compensation and optimum start controls	3,408	109,056
Building Energy Management System (BEMS)	3,408	54,528

3.3.4 The effect of other policies on retrofit opportunities within Islington

There is currently an active policy agenda nationally on achieving reduced carbon emissions from homes and businesses. Several new policy interventions have been or will be introduced, and some existing policies are being made more ambitious. This is potentially significant from the standpoint of a developer carbon offset fund within Islington, as these policy interventions will drive some of the same retrofit measures that would otherwise be funded by developer offset payments. It is desirable for a carbon offset fund to achieve carbon emissions additional to those that would otherwise be achieved. This section therefore examines the potential effect of the main national policy interventions in order to establish whether there is enough capacity within the existing stock to make a developer offset fund feasible, and what the potential effect of these on a price of carbon for the offset fund might be.

An analysis of carbon emissions within Islington and the expected effect of national policy on these out to 2020 was carried out by the Centre for Sustainable Energy in 2010. The effect of national policies was examined separately for the domestic sector and the non-domestic sector, based on Islington achieving a fair share of the total national emission reductions anticipated. Table 31 shows the additional annual emission reductions from the residential stock in Islington for each of the major policy interventions affecting that sector and for each year between 2008 and 2020. Table 32 does the same for the non-domestic sector in Islington.

Table 31 Anticipated effect of carbon reduction policies on emissions from the residential sector in Islington 2008-2020

Year	Additional annual emission reductions due to policy/ tonnes CO_2 per annum					
	CERT 2008-2011	CERT 2011 onwards	CESP	RHI (residential)	FIT (residential)	Smart meters
2008	2,600	0	0	0	0	0
2009	2,990	0	260	0	0	0
2010	3,070	0	0	0	200	0
2011	2,880	0	0	260	190	4,720
2012	260	3,930	0	260	400	0
2013	270	3,410	0	270	780	0
2014	0	3,940	0	520	790	0

2015	0	3,410	0	530	790	0
2016	0	3,930	0	1,050	1,570	0
2017	0	3,410	0	1,040	790	0
2018	0	3,940	0	1,320	790	0
2019	0	3,410	0	2,090	780	0
2020	0	3,930	0	2,100	790	0
Total in 2020 (over 2008)	**12,070**	**33,310**	**260**	**9,440**	**7,870**	**4,720**

Table 32 Anticipated effect of carbon reduction policies on emissions from the non-domestic sector in Islington 2008-2020

Year	**Additional annual emission reductions due to policy/ tonnes CO_2 per annum**				
	RHI	**CRC**	**Product policy**	**Smart meters**	**EPBD**
2008	0	0	540	0	0
2009	0	0	540	0	0
2010	0	0	810	0	0
2011	540	540	270	0	0
2012	0	810	540	270	270
2013	1,080	540	540	270	0
2014	1,350	1,080	550	540	0
2015	270	540	270	270	270
2016	270	270	270	540	270
2017	1,620	820	1,080	270	0
2018	2,450	540	270	540	270
2019	2,160	540	540	270	0
2020	3,780	810	540	280	0
Total in 2020 (over 2008)	**13,520**	**6,490**	**6,760**	**3,250**	**1,080**

It is difficult to predict what pattern of uptake of retrofit measures will occur as a result of the individual policy measures out to 2020, and therefore how many individual measures might be left for an offset fund. However, a conservative estimate on the cost of measures an offset fund might have to meet at a given point in time can be made by assuming:

- the entirety of emissions savings achieved by relevant policies are through the retrofit of measures considered within this study
- the measures taken up as a result of the policy intervention are the most cost effective possible

Policy interventions relevant to the uptake of the measures considered for the residential sector in this report are:

- CERT 2008-2011 and CERT post 2012 for most forms of fabric improvement, fuel switching and LZCs
- CESP for community wide energy efficiency and community heating programmes
- FIT for renewable generating technologies
- RHI for renewable heat technologies (which is assumed to include ASHPs)

Smart meters are assumed to achieve emissions through behaviour change as a result of greater awareness of energy use, and not drive increased uptake of retrofit measures.

For the non-domestic sector, the main policy driver for the uptake of retrofit measures considered in this report is assumed to be the Carbon Reduction Commitment (CRC). The RHI would also be influential but only for renewable heating technologies. Product policy is assumed to achieve emissions reductions through a slow process of more efficient energy using products coming onto the market and gradually replacing old products. The EBPD is assumed to achieve emission reductions in the non-domestic sector through improved new build standards and better operational efficiency of existing plant as a result of improved inspection regimes.

Under these assumptions, the impact of policy interventions on the number of retrofit measures available to an offset fund is as shown in Table 33 for the residential sector and Table 34 for the non-domestic sector.

Table 33 Effect of national policy on the availability of retrofit opportunities in the residential stock in Islington

Domestic retrofit measure	Cost of carbon £/annual tonne CO_2 saved	Total potential emission reduction/ tonnes CO_2 per annum	Effect of interventions
Loft 0mm insulation	307	4,295	Used up by CERT 2008-2011
Connection to cluster B district heating (Extended scheme)	591	4,252	
Cavity wall insulation	663	5,423	Used up by CERT 2008-2011
Draught-proofing (DIY)	741	5,579	
Connection to cluster B district heating (Core scheme)	749	2,430	
External solid wall insulation (when refurbishing existing wall)	776	48,295	Being used up by CERT post 2011 in 2013 and 2020
Loft 1-50mm	1025	1,375	Used up by CERT 2008-2011
Internal solid wall insulation	1203	45,663	
Electric heating replaced with gas central heating	1421	23,906	
Loft 51-75mm	1508	563	
Condensing boiler from stock average	1549	25,005	
Draught-proofing (Professional installation)	1648	5,579	
Loft 76-100mm	1662	439	
External solid wall insulation	4136	48,295	

ASHP (space heating only)	5561	82,102	RHI takes until 2016 to ramp up to 1000 tonnes per year
Double glazing (single to double)	7071	21,909	
Solar water heating	11521	5,907	RHI takes until 2016 to ramp up to 1000 tonnes per year
PV (2.5kWp)	17476	20,768	FIT takes until 2016 to ramp up to 1000 tonnes per year

Table 34 Effect of national policy on the availability of retrofit opportunities in the commercial stock in Islington

Non-domestic retrofit measure	**Cost of carbon £/annual tonne CO_2 saved**	**Total potential emission reduction/ tonnes CO_2 per annum**	**Effect of interventions**
Increase roof insulation	315	10,981	CRC using this up in 2013 and 2020
Insulating pipework	315	26,489	
T8 to T5 adapters (lighting)	350	12,780	
Fit draft stripping to external windows and doors	420	27,264	
Cavity wall insulation	420	4,430	
Install weather compensation and optimum start controls	525	109,056	
Building Energy Management System (BEMS)	3800	54,528	

In summary, assuming all policy interventions achieve all of their carbon savings through retrofit of the measures considered in this study (in precise order cost effectiveness), it is estimated that CERT post 2011 would be driving the uptake of solid wall insulation as part of solid wall refurbishment works (with a carbon abatement cost of £776 per annual tonne CO_2) in the residential sector in both 2013 and 2020 (almost using this measure up by 2020). It is estimated that the CRC would be driving the uptake of roof insulation (with a carbon abatement cost of £315 per annual tonne CO_2) in the non-domestic sector in both 2013 and 2020.

3.4 Deriving a price per tonne for carbon offsetting in Islington

To understand what an appropriate price for a tonne of carbon within the developer offset fund should be, and how quickly this might need to rise over time, it is necessary to consider the rate at which new development comes forward and the level of offset that this will require.

Projected annual housing completions over the period to 2026 is available from the LBI housing trajectory[12], and the anticipated growth rate for both office space[13] and retail space[14] out to 2026 can be derived from the most recent employment and retail study updates. In the case of office space, the growth rate of 1.4% is derived from the Scenario 1 projections within the 2008 update to the Islington employment study (based on existing trends and socio-economic conditions), and then applied to the

12 Housing Land Supply Topic Paper, Appendix 3 (London Borough of Islington, 2008)
13 Islington Employment Survey- 2008 update, p.52 (Atkins, 2008)
14 Retail Study Update 2008, Appendix 2, Tables 10, 18, 26 and 32 (DTZ, 2008)

2008 total for B1 units (1778 with an average area of 1018 m^2). In the case of retail space, the growth rate derived is based on projections for the 4 areas considered within the 2008 update to the Islington retail study under the assumption that development in King's Cross does not significantly reduce growth in Islington (although the difference between the two cases is not very large). This annual growth rate of 5% has then been applied to the current number of A-class units in Islington based on Land Use UK data (1630).

The carbon emissions associated with new developments have been calculated assuming a Part L 2010 compliant baseline. Both regulated and unregulated emissions were included. The Zero Carbon Hub archetypes were used for the domestic cases, and the small office case study (1296 m^2) and retail component of the mixed use case study (96 m^2) were used to evaluate carbon emissions from new office and retail developments. The mix in built forms for the domestic stock is assumed to remain constant over the growth period considered.

The effect of changing policy has also been taken into account. The level of offset required assumes that a 40% onsite reduction target against a Part L 2006 compliant baseline (20% over Part L 2010 compliant) has been implemented from 2010, and that the introduction of the Zero Carbon Homes policy in 2016 occurs, which is anticipated to require a 70% reduction onsite relative to a Part L 2006 compliant baseline (60% over Part L 2010 compliant).

Under these assumptions, the total requirement for offset emissions from new development in Islington is shown annually in Table 35.

Table 35 Total requirement for carbon offset from new development in Islington 2010-2020

Year	New dwellings	New B1 units	New A-units	Total offset required for new developments in year/ tonnes CO_2 per annum	Cumulative offset required for new developments/ tonnes CO_2 per annum
2011	2,361	26	90	8,240	8,240
2012	1,225	27	95	6,152	14,392
2013	1,207	27	99	6,209	20,601
2014	1,629	27	104	7,110	27,711
2015	1,843	28	109	7,617	35,328
2016	1,435	28	115	6,936	42,264
2017	1,011	29	121	3,114	45,378
2018	1,014	29	127	3,171	48,549
2019	1,054	29	133	3,265	51,814
2020	993	30	140	3,264	55,078

Table 35 shows that the total cumulative CO_2 offset requirement from all new development in Islington from 2010 onwards is anticipated to be around 20,600 tonnes per annum in 2013 and around 55,000 tonnes per annum in 2020.

Comparison of these figures with the potential savings set out for the measures in Table 33 and Table 34 indicates that even with the effect of policy interventions, there is estimated to be a sufficiently large pool of emission reductions from retrofit measures to support the operation of a developer offset fund until 2020.

The offset potential from retrofit measures in the non-domestic sector in Islington is potentially significant, the figures in Table 34 indicating that sufficient potential might exist to provide all the offset required from all new development in Islington to 2020 at a cost of £525 per tonne annual tonne of carbon dioxide or less. However, the emission reduction potentials shown in Table 34 are based on a relatively small number of installations within Islington and should therefore be treated with caution. It is also the case generally that the level of emissions reduction achievable by a given retrofit measure in the non-domestic sector is highly variable and therefore uncertain due to the much greater variability in non-domestic buildings. There are also social reasons why a local authority might wish to focus more of the retrofit effort from a developer offset fund on the residential sector rather than the commercial sector. For these reasons, in deriving an initial price of per tonne of annual carbon offset, it is assumed that the vast majority of retrofit activity will occur in the residential sector, at least in the period to 2020.

A comparison of the potential for carbon reduction from retrofit measures in the domestic sector shown in Table 33 with the total cumulative offset required by 2013 (20,600 annual tonnes per annum) and 2020 (55,000 annual tonnes per annum) shows that, because the pool of potential savings from residential solid wall insulation is so large, once the relatively small pool of carbon savings achievable from more cost-effective measures is used up, solid wall insulation is likely to be the most cost effective retrofit measure available for the period to 2020, initially being external solid wall insulation as part of solid wall refurbishment, and then switching to internal solid wall insulation around 2020 (under the assumption of an equal three way split in the three forms of retrofit of solid wall insulation shown in Table 33). This conclusion is not significantly affected by the potential roll-out of a Borough-wide decentralised energy network 5 times larger than Cluster B at a carbon abatement cost less than the cost of solid wall insulation, as a comparison of yearly offset requirements from new development in Table 35 with potential savings from Cluster B (Table 29) indicates that total connections to a Borough wide network could support a developer offset fund for approximately 3 years (taking a high level estimate).

This would imply that setting a carbon offset cost at the level required to achieve retrofit of residential solid wall insulation, in order to give confidence that developer payments into an offset fund could support offset of residual development emissions via at least one residential retrofit measure over the period to 2013 (and perhaps beyond). The most cost-effective form of solid wall insulation (carried out as part of a wider wall refurbishment) has a carbon abatement cost of c. £800 per annual tonne of carbon saved. Adding s.106 management fee of 5% and a project management fee of 10% (following the example of Reigate and Banstead) would therefore lead to a carbon price of £920 per annual tonne emitted. As seen from Table 25, this price is within the range seen in other existing local authority offset schemes.

The price per tonne of carbon thus indicated does not have to be spent solid wall retrofits, and in the earlier stages of the operation of the offset fund it is likely to be spent on more cost effective measures, which could include some measures in the non-domestic sector. Equally, as the price has been set by solid wall insulation as part of a wider wall refurbishment, it is insufficient to offset residual emissions from new development through more expensive forms of solid wall insulation such as internal solid wall insulation. However, by the time solid wall insulation becomes the most cost-effective option for offsetting, prices for these more expensive forms of solid wall insulation may have fallen.

3.5 Potential approaches to implementing a buyout fund

3.5.1 Purpose of and types of fund

A local authority carbon fund which pools contributions from developers towards community and large scale renewable and low carbon energy infrastructure and other carbon saving measures can be grouped into those operated through planning and those related to building regulations. They can be established as a way of:

- off-setting any increase in energy demand or emissions from new developments. This is likely to be driven through the building regulations as a form of allowable solution
- funding or contributing to projects or infrastructure identified elsewhere in the district. This is more likely to have its basis in planning.

3.5.2 Funds implemented through Building Regulation Allowable Solutions

Post-2016, the Building Regulations will introduce a requirement for new residential developments to be zero carbon and post-2019 this requirement will be extended to all other types of building. This will govern much of the effort to reduce on-site carbon emissions from new developments. As a result the focus for planning in relation to energy is likely to shift towards delivering community and large scale infrastructure, because there will be less of a need to set standards for energy use and emissions on individual development sites. This is reinforced by the draft new PPS15 which states that area-wide development integrated targets will no longer be necessary.

The Government announced in July 2007 that all new homes will be zero carbon from 2016. In the Budget 2008, the Government also announced its ambition that all new non-domestic buildings will be zero carbon from 2019 and all new schools and other public buildings will be zero carbon from 2016.

A consultation in 2008, followed by a Government statement in July 2009, confirmed the definition of zero carbon that will be applied to new homes and set out how it will be taken forward. Achieving zero carbon includes three stages illustrated in Figure 2:

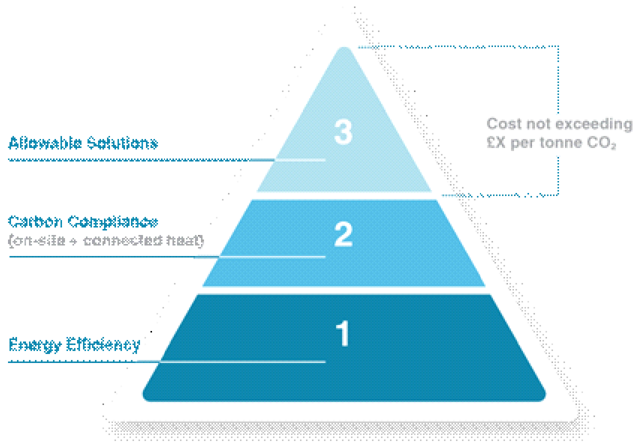


Figure 2 Levels of compliance with a zero carbon requirement

- **Energy efficiency**, the minimum level of which has not yet been agreed, but is likely to be measured in kWh/m^2/year and differentiate between dwelling types. This stage will take account of building fabric energy efficiency such as U-values, air tightness, thermal bridging and thermal mass.
- **Carbon compliance**, set at 70% of regulated emissions (the DER) and will take account of systems and controls, such as heating/cooling systems, RLC technologies and mechanical ventilation.
- **Allowable solutions**, which will cover the remaining carbon emitted from the dwelling for 30 years. The final list has yet to be confirmed but may include:
  - further carbon reductions on site, through energy efficiency or on-site generation
  - energy efficient appliances
  - advanced forms of building control systems which reduce the level of energy use in the home
  - exports of low carbon or renewable heat from the development to other developments
  - Investments in Renewable and Low Carbon community heat infrastructure

Other allowable solutions remain under consideration. A final Government announcement is expected towards the end of 2010.

The Impact Assessment that accompanied the Definition of Zero Carbon Homes consultation suggested a cap of £100 per tonne of CO_2 emitted. The levy would be charged on any residual CO_2 emissions remaining after taking into account reductions from energy efficiency and 'on-site' low and zero carbon energy generation. The £100 contribution level would need to be reviewed following further publication of any consultation documents or approved regulations in relation to 'allowable solutions'.

The price cap of £100 per tonne relates to a lifecycle tonne. An equivalent cost for an annual tonne can be obtained by multiplying this price by the lifetime of the building i.e. for a building lifetime of 30 years, £100 per tonne equates to £3000 per annual tonne.

[15] CLG (March 2010) Consultation on a Planning Policy Statement: Planning for a Low Carbon Future in a Changing Climate.

Large area wide district heat and power schemes in both new and existing development may be sufficiently large to contribute to local authority, regional or national energy generation targets rather than primarily mitigating increases in CO_2 emissions resulting from new development. The government proposals for allowable solutions post 2016 will place emphasis on local authorities to identify and support delivery of community scale solutions, and developing district heating networks in suitable areas is potentially one of the key solutions for which this investment could be used.

Table 36 illustrates the potential value of allowable solutions investment based on a value of £100 per tonne CO_2 over a 30 year lifetime for a number of different development sizes under Code level 5 and level 6. This assumes that all CO_2 reductions above carbon compliance are met through allowable solutions off-site.

Table 36 Potential local investment from allowable solutions funding for different scale developments

Number of dwellings	Code level 5 (30% CO_2 reduction through allowable solutions) Potential allowable solutions contribution £	Code level 6 (80% CO_2 reduction through allowable solutions) Potential allowable solutions contribution £
10	£4,800	£12,800
50	£24,000	£64,000
200	£96,000	£256,000
1000	£480,000	£1,280,000
5000	£2,400,000	£6,400,000

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

Allowable solutions are important in the context of carbon funds since it is possible that developers will be able to discharge their allowable solution obligations through some kind of payment mechanism. Money raised through allowable solution payments would likely be ring fenced for energy schemes (efficiency, generation and supply), whereas energy schemes will be competing with other spending priorities for Section 106 contributions (most notably affordable housing) and CIL money.

Three areas of uncertainty need to be considered once Government confirms its approach:

- how allowable solutions funds will be managed and distributed
- whether or not it will be permissible to combine allowable solutions contributions with other local authority funds, such as developer contributions obtained through planning, for distribution through one common mechanism
- if allowable solutions do not become a building regulation requirement until 2016, can a carbon fund be introduced in advance of this using other funds such as developer contributions obtained through planning? And would a fund introduced today need to change significantly in six years time when allowable solutions come into effect? It is worth noting that Government is currently consulting on changes to the definition of Code energy credits to bring them into line with the building regulations definition. When this happens the equivalent of allowable solutions payments could be available from developments targeting Code level 5 and above before the end of 2010

Early action by local authorities to establish local carbon funds could be influential in determining the formal definition of allowable solutions and the procedures by which they will be managed and operated.

3.5.3 Funds implemented through planning

Section 106 and the Community Infrastructure Levy (CIL), which came into force nationally on 6th April 2010, are the two likely candidates to provide the basis for requiring developer contributions to a carbon fund through planning policy, supported to some extent by the PPS1 Supplement 16.

The Government is currently consulting on proposed new Section 106 policy, to clarify the purpose of planning obligations in the light of CIL. Accordingly, “planning obligations should aim to secure necessary requirements that facilitate the granting of planning permission for a particular development, while CIL contributions are for general infrastructure need”. Essentially, the five policy tests set out in circular 5/05 will need to be more rigorously applied as a material consideration, and case law that has broadened their scope since then ignored.

CIL should be used to deliver the infrastructure needed to support development proposed in an area. Government guidance makes it clear that CIL is an appropriate mechanism for supporting energy infrastructure, including district heating. The East of Exeter New Growth Point Energy Strategy identifies a range of infrastructure requirements that could be funded or part funded in this way. The draft CIL regulations, published by CLG in March 2010, enable councils to borrow prudentially against future CIL receipts in order to ensure timely delivery of infrastructure. The South West’s Regional Infrastructure Fund could be used in a similar way.

The Local Authority, as the charging authority, will need to set out a charging schedule which will form part of the LDF (but not a development plan document). CIL must be levied in pounds per square metre of the net additional increase in floorspace (gross internal floor space) of any given development over $100m^2$. The level set must not adversely affect economic viability of development across the area. Differential rates can be set but only when justified on viability grounds. Advice on viability is included in the draft regulations.

Another alternative for a carbon fund could be a non-monetary mechanism, using the PPS1 Supplement as the justification. The PPS states “...planning authorities can set out how the proposed development would be expected to contribute to securing the decentralised energy supply system from which it would benefit.” It could be argued that this means either physically or financially. There are a growing number of examples in adopted and emerging policy (for example in Southampton, London and Manchester) where new developments are required to connect to off-site district heating networks, contribute to their expansion or be able to connect in future. This could offer a relatively straight forward approach but may not provide the flexibility to accommodate emerging local energy opportunities that a financial mechanism would.

3.5.4 Summary of potential approaches to implementing a buyout fund

There is a growing number of examples of carbon fund policies in adopted Core Strategies and there seems to be a strong case for including them in planning policy to provide a mechanism for delivering energy opportunities. However, all policies so far have been set up prior to the introduction of CIL and where they are not compliant may need to be revisited. Dover would appear to be the one example which would be compliant. Furthermore, when we have clarity over the allowable solutions, policies may need to change again unless they are flexible – Dover would again appear to offer this flexibility since detail is left to supplementary planning documents.

A carbon fund could fulfil more than one purpose and there are several options for how a policy might be defined. These options are:

- payment into a carbon fund, where development can demonstrate that it is not feasible or viable to meet other planning policy. A fund operated through CIL is unlikely to be able to operate in this way since a flat fee is charged based on floorspace, with no option to link this to carbon or to make exceptions. Allowable solutions will be linked to a development’s ability to meet building regulation requirements on-site rather than any planning requirement. Section 106 could offer the opportunity to develop this kind of fund but would be limited by the three tests(necessary to make the development acceptable in planning terms; directly related to the development; and fairly and reasonably related in scale and kind to the development), therefore could not be operated across a whole local authority area and would need to be negotiated on a case by case basis.

---

[16] CLG (2007) PPS1 Supplement: Planning and Climate Change

- payment into a carbon fund for all developments instead or in addition to other policy requirements directed at development. This kind of fund could be based around CIL and, depending on Government policy, allowable solutions. Section 106 would be limited by the three tests and so could only be applied to certain schemes.

- payment into a carbon fund, with discounts or exemptions for developments that can demonstrate an equivalent level of carbon savings would be achieved on-site or by direct investment. Depending on what is confirmed for allowable solutions, this potentially offers the only route for this kind of fund.

In Islington there will be schemes where Section 106 could be used for energy infrastructure but these will be limited to those meeting the three tests. Table 37 provides summary of the advantages and disadvantages of the different implementation mechanisms for a carbon offset fund.

In term of carbon fund charging mechanisms, contributions could be in the form of:

- an amount per tonne of CO_2 emissions from the proposed development, as is being considered for allowable solutions
- a simple tariff contribution, based a per m^2 of development basis as proposed by the CIL

It is an unfortunate time to be drawing firm conclusions on which mechanism, if any, should be used to operate a carbon fund since there remain so many uncertainties around allowable solutions. Ideally, these decisions should be deferred until Government has confirmed its position. If delay is not possible, current practice suggests that planning policy can refer to a fund in the way Dover's Core Strategy does without committing to one particular mechanism.

Table 37 Advantages and disadvantages of the different implementation mechanisms for a carbon buyout fund

Mechanism	Advantages	Disadvantages
Community Infrastructure Levy	• This mechanism has a clear legal basis • A transparent link will be made between the predicted costs of identified infrastructure needs and the charge to developers if a flat rate is calculated per m^2 of development • It may be possible to charge a different rate for different types of development, provided this is justified in terms of the economic viability of those classes of development • A flat rate charge gives more certainty over the level of income the Council is likely to receive than a variable rate linked to CO_2 emissions • Councils can borrow prudentially against future receipts	• The local authority would need to implement CIL along with a charging schedule according to the required methodology. This would require a PPS12 compliant infrastructure study and a gap to be demonstrated between funding needs and core public funding • Restrictions on how CIL is charged would mean that the fund cannot be linked directly to the projected CO_2 emissions from a site, it must be a flat rate per m^2 of building floor area. It may not be possible to offer discounts or exemptions to encourage on-site action, but this could still be encouraged by using additional policy • Finance is dependent on non energy development
Planning Obligations (Section 106)	• It may be possible to justify using section 106 if funding is used to offset an increase in CO_2 emissions from a new development by making equivalent savings elsewhere but only if meeting the three tests set out in • A precedent has been set in Milton Keynes, where section 106 is used to obtain developer contributions to a carbon fund, but this may no longer be allowed following introduction of CIL	• The three tests means that Section 106 is unlikely to be able to be used to fund infrastructure needs across the local authority area • Finance is dependent on non energy development
Allowable Solutions (post 2016)	• Government proposals for allowable solutions may provide a route for local authorities to collect funds to contribute to local renewable and low carbon energy infrastructure • Consultations to date have referred to allowable solutions charges being implemented at a rate per tonne of CO_2 emitted over a 30 year period from a development	• Allowable solutions have not yet been confirmed as a mechanism, nor have details of how allowable solutions funds will be collected from developers and distributed • Local authorities may not have access to these funds • Finance may be dependent on non energy development

3.6 Conclusions

As a result of the analysis in this section of the report, the following conclusions can be drawn:

- even allowing for the fact that there will be significant retrofit within the existing stock within Islington as the result of national policies such as CERT, there are sufficient offset opportunities available within Islington to support a developer offset fund for all new development to 2020 and beyond. This assumes a 40% reduction in total emissions from onsite measures relative to a Part L 2006 compliant baseline (or 20% relative to a Part L 2010 compliant baseline) from 2010, and the successful realisation of the Government's target for zero carbon new homes from 2016 (requiring at least a 70% reduction in total carbon emissions from onsite measures relative to a Part L 2006 baseline)

- assuming that nearly all retrofit activity as the result of a developer offset fund would occur in the residential sector in the period to 2020, and given the anticipated effect of national policies in addressing many of the remaining opportunities for cost effective retrofit measures, by 2013 the carbon offset price set would need to be sufficiently high to enable carbon offset through retrofit of solid wall insulation

- taking the cost per annual tonne of carbon dioxide saved of c.£800 for the most cost effective form of solid wall insulation (external solid wall insulation installed as part of a solid wall retrofit), and adding a s.106 management fee of 5% and a project management fee of 10% results in a carbon price of £920 per annual tonne offset
- funds raised as a result of a developer offset fund with a carbon price of £920 per annual tonne emitted do not have to be spent solid wall retrofits, and in the earlier stages of the operation of the offset fund are likely to be spent on more cost effective measures, which could include some measures in the non-domestic sector. Equally, as the price has been set by solid wall insulation as part of a wider wall refurbishment, it is insufficient to offset residual emissions from new development through more expensive forms of solid wall insulation, such as internal solid wall insulation. However, by the time solid wall insulation becomes the most cost-effective option for offsetting, prices for these more expensive forms of solid wall insulation may have fallen
- the emissions reductions available from cost-effective retrofits in the non-domestic sector are uncertain but potentially very significant. It is recommended that LBI investigate these further for the non-domestic stock in Islington

- given the large potential for cost effective emission reductions from retrofit of solid wall insulation within the existing stock and the use of the s.106 process to implement retrofit measures in other schemes, the s.106 process is likely to be the best implementation mechanism within Islington. However, it should be worded sufficiently flexibly to accommodate the as yet uncertain allowable solutions. Non-monetary requirements could be considered but may form only part of the approach

- Dover's Core Strategy shows how this could be done in a way already considered 'sound' by an Inspector

- detail should be set out in a supplementary planning document which can be updated as necessary

- if it were desired to fund the roll-out of community wide energy infrastructure though an offset fund then CIL would be a more suitable mechanism through which to operate the fund, given the constraints on the use of s.106 payments

.

4 Evidence base in support of the Borough-wide Code for Sustainable Homes and BREEAM targets

4.1 Introduction

The aim of this section of the report is to review the existing evidence base and analyse the extent to which this supports the case for the viability of proposed Borough-wide Code for Sustainable Homes Level 4 and BREEAM Excellent targets. The evidence base considered comprises the following:

- the professional fees associated with carrying out Code and BREEAM assessments
- the viability of the proposed BREEAM and Code targets for minor developments resulting from this report
- PPS1a Phase 1 report

4.2 Professional fees

The Code for Sustainable Homes and BREEAM 2008 schemes require that an independent accredited assessor undertakes the assessment, and there is therefore a professional fee involved in commissioning an assessment process for a scheme. In addition, further consultant fees are usually incurred in relation to credits requiring specialist sign-off. Ecology, sound insulation, daylighting and transport are examples of these.

Estimates of professional fees for the different schemes are provided in Table 38. These include the additional costs associated with specialist consultants for the cases where it is considered that these would be incurred. More detailed breakdowns of these professional fee estimates for each scheme are provided in Appendix 14.

Table 38 Estimated professional fees associated with Code Level 4 and BREEAM Excellent by case study

Case study	Case study description	Code/Ecohomes professional fees / £	BREEAM professional fees / £
P100300	1 detached house	10,015	N/A
P092717	7 new flats	27,385	N/A
P100806	Small office (B1)	N/A	30,730
P100915	B1 plus 8 flats	27,405	30,730
P100915	A1/A2/A3 plus 8 flats	27,405	30,730
P091383	Conversion of house to 4 flats	27,415	N/A

4.3 Non-energy costs associated with Code Level 4 and BREEAM Excellent

Code for Sustainable Homes Level 4 requires as a mandatory element that the dwelling achieves a 44% reduction over Part L 2006 emissions, which is equivalent to a 25% reduction over Part L 2010 (assuming the same emission factors for different fuel types). The modelling carried out within this study has tested the viability of achieving a 25% reduction over Part L 2010, and the costs associated with this requirement are therefore known.

The non-energy costs associated with achieving Code for Sustainable Homes Level 4 were identified from a previous study[17] examining the costs of compliance with different levels of the Code. For a small brownfield development the non-energy costs are as summarised in Table 39. The costs are the non-energy extra-over (E/O) costs for CSH Level 4 relative to a Part L 2006 compliant baseline. Following the recent consultation period, the Code is due to be updated in October 2010. Although the case studies in this report are assessed against a Part L 2010 compliant baseline, the costs for the non-energy credits within the Code for Sustainable Homes 2010 are not expected to change as result of aligning Part L 2010 with the new Ene 1 credit. However, until a policy decision has been made on the proposals which will be adopted, and a subsequent cost review is carried out, the actual cost uplift of building to Level 4 under Code 2010 will be unknown.

Table 39 The non-energy costs associated with achieving Code for Sustainable Homes Level 4 on a small brownfield site

Dwelling type	Code Non-Ene 1 costs/ £
Flat	1,095
Detached	1,160
Semi-detached	1,380
Terraced	1,225

The Code for Sustainable Homes, Ecohomes (for existing dwellings) and BREEAM schemes impose a number of requirements across a range of sustainability categories which can sometimes be unachievable due to the particular constraints of the site. For some issues, these constraints are likely to be more acute in the case of smaller sites than larger sites. Appendix 13 provides an analysis of the constraints that may be encountered for minor developments.

BREEAM 2008 requires as a mandatory requirement within the Ene 1 credit for an Excellent rating that an EPC score of 40 or below is achieved. This equates to an EPC rating at the upper end of the C band, or the lower end of the B band, depending on the nature of the non-domestic building (use type and whether it is air conditioned). There is therefore no direct link to emissions reductions under Part L 2010 and EPC ratings which can be applied across non-domestic buildings generally. However, based on previous project experience, in general terms it should be possible in at least some cases for a non-domestic building achieving the level of carbon emissions indicated as possible in this study to achieve this level of EPC rating. We have assumed for the purpose of costing the energy credit associated with BREEAM Excellent that the non-domestic building is implementing the maximum level of LZCs possible for the site.

For the non-energy costs, previous AECOM project experience has been used to assess the types of strategy used to achieve BREEAM Excellent for office and retail buildings, and the site constraints that might apply on small scale developments have been taken into account in judging whether particular credits would be available. For the non-domestic case studies considered in this study, the non-energy costs are estimated to be as shown in Table 40. These have been reviewed internally within AECOM, and are judged to be sound estimates for the total non-energy costs that would be incurred in achieving BREEAM Excellent.

[17] Code For Sustaintable Homes, A cost review. DCLG, March 2010 p.99-101

Table 40 Estimated non-energy costs for BREEAM Excellent by case study

Case study	Case study description	BREEAM Excellent non-energy costs/ £
P100806	Small office (B1)	200,000
P100915	B1 plus 8 flats	160,000
P100915	A1/A2/A3 plus 8 flats	120,000

Total non-energy costs for all the schemes are shown in Table 41.

Table 41 Estimated total non-energy costs for BREEAM Excellent and Code Level 4 by case study

Case study	Case study description	CSH Level 4 /Ecohomes non-energy costs (total for scheme)/ £	BREEAM Excellent non-energy costs/ £
P100300	1 detached house	1160	N/A
P092717	7 new flats	7665	N/A
P100806	Small office (B1)	N/A	200,000
P100915	B1 plus 8 flats	8760	160,000
P100915	A1/A2/A3 plus 8 flats	8760	120,000
P091383	Conversion of house to 4 flats	4380	N/A

4.4 The viability of Code Level 4 and BREEAM Excellent targets for minor developments

Appendix 10 provides the detailed residual profit appraisals for each of the case studies showing the effect of the different carbon reduction targets and a Code Level 4 and/or BREEAM Excellent requirement on scheme profitability. For the residential components of the schemes, these are based on the lowest cost method of reaching the 25% onsite target (to reflect the energy related costs of achieving Code Level 4), together with the costs of offsetting the remaining regulated emissions plus all of the unregulated emissions at a cost per annual tonne of carbon emitted of £920 per tonne.

In the case of non-domestic components of the schemes, the energy costs are based on the maximum achievable reductions in on-site energy, which has been assumed to enable achievement of the required EPC rating for BREEAM Excellent. BREEAM non-energy costs and the cost of offsetting remaining emissions at £920 per tonne are also included.

The effect on cost viability of imposing a Code for Sustainable Homes Level 4 and/or BREEAM Excellent target on minor developments, in addition to onsite reduction target of 25% and an offset requirement to achieve net zero carbon emissions has been assessed in Section 2.4 of this report.

In summary, as a result of the analysis carried out for this report, it is estimated that:

- the cost viability of new build minor purely residential schemes would not be significantly adversely affected by a combination of a 25% reduction target, an offset requirement and a Code for Sustainable Homes Level 4 target in cases where all technology options are available, but it would become marginally viable in cases where DH and ASHPs are unavailable

- the cost viability of new build minor purely non-domestic schemes would be significantly adversely affected by a combination of an onsite reduction target (at any level over Part L 2010), an offset requirement and a BREEAM Excellent target

- for residential-led mixed use schemes, cost viability of the scheme as a whole would be very adversely affected if the residential component was subject to a 25% onsite reduction target, an offset requirement and a Code for Sustainable Homes Level 4 target, and in addition the small non-domestic component was subject to achieving the largest onsite reduction target possible (which would be a less than 16% improvement over Part L 2010), an offset target and a BREEAM Excellent target

- if the residential component of residential-led minor mixed use schemes was subject to a 25% onsite reduction target, an offset requirement and a Code for Sustainable Homes Level 4 target, but the small non-domestic component did not have any requirements of this kind, cost viability for the mixed use scheme as a whole would become marginally viable when all technology options are available but unviable when DH or ASHPs are not available

In conclusion, it is estimated that a Code for Sustainable Homes Level 4 target (in addition to an onsite reduction target of 25% over Part L 2010 and an offset requirement to achieve net zero carbon at £920 per annual tonne of carbon dioxide emissions) could be viable for new build minor residential schemes, including the residential component of mixed use schemes when DH or ASHPs available as technology options. However, a BREEAM Excellent target is unlikely to be viable for the majority of non-domestic minor developments.

It is recommended that, particularly in cases where viability is estimated to become more marginal as a result of low carbon policies, LBI adopt a case by case approach to assessment of minor schemes against the policy requirements.

4.5 The viability of Code Level 4 and BREEAM Excellent targets for major developments

In respect of major developments, the PPS1a evidence base prepared by Fulcrum Consulting has demonstrated that a carbon reduction target of around 40% of total carbon dioxide emissions over a Part L 2006 compliant baseline is technically and financially viable for the majority of major developments in Islington (new build office schemes being notable exceptions). This rises to 50% where connection to a district heating network is possible (again excluding offices).

Achieving Code for Sustainable Homes Level 4 requires as a mandatory element that new build dwellings achieve a 44% reduction in **regulated** emissions over a Part L 2006 baseline though onsite measures. This is less stringent than a 44% reduction in **total** emissions over a 2006 baseline, which would be broadly in line with the reduction targets shown to be viable by the PPS1a evidence base. Assuming that the emission reductions achieved in meeting a 40% reduction in total emissions are split proportionately between regulated and unregulated emissions, this target would therefore be consistent with achieving the energy related credits required by Code Level 4. As the total costs in achieving Code for Sustainable Homes Level 4 are dominated by the energy costs, it is reasonable to conclude that the proposed borough-wide target of Code Level 4 would be technically and financially viable for most major developments in Islington.

For non-domestic buildings, achieving BREEAM Excellent is dependent on the mandatory requirement of achieving an Energy Performance Certificate (EPC) rating of 40 or better. For this reason, the extent to which the PPS1a evidence base assessing the viability of carbon reduction targets for major non-domestic schemes supports the proposed borough-wide BREEAM Excellent target is more limited.

When assessing reductions in carbon dioxide emissions under Part L 2010, the building being assessed is compared with a Notional Building. The Notional Building is similar to the actual building, the main differences being that the Notional Building has standardised glazing areas for a non-domestic building of that type, and in cases where the actual building uses electricity as the heating fuel, the Notional Building instead uses oil. Significantly, the Notional Building has the same ventilation system as the actual building. The types of ventilation system are natural ventilation, mechanical ventilation, or a combination of the two ("mixed-mode" ventilation). Mechanical ventilation has higher carbon emissions associated with it due to increased electricity use for fans. Therefore, In terms of achieving a given percentage reduction over Part L 2010, there is little penalty in a building having mechanical ventilation, as the additional carbon emissions are also reflected in the Notional Building baseline.

However, the EPC rating for a building is derived by comparing it to a different baseline to the Notional Building, namely the Reference Building. The Reference Building differs significantly from the Notional Building in that it always has a mixed-mode ventilation system. The performance of the actual building compared with the Reference Building under the EPC regime is therefore dependent on the type of ventilation system selected, with mechanically ventilated buildings performing less well than mixed-mode buildings, and naturally ventilated buildings having an advantage.

It is therefore possible for a mechanically ventilated building to achieve a significant carbon reduction under Part L part but a relatively poor EPC rating, whereas for a naturally ventilated building carbon emission performance relative to a Part L baseline may be relatively poor but a good EPC rating could be achievable.

In non-domestic buildings, there is therefore no strong link between the percentage reduction in carbon dioxide emissions assessed through the Part L 2010 process and the EPC rating achieved. The PPS1a study based on assessing the viability of carbon emission reduction targets is therefore necessarily limited as evidence supporting the viability of a borough wide BREEAM Excellent target.

4.6 Conclusions

An assessment of the evidence base potentially supporting the viability of the proposed Borough-wide Code for Sustainable Homes Level 4 and BREEAM Excellent targets has resulted in the following conclusions:

- for minor residential developments, a Code for Sustainable Homes Level 4 target (in addition to a 25% onsite reduction target and a requirement to offset remaining emissions) is estimated to be viable, including cases where DH and ASHP are unavailable as technology options. For residential-led mixed use schemes, scheme viability becomes more marginal when this additional requirement is imposed on the residential component. Achieving this marginal viability was dependent on the absence of any planning policy requirements on the non-domestic component, and, for the case studies assessed, was also dependent on the use of DH or ASHPs
- for minor non-domestic developments, a BREEAM Excellent target is unlikely to be viable
- for major residential developments, the evidence base suggests that a Code for Sustainable Homes Level 4 target is likely to be viable