TOWER HAMLETS

CABINET

Tuesday, 5 January 2016 at 5.30 p.m.
C1, 1st Floor, Town Hall, Mulberry Place, 5 Clove Crescent, London, E14 2BG

CARBON OFFSET SOLUTIONS STUDY REPORT

The meeting is open to the public to attend.

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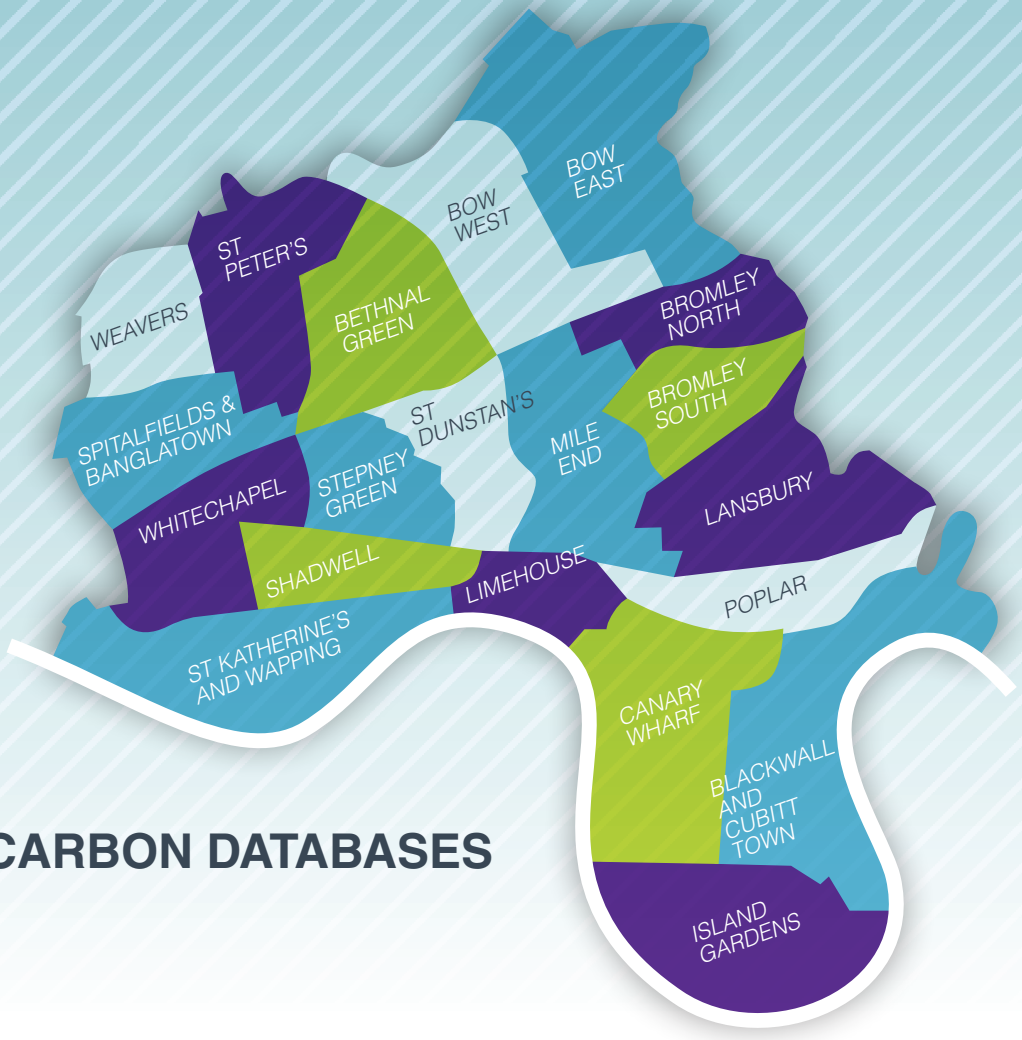
THE LBTH CARBON OFFSET FUND



REPORT
ENERGY AND CARBON DATABASES GIS TOOL

A study carried out by Etude on behalf of the London Borough of Tower Hamlets

Etude

TOWER HAMLETS

MAYOR OF TOWER HAMLETS

ACKNOWLEDGMENTS

The benchmarking review carried out as part of this study is based on the feedback of Council Officers who have kindly given some of their time to share their experience and expertise and contribute to this study.

We would particularly like to thank:

- Eloise Lobsey (London Borough of Islington)
- Jennifer Daothong (London Legacy Development Corporation)
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- Bob Fiddik (London Borough of Croydon)
- Martin Davies (Milton Keynes Council)
- The London Borough of Hackney

Feedback on the Milton Keynes Carbon Offset Fund was also kindly provided by Brad Hook (National Energy Foundation).

Beyond these interviews, we have conducted a comprehensive litterature research into Carbon Offset Funds. A bibliography is given in section 14.0. This study has benefited from the findings of these other studies carried out in the last few years.

We would also like to express our thanks to James Hardy at the Greater London Authority for his help in obtaining the residential Energy Performance Certificates.

We are grateful to the Zero Carbon Hub and in particular Tessa Hurstwyn (Technical Director), Ross Holleron (Projects Director) and Tassos Kougionis (Technical Manager) for their advice.

Finally and most importantly we would like to thank the London Borough of Tower Hamlets and in particular Abdul Khan, Prabhjot Singh Babra and Michele Baldelli for their help and advice. We are very grateful to Jonathan Taylor who has directed this study throughout its development.

… and a big thank you to the team who has worked on this study and the development of the associated energy and carbon databases: Anna, Peter, Dan, Aaron, Will, Chris and Leon.

COMMENTS

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1.0

EXECUTIVE SUMMARY

1.0 EXECUTIVE SUMMARY

The London Borough of Tower Hamlets is committed to the objective of reducing CO_2 emissions and has commissioned this study to investigate how a Carbon Offset Fund could help new developments comply with planning policy (in particular Managing Development Document Policy DM29) and fund carbon saving projects near-site or off-site.

Despite the context of uncertainty it is recommended that the London Borough of Tower Hamlets sets up a Carbon Offset Fund

The Housing Standards Review, the Deregulation Act 2015, the evolution of the Zero Carbon Homes policy (indefinitely postponed in July 2015) and recent changes energy efficiency support programmes (e.g. withdrawal of the Green Deal) create a context of uncertainty which is explained in section 3.0. Our analysis concluded that the London Borough of Tower Hamlets should not let this uncertainty delay its strategic plans to reduce CO_2 emissions across the borough as there are significant opportunities associated with Carbon Offsetting which could help to achieve carbon savings in the short, medium and long term, particularly through energy efficient domestic and non-domestic retrofits.

The Carbon Offset Price should be fair to developers but cost efficiency of individual measure should not be the only criteria for project selection

Section 5.0 clarifies a number of key concepts and principles associated with Carbon Offsetting including the Carbon Offset Price (£/tonne CO_2), i.e. the price which applicants will have to pay to offset their CO_2 emissions shortfall, and the Carbon Offset Ratio, i.e. the ratio between the carbon emission shortfall requiring offsetting and the carbon savings delivered by the Carbon Offset Fund. The combination of the Carbon Offset Price and the Carbon Offset Ratio is considered particularly critical: a clearly defined price should be fair for applicants and suitable to fund a wide range of carbon abatement measures while the ratio needs to be flexible to enable LBTH to take into account other Council's priorities (e.g. fuel poverty, value for money, local employment). There are also strong justifications for cost efficiency not to be the only metric and for a longer term strategy to influence the approach to funding. Other key components of a Carbon Offset Fund including payment mechanisms, project eligibility criteria and identification process, carbon accounting rules and verification requirements are also discussed in this section.

The Benchmarking Review (Section 6.0) summarises the results of the literature research and Local Authorities interview process. It includes both a quantitative comparison of various Carbon Offset Funds in operation or development in the UK and a qualitative analysis of the key approaches adopted and lessons to be learned by LBTH. This section is concluded by a set of recommendations:

A number of key recommendations have been gathered by our benchmarking review of existing or emerging Carbon Offset Funds in the UK

- A **Carbon Offset Price** of £1,800/tonne CO_2 (i.e. £60/tonne CO_2 over 30 years) should be used based on the GLA recommended price;
- The requirement to offset residual CO_2 emissions should focus on **regulated emissions** in line with DMD 29 and cover **all planning applications** i.e. residential and commercial, minor and major;
- **s106 agreements** should be used as the mechanism to obtain contributions into the Carbon Offset Fund;
- **Payment** of the contribution into the Carbon Offset Fund should be sought on commencement;
- **Carbon saving project delivery** should be a robust process including a structured project identification procedure and rigorous *ex ante* and *ex post* verifications;
- **Fund management principles** should include clarity, accountability and transparency. Further details are provided in Section 11.0 including the recommendation to set up a two-tier governance structure and in the medium term a Community Interest Company managed by LBTH officers.

A budget comprised between £0.5m and £2m should be available annually for Carbon Offset Solutions in Tower Hamlets over the next 20 years

Based on the assumptions and correction factors set out in this report the Carbon Offset Revenue Calculator indicates that a budget comprised **between £0.5m and £2m should be available annually for Carbon Offset Solutions** in the borough.

Section 8.0 summarises the estimated carbon and cost benchmarks of several carbon abatement measures to inform how this annual budget could be spent and recommends four key project types:

- **Domestic energy efficient retrofits focusing on the social housing sector (Fuel Poverty projects)**;
- **Non-domestic energy efficient retrofits focusing on public buildings;**
- **Community energy projects (e.g. community owned renewable energy projects);**
- **Connections to existing District Heating Networks.**

The complexity and diversity of the works involved in retrofits are significant compared with projects aiming at increasing the number of connections onto an existing District Heating Network or of PV installations. Therefore, the approach to domestic and non-domestic retrofits currently tends to be project-led: a building is put forward for retrofit and if considered suitable, a package of improvements is agreed and can be supported by one or several national or local funding and delivery mechanisms (e.g. ECO, Re:NEW, Re:FIT). However, the lack of strategy behind the allocation of funds is a significant issue and could raise important questions, e.g.

> *Should this school really have received funding for an energy efficient retrofit if it is not in the bottom 25% of the worst performing schools in the borough from an energy point of view?*
>
> *Should this apartment block have received this level of funding when an apartment block located closer to a major development site would have equally needed it?*

The ambition to deliver a study which will be useful to the London Borough of Tower Hamlets despite the context of uncertainty and to propose an innovative solution to identify potential retrofit projects have been constant drivers of the work undertaken. This report is therefore complemented by four other deliverables:

Four tools have been developed alongside this study to inform LBTH carbon offset decisions: a calculator, two energy/carbon databases and a GIS tool

1. a '**Carbon Offset Revenue Calculator**', which will enable the Sustainability Services Team within the London Borough of Tower Hamlets to assess the scale of the funds likely to be available. This will enable a forecast for the next 20 years based on the estimated development build-out and a set of key parameters which can easily be adjusted;
2. a '**Domestic Carbon Offset Solutions Database**' which provides key energy and carbon data for 8,000+ domestic properties in the social housing sector across the borough as well as the modelled impact of various carbon saving measures and their associated costs;
3. a '**Non-Domestic Carbon Offset Solutions Database**' which provides key energy and carbon data on 120+ non-domestic public buildings across the borough as well as benchmark information on various carbon saving measures and their associated costs;
4. a **Geographic Information System (GIS) tool** which now incorporates key information from the above databases on LBTH GIS maps. The GIS tool enables the user to visualise the current energy performance and carbon saving potential of a large number of existing buildings.

These two Carbon Solutions databases are the result of a significant work which involved analysis of a wide range of databases as well as data matching, post-processing and modelling. The key information provided includes:

a. Current energy consumption (kWh/year);

b. Current CO_2 emissions (tCO_2/year);

c. Estimated total potential CO_2 saving (tCO_2/year)

d. Estimated % CO_2 saving;

e. Estimated capital costs (£);

f. Cost per tCO_2 over the average lifetime of the improvements (£/tCO_2).

Items a-e form a separate database which has been linked to LBTH GIS tool, enabling it to display these key energy and carbon data on an interactive map of the borough. This can help to identify clusters of residential properties requiring energy efficiency improvements or a public building with a carbon saving potential matching the residual carbon emissions of a new development nearby.

The six figures below illustrate the type of information which can be derived from the databases:

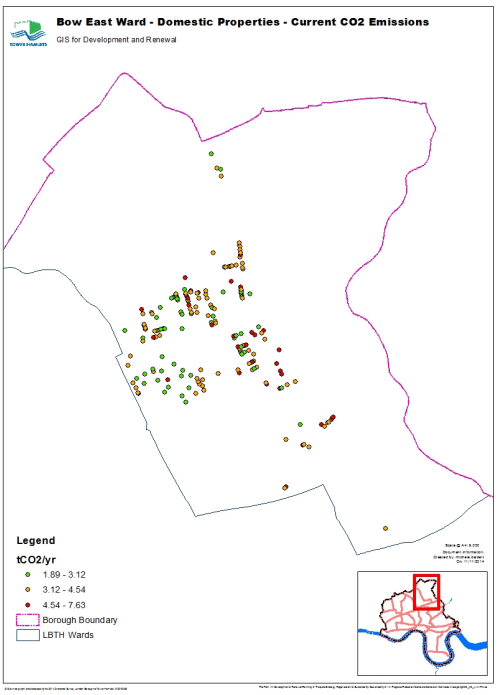


Figure 1: Social Housing – Current CO_2 emissions of domestic properties in the database located in each LBTH Ward (example for Bow East Ward)

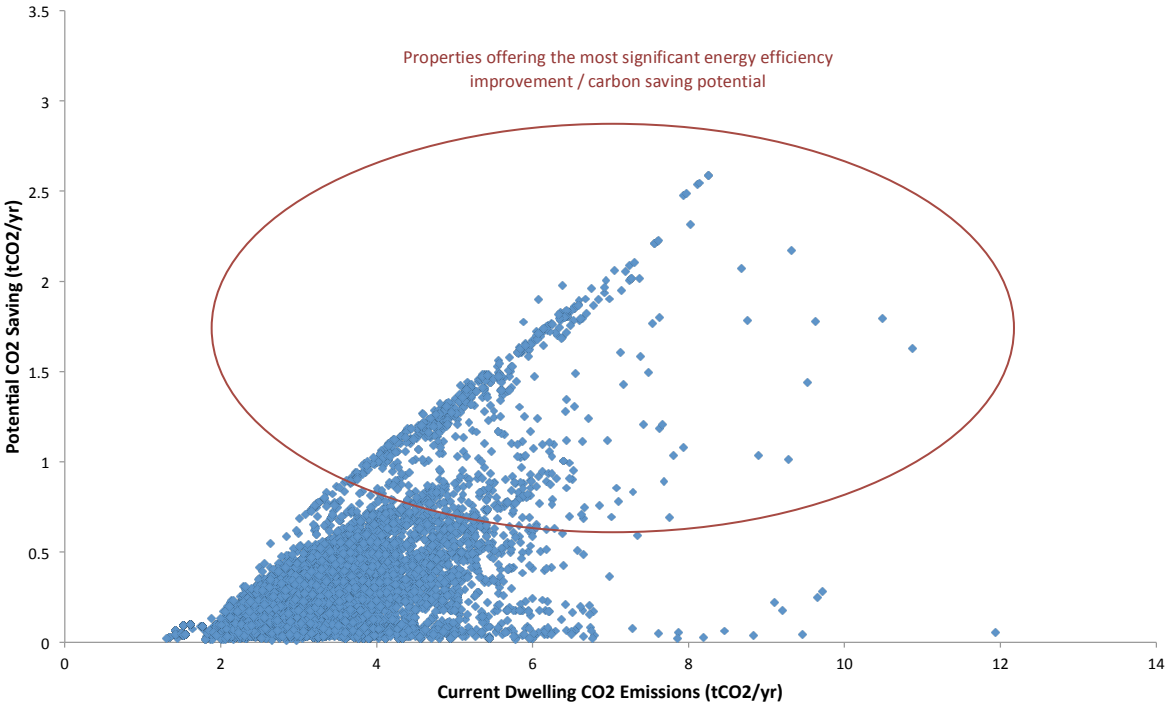


Figure 2: Social Housing – Dwelling CO_2 emissions vs Potential CO_2 reduction (based on 8,000+ dwellings)

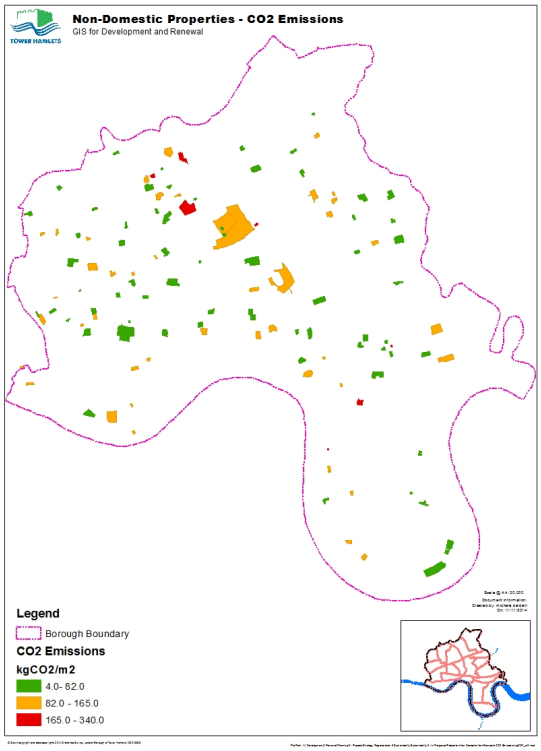


Figure 3: Non-domestic public buildings – Current CO_2 emissions ($kgCO_2/m^2/yr$)

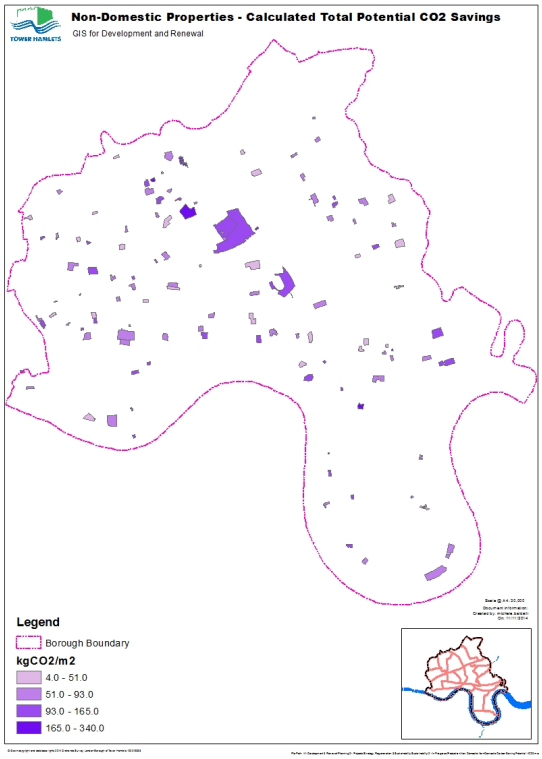


Figure 4: Non-domestic public buildings – Potential CO_2 savings ($kgCO_2/m^2/yr$)

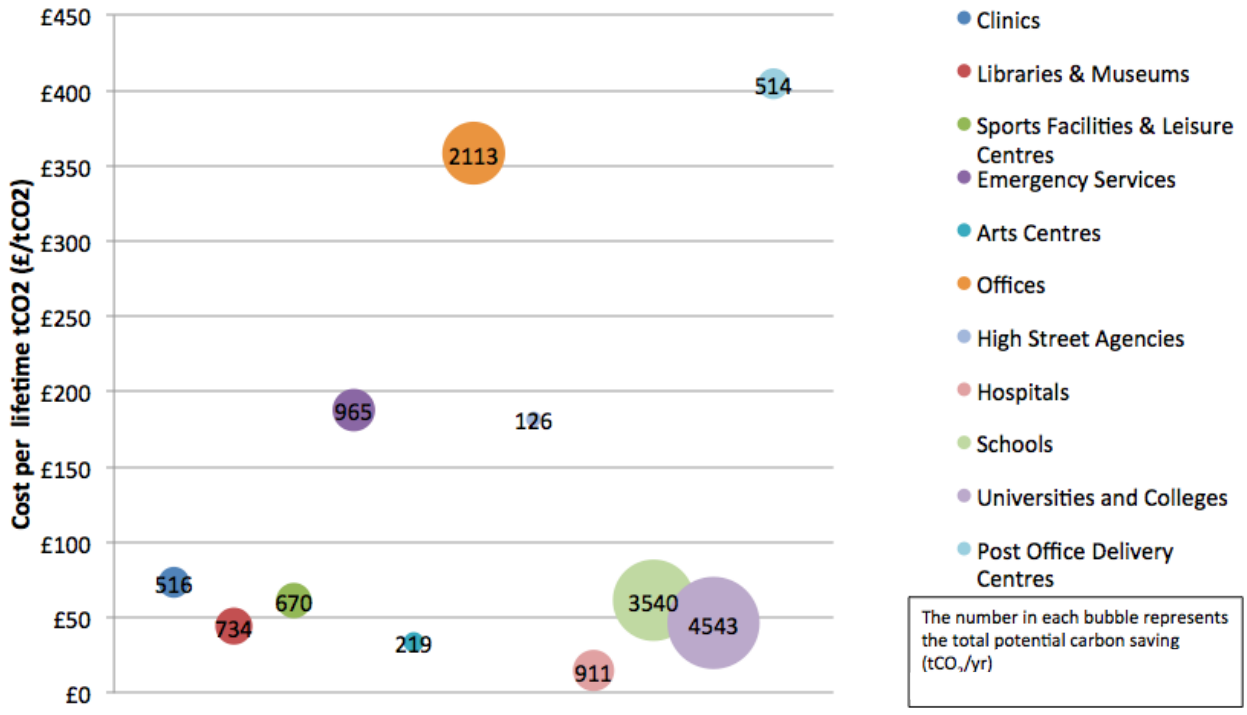


Figure 5: Non-domestic public buildings – costs and potential CO_2 savings (based on sample of 120+ public buildings)

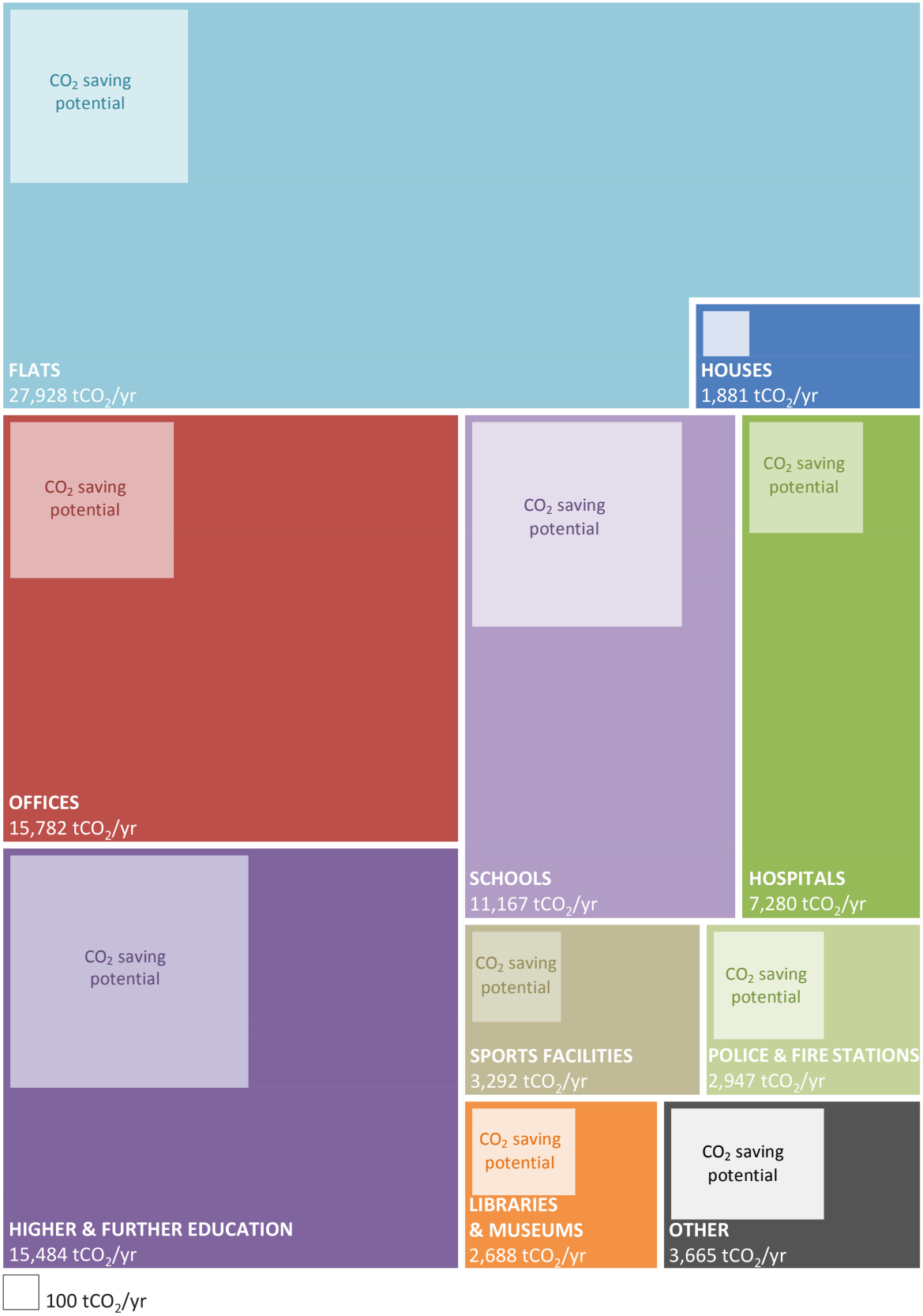
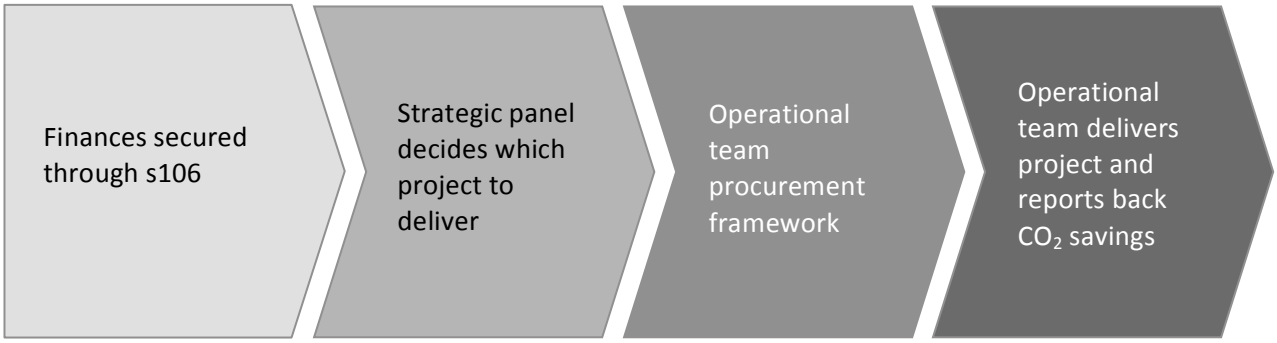
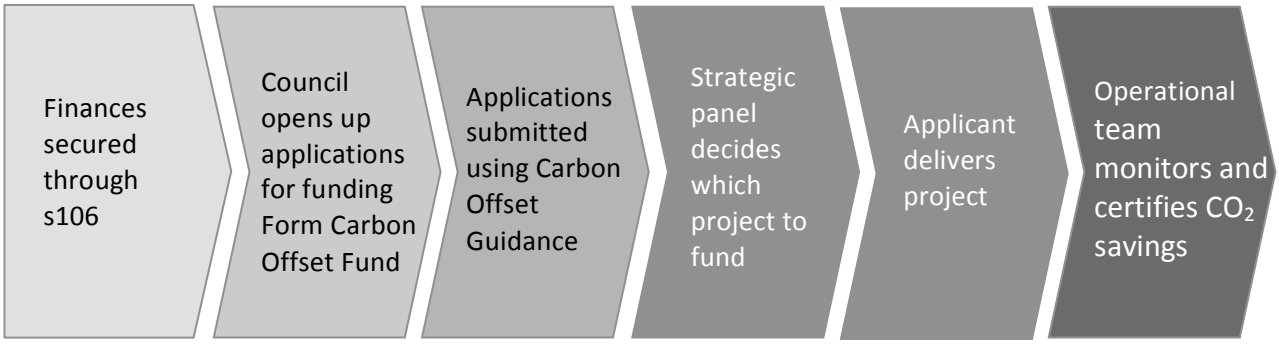


Figure 6: Visualisation of CO_2 emissions and CO_2 saving potential based on the LBTH Carbon Solutions databases developed as part of this study for 8,000+ social housing properties and 120+ public buildings

During the initial phase of the Carbon Offset Fund, the Council will use the GIS tool and the associated Carbon Solutions Databases to inform the allocation of funds to carbon saving projects. The following process will be followed.



In the second phase the Council will open the Carbon Offset Fund to bids from individuals and organisations across the borough. The following process will be followed:



Project prioritisation will be based on evolving factors including Council priorities, technological advancement and cost effectiveness of reducing CO_2 emissions

Projects that offer the best value for money and greatest benefits for the residents of Tower Hamlets will be a priority for delivery through the Carbon Offset Fund. Alleviating fuel poverty is a high priority for the Council and these projects will be given precedence as they directly benefit those who need it most. The implications for improving air quality will also be prevalent in decision making process.

Reducing energy costs and CO_2 emissions in council operational buildings will also be given high priority. These projects will provide financial savings to the Council due to significant expenditure on energy costs and the amount payable through the UK Government Carbon Reduction Commitment scheme.

Projects creating resilient, empowered and sustainable communities will be also given priority. In particular, projects enabling communities to control and own the generation and usage of renewable energy will be priorities as they offer the potential to bring communities together and play a part in creating self-sustaining communities.

Energy efficiency measures and renewable energy technologies will continues to improve and advance. The list of technologies, and the order of priority as identified in this Study, will be continually revised to ensure the measures offer best value for money and CO_2 reduction.

2.0

LIST OF ABBREVIATIONS

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BER **Building Emission Rate**: regulated carbon emission rate for a new non-domestic property as assessed by accredited Part L softwares and expressed in $kgCO_2/m^2/yr$. The BER is compared against the TER (Target Emission Rate) which represents the carbon emission limit set by Part L of the Building Regulations.

CERT **Carbon Emissions Reduction Target**: Government scheme based on a requirement imposed on UK gas and electricity suppliers who had to achieve targets for reducing carbon emissions in domestic properties. The scheme ran from 2008 to 2012.

CESP **Community Energy Saving Programme**: Government scheme creating an obligation on major energy suppliers to deliver energy saving measures to low-income households in specific areas of the UK. The scheme ran from 2009 to 2012.

CEF **Community Energy Fund**: see Carbon Offset Fund.

CHP **Combined Heat and Power**: simultaneous generation of usable heat and electricity.

CIC **Community Interest Company**: new type of company introduced in 2005. They include community enterprises, social firms, mutual organisations such as co-operatives, and large-scale organisations operating locally, regionally, nationally or internationally. A CIC uses its profits and assets for the public good.

CIL **Community Infrastructure Levy**: planning charge introduced in England and Wales to help deliver infrastructure to support development.

CLG **Company Limited by Guarantee**: alternative legal structure to the CIC with less constraints.

COF **Carbon Offset Fund**: fund receiving payments from projects failing to achieve their target CO_2 emissions on-site and investing in a fund in order to save carbon elsewhere.

CWI **Cavity Wall Insulation**: insulation placed between the outer brick layer and the inner layer.

DECC **Department of Energy and Climate Change**: Government department in charge of the UK energy policy.

DER **Dwelling Emission Rate**: regulated carbon emission rate for a new domestic property as assessed by accredited Part L softwares and expressed in $kgCO_2/m^2/yr$. The DER is compared against the TER (Target Emission Rate) which represents the carbon emission limit set by Part L of the Building Regulations.

DCLG **Department for Communities and Local Government**: Government department for communities and local government.

DM29 **LBTH Development Management Document Policy DM29** which requires new developments to exceed the requirements of Building Regulations in terms of CO_2 emissions.

ECO **Energy Companies Obligation**: Government scheme introduced in January 2013 to work alongside the Green Deal and reduce energy consumption of existing buildings. The Current phase of the ECO due to end in March 2017.

EU ETS	**European Union Emission Trading Scheme**: the largest multi-country, multi-sector greenhouse gas emissions trading system in the world. Creates a market and price for carbon allowances in order to reduce global carbon emissions.
FiT	**Feed in Tariffs**: payments to ordinary energy users for the renewable electricity they generate, designed to accelerate investment in renewable electricity technologies.
GLA	**Greater London Authority**: Regional Authority in London.
IfS	**Institute for Sustainability**: independent charity established in 2009 to accelerate the delivery of economically, environmentally and socially sustainable cities and communities.
LBTH	**London Borough of Tower Hamlets**
Part L	**Part L of the Building Regulations**, including Approved Documents Part L1 and L2 relate to the conservation of fuel and power in dwellings and non-domestic buildings.
RE:FIT	Program offered by the Mayor or London to reduce energy use and carbon emissions by 40% in public sector buildings in London by 2025.
RE: NEW	Program offered by the Mayor or London that installs energy efficiency measures in London's homes to reduce CO_2 emissions, water use and NOx emissions.
RHI	**Renewable Heat Incentive**: fixed payment for the renewable heat generated by homeowners, private and social landlords.
RHPP	**Renewable Heat Premium Payment**: one-off payments to householders to help them invest in renewable heating technologies – solar thermal panels, heat pumps and biomass boilers. The scheme closed at the end of March 2014.
S106	**Section 106**: also known as planning obligations.
SAP	**Standard Assessment Procedure**: methodology for assessing and comparing the energy and environmental performance of dwellings.
SALIX	**Salix Finance** proposes 100% interest-free loans to the public sector to improve their energy efficiency and reduce their carbon emissions.
SBEM	**Simplified Building Energy Model**: computer program that provides a standardised analysis of a non-domestic building's energy consumption and determine the associated CO_2 emission rates. The purpose of the software is to produce consistent evaluations of energy use for the purpose of evaluating compliance with Part L2 of the Building Regulations.
SWI	**Solid Wall Insulation**: generally a composite system composed of three basic layers: an insulant, a fixing, and a protective, decorative finish. The insulation product is fixed on a solid external wall. The two main types of solid wall insulation are external and internal.
TER	**Target Emission Rate**: minimum allowable standard for the energy performance of a building defined by the annual CO_2 emissions of a notional building / dwelling of the same type, size and shape to the proposed building / dwelling.
ZCH	**Zero Carbon Hub**: the Zero Carbon Hub was established in 2008, as a non-profit organisation, to take day-to-day operational responsibility for achieving the government's target of delivering low carbon homes.

3.0

CONTEXT

3.0 CONTEXT

3.1 Brief from the London Borough of Tower Hamlets

3.1.1 Carbon emissions in Tower Hamlets

Of the 33 Local Authorities in Greater London, Tower Hamlets produces the third highest level of total carbon emissions. DECC figures show that whilst 30 of the 33 London Boroughs have continually reduced their CO_2 levels (on average 11% reduction per Borough on 2005 levels) the LBTH total emissions have risen by 12%.

Planning policy aims at minimising CO_2 emissions from new developments. However, recent experience has indicated that achieving the required carbon reduction target on-site is not always technically feasible or financially viable. Offsetting the residual emissions is therefore required in these cases in order to fund carbon saving measures off-site.

This additional financial resource is an opportunity for the London Borough of Tower Hamlets. A Carbon Offset Fund would be able to influence greater carbon reductions in the existing stock while acting alongside other mechanisms / incentives (e.g. ECO). It could also help to address other issues relevant to the community in Tower Hamlets (e.g. fuel poverty).

3.1.2 Planning policy

The Core Strategy is the key spatial planning document for Tower Hamlets, setting out the spatial vision for the borough and how it will be achieved. It is one of the key tools to realise the vision of the Community Plan. The Core Strategy was formally adopted by the Council in September 2010 and includes Policy SO24 which seeks to achieve a zero carbon borough in the 21st century, with a 60% reduction in carbon emissions by 2025.

In addition to Policy SO24, LBTH Managing Development Document Policy DM29 sets out carbon reduction as well as sustainable design and construction requirements within the borough as follows:

1. *Development will be required to be accompanied by an Energy Assessment to demonstrate its compliance with the following:*

   Residential development

Year	***Improvement over 2010 Building Regulations***
2011-2013	*35% CO_2 emissions reduction*
2013-2016	*50% CO_2 emissions reduction**
2016	*Zero Carbon*

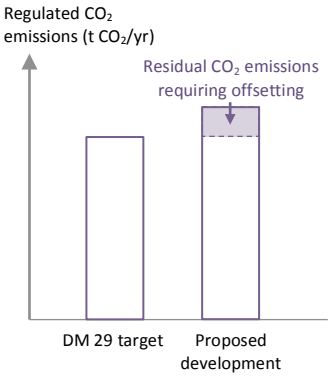
   Non-residential development

Year	***Improvement over 2010 Building Regulations***
2011-2013	*35% CO_2 emissions reduction*
2013-2016	*50% CO_2 emissions reduction**
2016-2019	*As per building regulations*
2019	*Zero Carbon*

2. *Development will be required to connect to or demonstrate a potential connection to a decentralised energy system.*

** This is considered to be equivalent to a 45% improvement over 2013 Building Regulations*

The proposed CO_2 emission reductions as outlined in Policy DM29 provide a responsive framework to take forward the LBTH Community Plan and Core Strategy target to reduce carbon emissions by 60% by 2025 against a 1990 baseline and reduce greenhouse gas emissions in accordance with the aims of the Climate Change Act 2008.



The CO_2 reduction target should ideally be met on-site

It is important to note that Policy DM29 focuses on the cumulative steps of the energy hierarchy to deliver CO_2 emission reductions: energy demand should be reduced as much as possible through energy efficiency and energy supply should be low carbon. The carbon dioxide reduction targets set out in Policy DM29 should ideally be met on-site. However, where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site in accordance with the Planning Obligations SPD adopted in January 2012 which states that:

> *The remaining carbon emissions will be offset through providing new and additional opportunities to reduce carbon emissions from existing housing in the Borough or community energy saving programmes or other initiatives.*

The LBTH Sustainability Service has emphasised that the contribution to the Carbon Offset fund will only be accepted if the applicant's justification for not fully achieving the DM29 planning policy carbon reduction targets on-site is considered acceptable. In no circumstances will a contribution to the Carbon Offset fund be accepted by LBTH if the on-site carbon performance could reasonably be further improved.

The principle of carbon offsetting is supported by the GLA

This approach is supported by the Greater London Authority (GLA) in the London Plan. Policy 5.2 sets out the CO_2 reduction targets to be met by new planning applications. It also states that:

> *Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.*

3.1.3 The Brief

The Sustainability Service within the London Borough of Tower Hamlets set out the key objectives of this Carbon Offset Solutions study:

1) to quantify the amount of monies that may be available to fund Carbon Offset Solutions, based on planned development in the borough,
2) to identify a portfolio of potential projects and solutions which may comprise or be included as Offset Solutions.

3.2 A context of uncertainty

Policy DM29 and the Planning Obligations SPD form a structure which enables applicants to contribute to a Carbon Offset Fund in order to offset the carbon emission shortfall if compliance with planning policy cannot be fully achieved on site. This structure is adequate but could be affected by a range of potential changes to the regulatory framework as a result of the Housing Standards Review, the Deregulation Act 2015 and the indefinite postponement of the future Zero Carbon policies. This section summarises each of these potential changes.

3.2.1 *Housing Standards Review and Deregulation Act 2015*

The Planning and Energy Act 2008 states that:

> *A local planning authority in England may in their development plan documents, and a local planning authority in Wales may in their local development plan, include policies imposing reasonable requirements for:*
>
> *(a) a proportion of energy used in development in their area to be energy from renewable sources in the locality of the development;*
>
> *(b) a proportion of energy used in development in their area to be low carbon energy from sources in the locality of the development;*
>
> *(c) development in their area to comply with energy efficiency standards that exceed the energy requirements of building regulations..."*

Item (c) above is particularly relevant as LBTH Policy DM29 and London Plan Policy 5.2 both require new developments to exceed the carbon requirements of the building regulations.

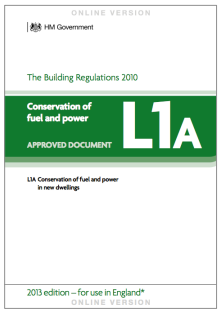
The Housing Standards Review was launched in 2012 by CLG with the aim of reducing bureaucracy and costs on house builders; reforming and simplifying the framework of building regulations, guidance, local codes and standards; making the housebuilding process easier to navigate by reducing confusion between the planning and building regulations regimes; reducing contradictions and overlap between standards and allowing local choice but within sensible parameters. The review has led to the inclusion in the Deregulation Act 2015 of an amendment to the Planning and Energy Act 2008 which would prevent Local Authorities from setting higher energy efficiency requirements than those required by the Building Regulations for new dwellings. Chapter 20 Clause 43 of the Deregulation Act 2015 states the following:

> ***43 Amendment of Planning and Energy Act 2008***
>
> *In the Planning and Energy Act 2008, in section 1 (energy policies), after subsection (1) insert—*
>
> *"(1A) Subsection (1)(c) does not apply to development in England that consists of the construction or adaptation of buildings to provide dwellings or the carrying out of any work on dwellings."*

There is however still a significant degree of uncertainty around those potential changes and in particular:

- **Whether the proposed change would take effect in London**. We have assumed that it will, although there is a possibility that the Greater London Authority and London Boroughs could be able to set higher carbon reduction targets;
- **When the change would be enforced**. We have assumed that this will not happen before the Zero Carbon Homes/Nearly Zero Energy policy comes into force (now assumed to be 2020)[1];
- **Whether it would apply to residential developments only or all developments**. We have assumed that the restriction would not apply to non-domestic buildings as Clause 43 specifically refers to dwellings;
- **Whether it will affect the overall carbon reduction targets or not**. If clause (c) above is the only clause amended it would only affect the level of energy efficiency which could be required but would still enable local authorities to require greater carbon reductions than the Building Regulations through low carbon energy sources. We have assumed that all clauses will be changed though and that LBTH would not be able to require greater carbon reductions for new dwellings than the Building Regulations from 2020.

3.2.2 *Future building regulations and Zero Carbon Homes*



Standards for carbon emissions for new and existing buildings are being driven at the national level by Part L of the Building Regulations. The current version is Part L 2013 and it is uncertain when the new version of Part L will come into force. A notional date of 2020 has been assumed.

Zero Carbon policies have been postponed

Part L 2016 had been the subject of significant work and consultation over the last 7 years and was going to see the introduction of the Zero Carbon Homes policy (applicable to domestic buildings only) while Zero Carbon regulations applicable to non-domestic public buildings were expected to come into force in 2018 and Zero Carbon regulations applicable to other non-domestic private buildings were expected to come into force in 2019. However, the Zero Carbon policies have now been postponed indefinitely.

The following statement can be found in '*Fixing the foundations: Creating a more prosperous nation'* published by HM Treasury on 10th July 2015:

> ***Improving the planning process - ensuring planning decisions are made on time***
>
> *The government will […] repeat its successful target from the previous Parliament to reduce net regulation on housebuilders. The government does not intend to proceed with the zero carbon Allowable Solutions carbon offsetting scheme, or the proposed 2016 increase in on-site energy efficiency standards, but will keep energy efficiency standards under review, recognising that existing measures to increase energy efficiency of new buildings should be allowed time to become established.*

[1] *The Official Report, Commons dated 23/6/14; col. 153 states the following: "We are aware that within that framework, the decision on the commencement date for amendments to the Planning and Energy Act 2008, which restrict the ability of local authorities to impose their own special requirements, must be made in such a way that the ending of those abilities to set special requirements knits properly with the start of the operation of standards for zero-carbon homes".*

Following the publication of this report, clarification was sought from Amber Rudd, Secretary of State for Energy and Climate Change at the Energy and Climate Change Committee on 21st July 2015.

> ***Energy and Climate Change Committee, Oral evidence: DECC Priorities 2015, HC 287 Tuesday 21 July 2015, Q81-82***
>
> ***Q81 Dr Whitehead:*** *I imagine, Minister, from what you have been saying on this particular section you were as shocked as I was to hear that the Government has pulled the entire plug on the 2016 target for zero carbon homes and the Allowable Solutions programme on zero carbon homes. Were you consulted about this when it happened and are you working hard to get this reversed?*
>
> ***Amber Rudd:*** *What has been done at the moment is to postpone it. We must face up to the fact that we do have a housing crisis and that particularly the Allowable Solutions point was perceived as a tax on delivering new houses. I know that my colleagues at DCLG are very committed to making sure that we build new houses. That is the first point I would make. Secondly, in the discussions that I did have with the Secretary of State we did agree that he would work closely with me, with my Department, and that he and I would meet to discuss further what can be done for the existing housing stock. Getting improvements to the existing housing stock seems like the big prize to try to work with DCLG on. So, although we are not having new zero carbon homes for now, we are working together on seeing what we can do for the existing housing stock.*
>
> ***Q82 Dr Whitehead:*** *Then we have to improve all the stock that exists at that point that is not zero carbon.*
>
> ***Amber Rudd:*** *That to me is the bigger area in terms of working with DCLG to see what we can improve on existing housing stock. As you may be aware, by 2020 under European regulations new buildings need to be almost zero carbon and that will be there quite soon I am sure.*

Based on the information available at the time of writing it has been assumed in this report that the Zero Carbon policies will be postponed until 2020 and that there will be no national framework for allowable solutions. This is obviously subject to change.

Zero Carbon homes: an evolving definition

As technical evidence gradually demonstrated the technical difficulty and prohibitive costs of achieving Zero Carbon on-site from all energy uses, the definition of Zero Carbon Homes has evolved over time with the gradual introduction and adjustment of three key concepts:

- **Fabric Energy Efficiency** in order to ensure a minimum level of performance from the building fabric and services;
- **Carbon Compliance** to ensure that carbon reduction through on-site or near-site systems is optimised;
- **Allowable Solutions** to enable the residual emissions to be offset through off-site carbon abatement measures.

The latest Zero Carbon Homes definition focused on 'regulated' emissions, i.e. those resulting from energy use for heating, domestic hot water, fixed lighting and ventilation which are controlled by Part L of the Building Regulations.

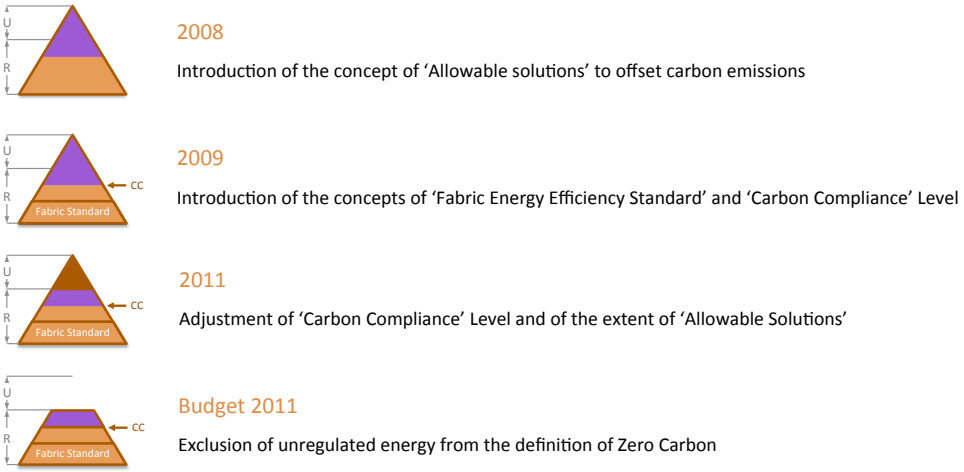


Figure 7: Evolution of the Zero Carbon Homes definition

The latest proposals from Government (before the postponement of the Zero Carbon policies) suggested that the Carbon Compliance requirements will be set at a level broadly equivalent with the mandatory carbon reduction requirement for Code for Sustainable Homes Level 4 (i.e. 25% better than Part L 2010, 19% better than Part L 2013 on average), although this was still uncertain[2].

3.2.3 The Energy Companies Obligation

The Energy Companies Obligation (ECO) is an energy efficiency programme which replaced the Carbon Emissions Reduction Target (CERT) and the Community Energy Saving Programme (CESP) at the beginning of 2013. ECO places legal obligations on the large energy suppliers to deliver energy efficiency measures in domestic properties, with a particular focus on low income areas and hard-to-treat properties. It was designed to work alongside the Green Deal.

Although a number of successful energy saving projects were delivered through ECO, the Government's decision to offer a £50 reduction on the average energy bill at the end of 2013 impacted the Energy Companies Obligation. A number of schemes had their funding reduced and could not go ahead. The changes to ECO last year demonstrate that relying on a single mechanism to deliver energy efficiency measures is more risky than to have a number of schemes, both national and local, which can complement each other.

3.2.4 The Green Deal

On 23rd July 2015, the Government announced that in light of low take-up and concerns about industry standards there shall be no further funding to the Green Deal Finance Company. The Government will also stop any future funding releases of the Green Deal Home Improvement Fund.

It was also announced that the Government will work with the building industry and consumer groups on a new value-for-money approach. Details of this new approach were not available at the time of writing.

[2] *Please refer to minutes of the Grand Committee on the Infrastructure Bill on 17th July 2014 available at: http://www.publications.parliament.uk/pa/ld201415/ldhansrd/text/140717-gc0001.htm*

3.3 Delivering a useful work to the London Borough of Tower Hamlets

3.3.1 Moving away from the cloud of uncertainty

Our ambition was for this work to be useful to the London Borough of Tower Hamlets despite this context of uncertainty. Therefore, we have adopted two principles in the development of this report, the associated databases and the GIS tool:

- We have carried out a very significant amount of work on Carbon Offset solutions which could be used by LBTH to deliver carbon saving projects and/or apply for funding in the future;
- We have based our recommendations on the period to 2017 but have considered throughout the study the potential evolution for the period 2017-2020 and, ultimately, beyond 2021.

We think that this enhances the chances of this work to be useful from the outset.

3.3.2 Timescale covered by the study

The study covers the next 20 years (i.e. 2015-2034). It is obvious that uncertainty would increase overtime but 20 years was considered to be a reasonable term to inform strategic decisions by the London Borough of Tower Hamlets.

3.3.3 What is certain

Beyond the uncertainty summarised in section 3.2, a few key elements are certain:

- The challenge associated with climate change will not go away;
- The UK has a binding target of a 80% carbon emission reduction on 1990 levels by 2050;
- The EU Energy Performance of Buildings Directive (EPBD) requires all buildings to be 'nearly zero energy' by 2020;
- Retrofitting existing properties will be a key source of carbon savings and an opportunity to address fuel poverty and create local jobs.

In particular, Article 9 of the Directive 2010/31/EU requires that:

> *Member States shall ensure that by 31 December 2020 all new buildings are nearly zero-energy buildings; and after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings.*

A nearly zero-energy building is defined as a building that has an excellent energy performance: the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

EU countries have to draw up national plans to increase the number of nearly zero-energy buildings and in October 2014, the European Commission published a report about the information communicated by Member States on Nearly Zero-Energy Buildings (NZEBs). The following statement is an extract from the UK's response and indicates that the Zero Carbon Policies and Allowable Solutions were supposed to be an integral part of the plan to deliver nearly zero energy buildings:

The intent to deliver 'zero carbon' new buildings is one of the major steps that UK is taking towards meeting both its carbon targets and energy targets. In England, it is intended that all new-build homes from 2016 will have net carbon emissions of zero tonnes per year. This will be achieved by promoting features such as low energy, high performance housing

through the use of energy efficient fabrics and on-site renewables. There will also be support for off-site carbon abatement projects to ensure that all carbon emissions from regulated energy will be off-set and the building will add no more carbon-dioxide.

In light of the postponement of the Zero Carbon Homes policy, the plan above is clearly affected. However, it is assumed the UK will still prepare plans to comply with article 9 of the EU EPBD on the Nearly Zero Energy Buildings (NZEB) requirements.

It should also be noted that in order to coordinate and monitor the efforts of the member states towards NZEBs, the EU Commission requires countries to report their methodologies and approaches, explaining both the logic and processes behind their reported targets and national plans. The EU Commission's guidelines include a set of criteria that relate to cost-optimality, national building stock mix and lifecycle analysis of buildings

The EU EPBD also states that:

> *Member States shall develop policies and take measures such as the setting of targets in order to stimulate the transformation of buildings that are refurbished into nearly zero-energy buildings.*

Although the mechanisms to achieve these aims are uncertain, the overall direction is clearly defined and encompasses designing and building very low energy buildings, improving the energy efficiency of existing buildings and decarbonising energy supply.

3.3.4 *What will happen after the introduction of the Zero Carbon / Nearly Zero Energy Buildings policies (assumed to be implemented by 31st December 2020)?*

Currently, if an applicant demonstrates successfully that it is not technically feasible or viable for a particular scheme to fully meet LBTH carbon reduction targets on-site, a s106 payment to fund carbon saving measures elsewhere in the Borough can be agreed in order to offset the scheme's residual regulated carbon emissions.

Assuming that the Zero Carbon / NZEB policies are introduced in 2020, that the Planning and Energy Act 2008 amendment for new dwellings will come into force at the same time and that Local Authorities will therefore not be able to set more demanding energy efficiency target for domestic buildings, the situation will evolve differently for domestic and non-domestic buildings.

Domestic Buildings

Developers will need to comply with the Zero Carbon Homes / NZEB policy.

As LBTH will not be able to impose a more stringent carbon target for new dwellings, it is assumed that residential buildings complying with the Zero Carbon Homes / NZEB policy will not contribute to the LBTH Carbon Offset Fund.

Non-Domestic Buildings

The Zero Carbon / NZEB Policy for non-domestic buildings is unlikely to come into force before 2018 for public buildings and 2020 for other buildings.

LBTH will still be able to impose a more stringent target for non-domestic buildings. Therefore, if the Zero Carbon / NZEB Policy is less demanding than DMD 29, non-domestic buildings failing to achieve the carbon target equivalent to DMD 29 (i.e. 45% improvement on 2013 Building Regulations) will have to offset their residual CO_2 emissions through the LBTH Carbon Offset Fund.

Summary

1. The level of energy performance of new buildings will increase over time but the national requirements in terms of energy efficiency are unlikely to change before the introduction of the Zero Carbon / NZEB policies: there will therefore be a need to offset residual carbon emissions for the foreseeable future.
2. LBTH should be able to collect payments from non-domestic buildings failing to comply with DMD 29 even after the introduction of the Zero Carbon / NZEB policies.

3.3.5 A new step on LBTH's path to a Low Carbon Borough

A number of national, regional and local programmes (e.g. CERT, CESP, ECO, RE-NEW, RE-FIT) have already delivered energy efficiency improvements and carbon savings in Tower Hamlets.

The ever pressing need to reduce carbon emissions and the introduction of tighter carbon standards for new buildings (Zero Carbon, Nearly-Zero Energy Buildings) are creating a significant opportunity for the London Borough of Tower Hamlets.

Despite the uncertain context, it is clear that the ability for LBTH to structure their approach towards Carbon Offset Solutions even further could put them in a situation of being able to deliver significant carbon saving projects. The main opportunities for the London Borough of Tower Hamlets are:

- the capability to invest in projects that deliver wider benefits to the local community such as mitigating fuel poverty and generating local employment;
- the ability to bring forward projects which are not being delivered by the private sector due to specific barriers (e.g. cost efficiency) that the LBTH Carbon Offset Fund could help to overcome;
- the possibility to ensure that an appropriate proportion of the investment raised from local development for carbon reduction is invested locally.

This would also enable local democratic control over the management of Carbon Offset projects in the local area.

Ensuring that Carbon Offset Solutions funds raised from development in Tower Hamlets is invested in carbon reduction projects in the area and that the London Borough of Tower Hamlets has a role in identifying those projects should be a key outcome of this study.

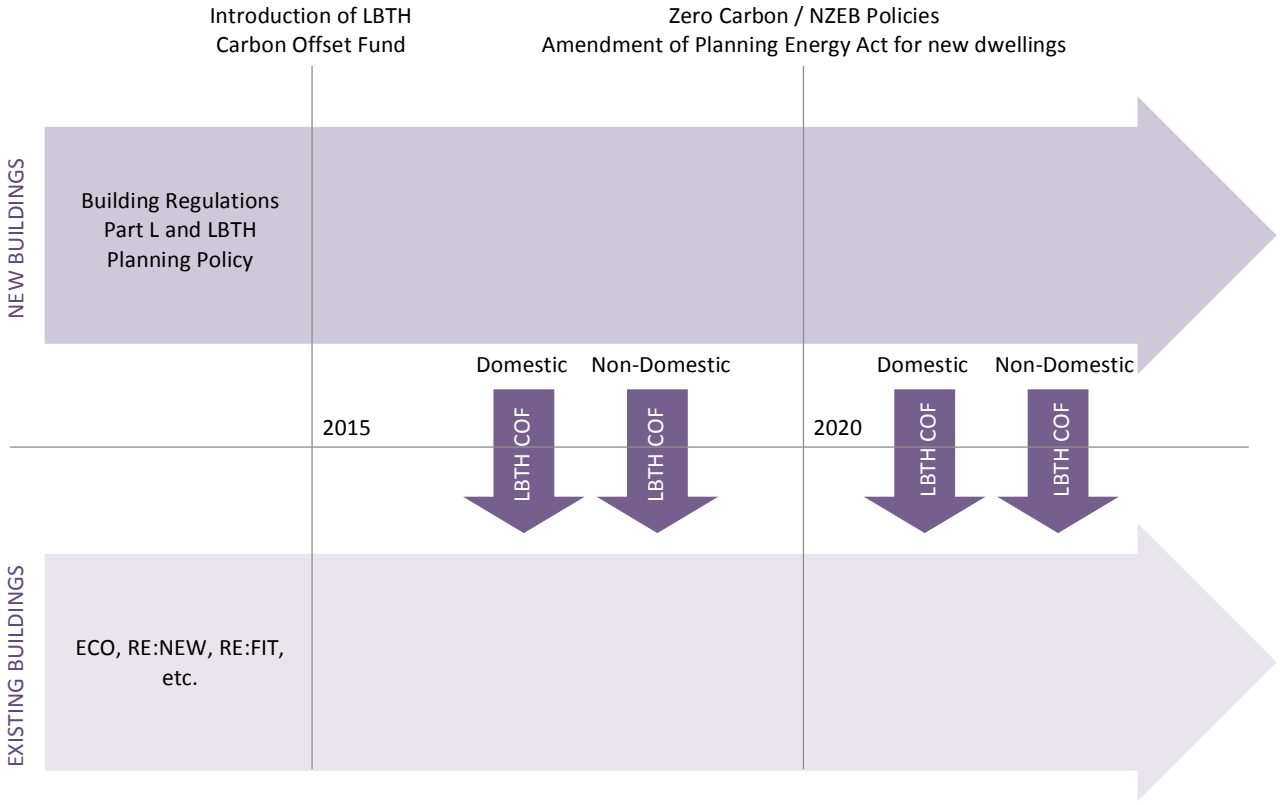


Figure 8: Outline evolution of the sources of revenues for energy efficient retrofits in Tower Hamlets

4.0

THIS REPORT

4.0 THIS REPORT

4.1 Methodology

Based on the literature research carried out as part of this study and on detailed discussions with the Sustainability Service within the London Borough of Tower Hamlets, it was decided to split the work into seven distinct workstreams.

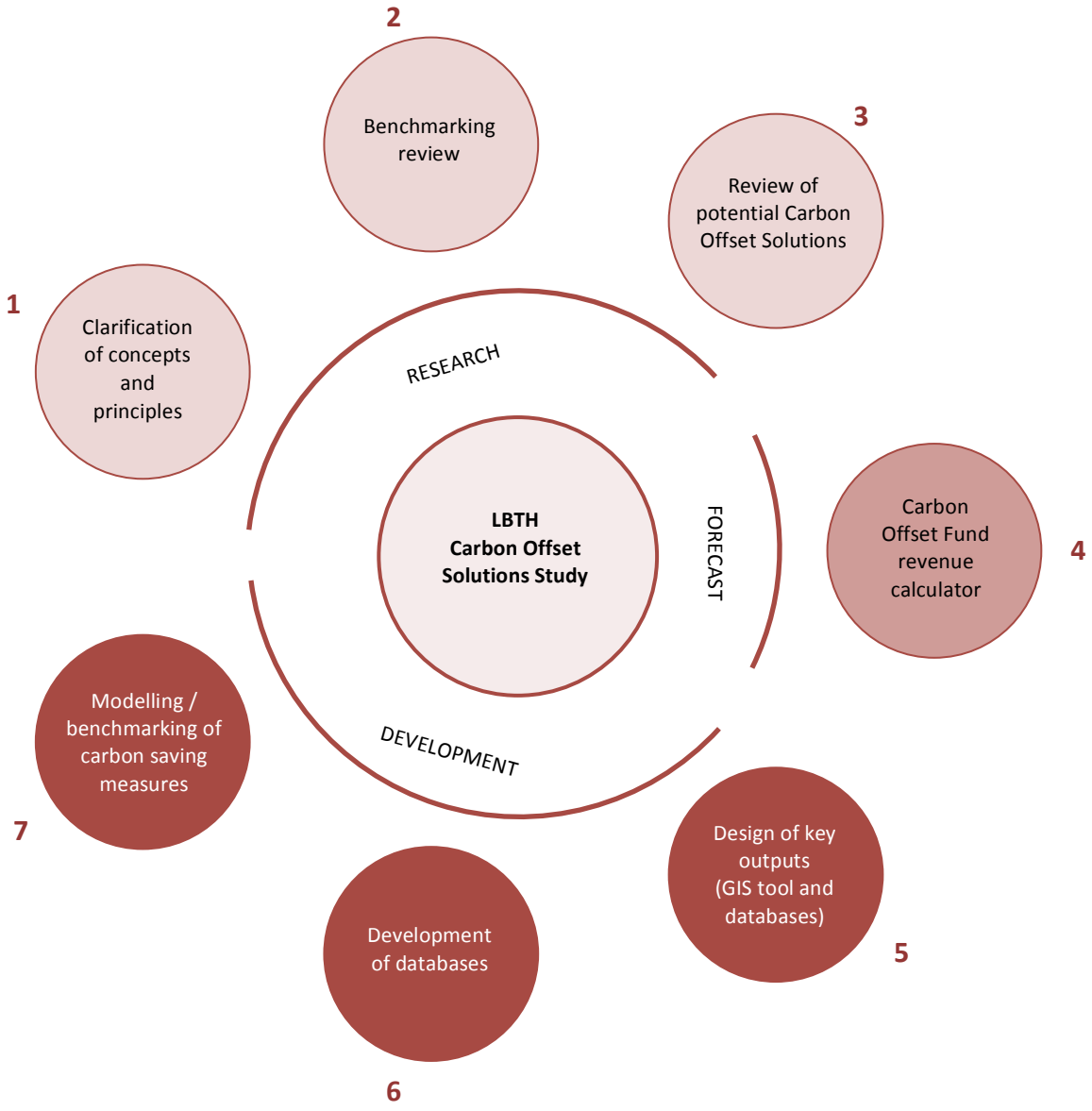


Figure 9: the seven key workstreams of this Carbon Offset Solutions Study

The first three workstreams elaborated on the work already undertaken by the Government and other Local Authorities and focused on key lessons which can be drawn from it.

- **Workstream 1** aimed at clarifying key concepts which need to be defined in the development of a specific LBTH Carbon Offset fund/strategy;
- **Workstream 2** was dedicated to the 'benchmarking review' of existing/planned Carbon Offset Funds in the UK with a particular focus on London in order to enable a factual comparison between them and to obtain the qualitative feedback of officers in charge of them in each of the consulted Local Authorities;
- **Workstream 3** aimed at reviewing the range of available Carbon Offset Solutions and gather cost and carbon efficiency benchmarks for each of them.

The objective of **Workstream 4** was to estimate the likely scale of revenues which could be accessed by LBTH, either directly or indirectly, in order to fund carbon saving measures in the borough.

The remaining three workstreams focused on going beyond the work already undertaken and on developing innovative tools which can be used by LBTH to identify carbon saving projects and opportunities:

- **Workstream 5** was dedicated to the definition and design of the two key deliverables of this study alongside this report: the GIS mapping tool and the associated extended databases;
- **Workstream 6** consisted of researching, analysing, and processing a large number of databases associated with existing buildings in order to determine their current energy performance;
- **Workstream 7** developed around the energy modelling of the properties identified in Workstream 6 in order to ascertain the total carbon saving potential and associated costs as well as the potential impact of individual measures.

Although these workstreams mostly developed independently, brainstorming sessions were also organised in order to enable cross-fertilisation and consistency between key principles and ideas identified as part of each individual workstream.

4.2 Structure of the report

The structure of this report broadly echoes the structure of the workstreams.

- Section 5.0 clarifies key Carbon Offsetting concepts;
- Section 6.0 provides a summary of the benchmarking review;
- Section 7.0 assesses the scale of funding for Carbon Offset Solutions which can potentially be accessed;
- Section 8.0 provides an overview of potential Carbon Offset Solutions and their associated cost and carbon benchmarks;
- Sections 9.0 and 10.0 focus on the databases (research, development, analysis, modelling) and the associated GIS mapping tool output;
- Section 11.0 proposes a potential management and governance structure to oversee the delivery of this large programme of Carbon Offset solutions;
- Section 12.0 summarises the consultation activities undertaken as part of this Study.

4.3 Associated deliverables

The originality of this work and, we hope, its usefulness is largely associated with the fact that this report is not the only deliverable forming part of this Carbon Offset Solutions Study.

The **GIS mapping tool** developed by LBTH can now display key energy/carbon data associated with more than 8,300 social housing properties and 120 non-domestic public buildings. It has the potential of being used as a tool which can inform project selection and will hopefully be the missing link between LBTH's strategic approach towards carbon reduction and the allocation of funds towards one particular project as it will help to shortlist a number of relevant and comparable projects. The main advantage of the expression of this key data on the GIS mapping tool is that it enables the user to visualise whether there is potential for carbon offsetting within the vicinity of a planning application (or indeed any given location) or clusters of potential retrofit projects.

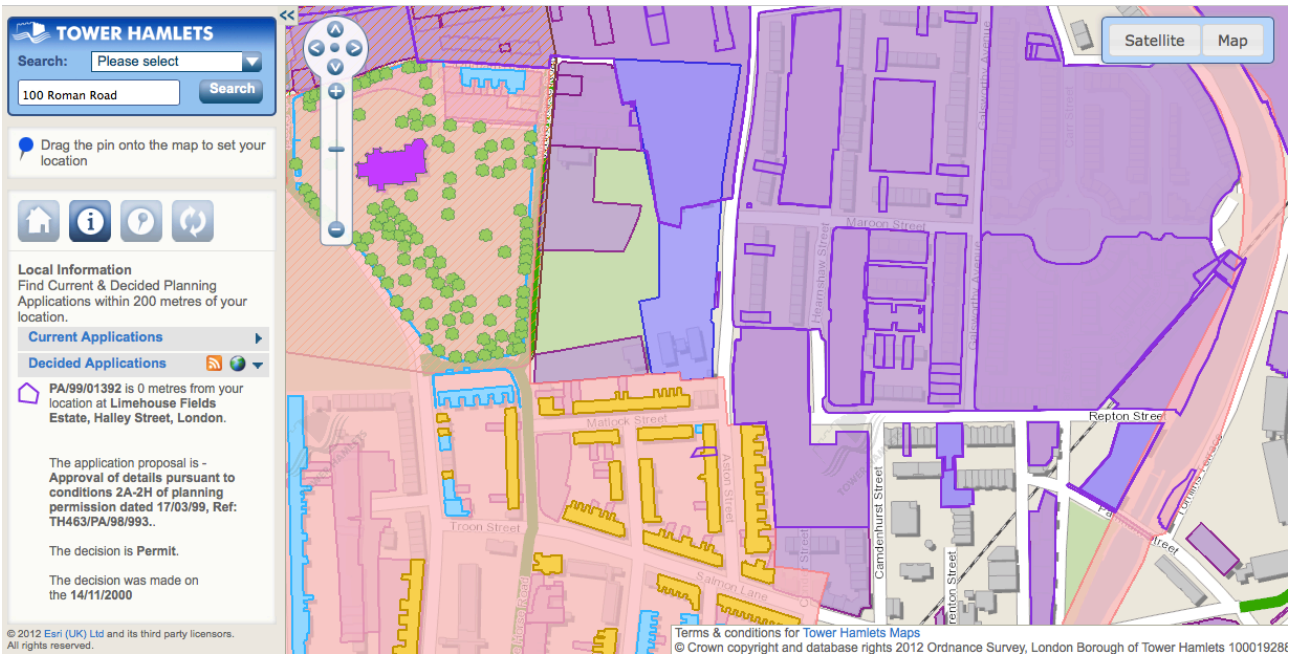


Figure 10: Screenshot of the LBTH GIS tool

The **Domestic Carbon Offset Solutions database** and **Non-Domestic Carbon Offset Solutions database** provide additional information compared with the GIS mapping tool. Once a number of projects have been initially shortlisted using the GIS mapping tool, these databases can be referred to by the user and provide him/her with the likely impact (in terms of carbon and cost) of a long list of potential measures as well as a comprehensive overview of energy-related data available for this particular property. This process can lead to a refined shortlist of potential projects and/or provide more detailed information to the organisation which will be in charge of surveying the relevant building(s) in order to validate the suggestions of the database.

The aim of the GIS mapping tool and of the Domestic and Non-Domestic Carbon Offset Solutions databases is not to lead to a single project selection on which works can directly be undertaken but rather to establish rationally a shortlist of projects which can then be surveyed and taken forward. The objective is to put 'science' in the project selection process and provide LBTH with quantifiable and transparent reasoning for funding a specific project and tools for their carbon reduction investments.

Project number	20140055
Project name	LBTH Carbon Offset Solutions Study
Document	Domestic Carbon Offset Solutions Solutions Database
Tab	Domestc Database

Etude

Tower Hamlets Domestic Addresses by Local Land & Property Building Data ID

Matched with NROSH (all) and EPC data (Quality Level 3)

Cells in red contain formulas. Fill formulas down to recalculate. Repaste cells in black to improve spreadsheet performance.

CHM Summary Statistics

Average	0.32	13%
Total	2,690	
Extrapolated	14,330	

Reference Data: LLPG REF Tower Hamlets UPRN	NROSH NROSH PROPERTY-ID	EPC EPC DATABASE EPC REF	Dwelling Data Used for Energy Modelling: NROSH DATA Row Match	AGE	EPC DATA & RECOMMENDATIONS Row Match	Raw PROPERTY_TYPE	Raw TOTAL_FLOOR_AREA	Raw ENERGY_RATING_CURRENT	Recommendations Recommendation	Recommendations Indicative EPC Installation Cost - Low	Recommendations Indicative EPC Installation Cost - High	Recommendations In Use Factor	Recommendations Lifetime (Years)	CHM OUTPUTS Row Match	Modelled Current Energy Use (kWh/year)	Modelled Current CO2 Emissions (tCO2/year)	Modelled Modelled Energy Bill reduction per year (£/year)	Modelled CO2 Saving inc. In Use Factor (tCO2/year)	Modelled % CO2 Saving	Modelled Cost per tCO2 over lifetime (Low-High) (£/tCO2)	Modelled Midpoint Cost per tCO2 over lifetime (£/tCO2)
Count 131,913	44,290	12,964	12,964		8,313									8,313							
6168723	5433662	403518320091126		2009		Flat	108	86	35,	£55	£80	0%	5		20,498	3.81	£11	0.05	1%	£202-£293	£248
6168730	5433643	403304320091126		1955		Flat	53	87	35,	£55	£80	0%	5		13,105	2.41	£9	0.05	2%	£233-£339	£286
6168731	5433644	403534720091126		1955		Flat	53	88	35,	£55	£80	0%	5		13,115	2.42	£9	0.05	2%	£233-£339	£286
6168732	5433645	403765220091126		1955		Flat	53	88	35,	£55	£80	0%	5		13,115	2.42	£9	0.05	2%	£233-£339	£286
6168733	5433646	403715320091126		1955		Flat	53	88	35,	£55	£80	0%	5		13,115	2.42	£9	0.05	2%	£233-£339	£286
6168734	5433647	403602220091126		1955		Flat	53	88	35,	£55	£80	0%	5		13,115	2.42	£9	0.05	2%	£233-£339	£286
6168735	5433648	403333620091126		1955		Flat	53	88	35,	£55	£80	0%	5		13,115	2.42	£9	0.05	2%	£233-£339	£286
6168736	5433649	403503320091126		1955		Flat	53	87	35,	£55	£80	0%	5		13,105	2.41	£9	0.05	2%	£233-£339	£286
6168737	5433650	403379620091126		1955		Flat	52	85	35,	£55	£80	0%	5		13,111	2.41	£11	0.06	2%	£187-£272	£230
6168738	5433651	403621920091126		1955		Flat	53	87	35,	£55	£80	0%	5		13,122	2.42	£11	0.06	2%	£187-£272	£230
6168739	5433652	403424220091126		1955		Flat	53	86	35,	£55	£80	0%	5		13,122	2.42	£11	0.06	2%	£187-£272	£230
6168740	5433653	403319120091126		1955		Flat	53	86	35,	£55	£80	0%	5		13,122	2.42	£11	0.06	2%	£187-£272	£230
6168741	5433654	403235220091126		1955		Flat	53	87	35,	£55	£80	0%	5		13,122	2.42	£11	0.06	2%	£187-£272	£230
6168742	5433655	403302720091126		1955		Flat	53	86	35,	£55	£80	0%	5		13,122	2.42	£11	0.06	2%	£187-£272	£230
6168743	5433656	403673220091126		1955		Flat	52	85	35,	£55	£80	0%	5		13,111	2.41	£11	0.06	2%	£187-£272	£230
6029412	4971663	620370520110420		1969		Maisonette	69	71	20,	£2,200	£3,000	25%	12		18,781	3.50	£19	0.14	5%	£1288-£1757	£1,523
6029388	4971509	551289720101011		1969		Flat	47	77	35, 21,	£2,255	£3,080	25%	8.5		12,804	2.36	£17	0.10	6%	£2639-£3604	£3,122
6029413	4971490	234029920090226		1969		Flat	69	74	11, 20,	£2,550	£3,450	50%	11		20,029	3.75	£38	0.28	15%	£821-£1110	£966
6170283	5555672	795710920120530		1987		Flat	41	59	7, 35, 27,	£7,055	£21,080	33%	12		18,775	3.32	£47	0.22	10%	£2718-£8122	£5,420
6004275	5433720	679500020110919		1987		Flat	34	51	3, 7,	£4,015	£14,030	33%	25		17,062	3.02	£45	0.25	12%	£649-£2267	£1,458
6004277	5433722	640232420110609		1987		Flat	38	60	3, 7,	£4,015	£14,030	33%	25		17,932	3.17	£48	0.26	12%	£610-£2132	£1,371
6004279	5433724	142247620101119		1987		Flat	40	35	7,	£4,000	£14,000	33%	40		18,389	3.26	£20	0.11	5%	£904-£3164	£2,034
6004280	5433725	599999520110304		1987		Flat	32	23	7,	£4,000	£14,000	33%	40		24,330	4.31	£16	0.09	3%	£1116-£3907	£2,512
6004282	5433727	763408720120321		1987		Flat	41	30	35, 7,	£4,055	£14,080	33%	22.5		28,604	5.06	£28	0.15	5%	£1177-£4087	£2,632
6004283	5433728	789381320120516		1987		Flat	35	62	7, 35, 49,	£4,640	£14,805	33%	10		17,609	3.12	£23	0.12	6%	£3722-£11877	£7,800
6004285	5433712	520814120100730		1965		Flat	42	59	3, 7,	£4,015	£14,030	33%	25		23,350	4.13	£135	0.74	27%	£217-£760	£489
6004293	5433715	547662520101002		1965		Flat	38	46	3, 7,	£4,015	£14,030	33%	25		22,054	3.90	£123	0.67	26%	£239-£835	£537
6086158	5433857	425531620101010		1965		Flat	37	36	35, 7,	£4,055	£14,080	33%	22.5		30,889	5.47	£95	0.52	14%	£346-£1203	£775
6086205	5433858	480403020100505		1965		Flat	37	51	3, 7,	£4,015	£14,030	33%	25		22,635	4.01	£122	0.66	25%	£242-£844	£543
6004303	5433844	420176620100113		1965		Flat	42	65	3, 35,	£70	£110	15%	7.5		19,729	3.49	£47	0.26	9%	£36-£57	£47
6004309	5433832	208458120081219		1965		House	32	25	35,	£55	£80	0%	5		28,147	4.98	£10	0.05	1%	£210-£306	£258
6004314	5433852	210458720090113		1972		House	48	69	35, 25,	£455	£1,080	10%	7.5		28,807	5.10	£5	0.03	1%	£2101-£4986	£3,544
6004319	5433836	188308920081118		1965		Maisonette	71	59	35,	£55	£80	0%	5		24,192	4.55	£6	0.03	1%	£344-£501	£423
6004321	5433838	495095520100605		1951		Flat	44	82	35,	£55	£80	0%	5		12,239	2.26	£7	0.04	2%	£291-£423	£357
6021896	5433708	834015920120911		1969		Flat	53	77	35,	£55	£80	0%	5		13,937	2.57	£23	0.12	5%	£93-£136	£115
6052697	4814555	551245120101011		1969		Maisonette	69	79	35, 21,	£2,255	£3,080	25%	8.5		15,690	2.90	£20	0.13	6%	£2120-£2896	£2,508
6648863	5610882	127294920080722		1969		Flat	75	60	35, 13, 20,	£2,605	£3,530	50%	10		22,120	4.14	£50	0.36	17%	£734-£994	£864
6055489	4816232	922692920130430		1969		Maisonette	78	66	35,	£55	£80	0%	5		20,197	3.76	£25	0.13	3%	£86-£126	£106
6136111	5762488	590723220110209		1969		Maisonette	70	73	35, 13, 21,	£2,605	£3,530	50%	10		20,731	3.87	£48	0.33	17%	£781-£1058	£920
6029391	4971510	551229620101011		1969		Flat	54	64	35, 13, 21,	£2,605	£3,530	50%	10		14,783	2.73	£25	0.16	12%	£1604-£2173	£1,889
6029392	4971487	551394420101011		1969		Flat	54	76	35, 21,	£2,255	£3,080	25%	8.5		13,904	2.57	£15	0.10	5%	£2778-£3795	£3,287
6029385	4971660	589139920110205		1969		Flat	57	73	35, 13, 21,	£2,605	£3,530	50%	10		18,120	3.38	£37	0.26	15%	£1011-£1371	£1,191
6029387	4971661	837750120120920		1969		Flat	68	75	35,	£55	£80	0%	5		18,368	3.42	£17	0.09	3%	£129-£187	£158
6029400	4971885	634046420110525		1969		Maisonette	68	70	20,	£2,200	£3,000	25%	12		18,487	3.45	£19	0.14	5%	£1308-£1783	£1,546
6029402	4971512	840950820121001		1969		Maisonette	70	72	35,	£55	£80	0%	5		19,439	3.62	£24	0.12	3%	£92-£134	£113
6029407	5093475	879064820130201		1969		Flat	62	71	35,	£55	£80	0%	5		17,472	3.25	£19	0.10	3%	£114-£166	£140
6029415	4971612	177074720091124		1956		Flat	74	74	13, 21,	£2,550	£3,450	50%	11		21,763	4.08	£45	0.33	16%	£703-£952	£828
6029417	4971491	316366520090707		1967		Flat	60	81	35,	£55	£80	0%	5		13,345	2.45	£12	0.06	3%	£175-£255	£215
6029419	4971613	316915120090707		1967		Flat	58	83	35,	£55	£80	0%	5		13,150	2.42	£12	0.06	3%	£177-£257	£217
6029420	4971665	316233220090707		1967		Flat	58	84	35,	£55	£80	0%	5		13,150	2.42	£12	0.06	3%	£177-£257	£217
6029425	4971897	316781920090707		1967		Flat	59	83	35,	£55	£80	0%	5		13,233	2.43	£12	0.06	3%	£176-£256	£216
6029389	4971815	316327220090825		1967		Flat	130	80	35,	£55	£80	0%	5		20,066	3.71	£16	0.08	2%	£135-£197	£166
6028766	2992020	316875820090707		1967		Maisonette	4	79	35,	£55	£80	0%	5		7,017	1.31	£4	0.02	2%	£497-£724	£611
6165123	5763378	316648520090707		1967		Flat	60	84	35,	£55	£80	0%	5		13,345	2.45	£12	0.06	3%	£175-£255	£215
6165124	5763586	316969820090707		1967		Flat	58	85	35,	£55	£80	0%	5		13,150	2.42	£12	0.06	3%	£177-£257	£217
6165125	5764084	316437620090707		1967		Flat	58	85	35,	£55	£80	0%	5		13,150	2.42	£12	0.06	3%	£177-£257	£217
6165126	5763469	316210320090707		1967		Flat	59	85	35,	£55	£80	0%	5		13,233	2.43	£12	0.06	3%	£176-£256	£216
6165127	5763413	316759020090707		1967		Flat	130	81	35,	£55	£80	0%	5		20,066	3.71	£16	0.08	2%	£135-£197	£166
6165128	5763500	316542920090707		1967		Maisonette	86	81	35,	£55	£80	0%	5		15,463	2.84	£14	0.07	3%	£152-£221	£187
6165129	5763845	316315520090707		1967		Flat	60	85	35,	£55	£80	0%	5		13,345	2.45	£12	0.06	3%	£175-£255	£215
6165130	5763841	316864120090707		1967		Flat	58	85	35,	£55	£80	0%	5		13,150	2.42	£12	0.06	3%	£177-£257	£217
6165131	5763562	316636820090707		1967		Flat	58	86	35,	£55	£80	0%	5		13,150	2.42	£12	0.06	3%	£177-£257	£217
6165132	5763459	316409520090707		1967		Flat	59	85	35,	£55	£80	0%	5		13,233	2.43	£12	0.06	3%	£176-£256	£216
6165133	5763634	316426020090707		1967		Flat	44	86	35,	£55	£80	0%	5		11,591	2.13	£11	0.06	3%	£183-£266	£225
6165134	5763717	316198720090707		1967		Flat	52	83	35,	£55	£80	0%	5		12,644	2.32	£11	0.06	3%	£184-£268	£226
6165135	5763732	316747420090707		1967		Flat	60	82	35,	£55	£80	0%	5		13,879	2.56	£12	0.06	2%	£178-£259	£219
6165136	5764078	316520220090707		1967		Flat	58	83	35,	£55	£80	0%	5		13,660	2.52	£12	0.06	2%	£180-£262	£221
6165137	5763828	316614220090707		1967		Flat	58	83	35,	£55	£80	0%	5		13,660	2.52	£12	0.06	2%	£180-£262	£221
6165138	5763705	316935520090707		1967		Flat	59	83	35,	£55	£80	0%	5		13,754	2.53	£12	0.06	2%	£179-£261	£220
6165139	5763891	316708320090707		1967		Flat	40	83	35,	£55	£80	0%	5		11,492	2.11	£11	0.06	3%	£195-£283	£239
6165140	5763989	316802420090707		1967		Flat	57	80	35,	£55	£80	0%	5		13,586	2.50	£12	0.06	2%	£182-£264	£223
6165141	5763718	316302220090707		1967		Maisonette	43	82	35,	£55	£80	0%	5		11,724	2.15	£11	0.06	3%	£188-£274	£231
6165142	5763580	432675420100205		1926		Maisonette	79	78	35, 8,	£3,355	£6,580	15%	7.5		17,184	3.18	£34	0.21	8%	£2092-£4102	£3,097
6165143	5764090	267523320090416		1972		House	33	79	8,	£3,300	£6,500	15%	10		11,613	2.15	£5	0.04	2%	£8962-£17652	£13,307
6165144	5763616	691003120120313		1975		House	115	59	35, 19, 8, 7, [illegible]	£20,355	£40,580	33%	10		30,244	5.68	£76	0.54	14%	£3748-£7472	£5,610

Figure 11: Extract of the Domestic Database

4.4 Issues excluded from the scope

This study does not cover the legal implications of the Carbon Offset Fund and in particular the issues associated with public procurement and funding. It is recommended that this study is discussed with LBTH legal advisors to ensure that its recommendations would not contravene these rules.

5.0

CARBON OFFSETTING:

KEY CONCEPTS

5.0 CARBON OFFSETTING – KEY CONCEPTS

5.1 The principle of carbon offsetting

5.1.1 Principle

If a process cannot comply directly with a target level of carbon emissions as it is not feasible, practical or viable, the process can nevertheless be deemed 'compliant' if carbon savings elsewhere can be funded and delivered.

The most widely recognised form of offsetting is associated with **transport**: for instance, as carbon emissions associated with an airplane trip are constrained by the average fuel efficiency of the plane (or the average fuel efficiency of a fleet of planes), some airlines do offer to their customers the possibility of offsetting the carbon emissions associated with their trip by paying into a Carbon Offset Fund which will aim at saving an equivalent amount of carbon elsewhere.

A more significant example of carbon offsetting is the **European Union Emissions Trading System (EU ETS)** which aims at reducing industrial greenhouse gas emissions cost-effectively. It covers 45% of the EU's greenhouse gas emissions (more than 11,000 power stations and industrial plants in 31 countries) and is the biggest international system for trading greenhouse gas emission allowances. It focuses on emissions which can be measured, reported and verified with a high level of accuracy. The EU ETS works on the 'cap and trade' principle. A limit is set on the total amount of certain greenhouse gases that can be emitted by the factories, power plants and other installations in the system. The cap is reduced over time in order to deliver a gradual reduction: in 2020, emissions from sectors covered by the system will be 21% lower than in 2005 and by 2030, they will be 43% lower. Within the cap, companies receive or buy emission allowances which they can trade with one another as needed. They can also buy emission credits from the deployment of carbon reduction projects in developing countries through the Clean Development Mechanism.

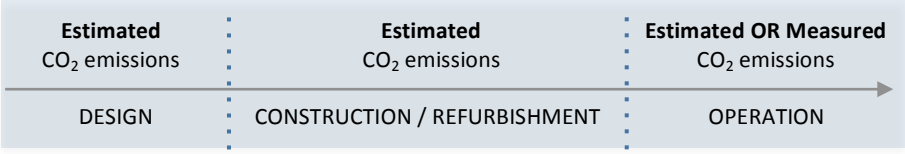
Another example of Carbon Offset Scheme is **the Woodland Carbon Code**, a voluntary standard for woodland creation projects in the UK and the associated carbon dioxide they sequester. It encourages a consistent approach to woodland carbon sequestration projects and offers clarity and transparency to customers about the carbon savings that their contributions may realistically achieve. Compliance with the code means that woodland carbon projects are responsibly and sustainably managed to national standards, publicly registered and independently verified, use standard methods for estimating the carbon that will be sequestered and meet transparent criteria and standards to ensure that real carbon benefits are delivered. Independent certification to this standard provides assurance and clarity about the carbon savings of these sustainably managed woodlands.

Although these Carbon Offset mechanisms vary in scope and size, their core principles should apply to the development of the LBTH Carbon Offset Fund: additionality, clarity and accountability.

5.1.2 Carbon offsetting in the built environment

In the built environment, carbon emission figures referred to are generally of two types:

- CO_2 emissions **estimated** during design, construction/refurbishment and operation;
- **actual** CO_2 emissions emitted during operation.



Carbon Offset Funds in the built environment currently obtain their revenues from the difference between the **estimated project** CO_2 emissions and the **estimated target** CO_2 emissions required by planning policy as it may not be technically feasible or financially viable to achieve the required carbon standards through on-site measures. The shortfall is established using accredited Part L softwares and is referred to as 'residual CO_2 emissions'.

The convention is for residual CO_2 emissions over 30 years to be offset

The residual CO_2 emissions can then multiplied by a number of years to establish the 'lifetime residual CO_2 emissions', i.e. the total CO_2 emissions which should be offset. The conventions are for this number of years to be 30 and for the number of years to be factored in the price of carbon (i.e. £60/tonneCO_2 x 30 = £1,800/tonneCO_2) rather than in the residual CO_2 emissions. Therefore, the residual CO_2 emissions remain annual for the purpose of the calculation of the offset contribution.

In Tower Hamlets, when a project does not meet its carbon targets on-site, it must contribute an appropriate payment to the LBTH Carbon Offset Fund in order to offset its residual CO_2 emissions and therefore be policy compliant. The fund can be used to deliver carbon savings in the borough, for example by targeting existing buildings to improve their energy performance.

Carbon Offsetting is seen by LBTH as a last resort option though and will only be accepted if clear evidence is provided to justify why a development cannot meet on-site the standards set out in planning policy.

5.1.3 *Additionality*

Additionality is a fundamental requirement of Carbon Offset schemes: it assesses the degree to which carbon savings would not have occurred without the Carbon Offset Fund and there are two 'grades' of additionality:

Additionality is a fundamental requirement of Carbon Offset Schemes

- **Full additionality**: none of the carbon savings would have occurred within a reasonable timescale without the funding. In this case, it can be said that the Carbon Offset Fund has acted as the mechanism for delivering carbon savings. 'Full additionality' means that there is no conflict between the LBTH Carbon Offset Fund and other funding mechanisms on a particular project;
- **Partial additionality**: the Carbon Offset Fund complements other funding streams and enables the project to go ahead. In this case, it can be said that the Carbon Offset Fund has helped to trigger carbon savings. 'Partial additionality' means that there is a level of synergy between the LBTH Carbon Offset Fund and other funding mechanisms on a particular project.

The two scenarios will occur as the Carbon Offset Fund may be used to 'unlock' investment by complementing existing funding. For instance a £100,000 project could be funded at 85% from ECO and 15% from the LBTH Carbon Offset Fund. However, we do not think that the carbon accounting approach adopted by some Local Authorities (i.e. a 'funder takes all' approach) would be suitable as the different programmes could potentially be claiming the same carbon savings. Therefore in this 'partial additionality' case, we would recommend that LBTH only accounts for the same proportion as its funding proportion of the estimated carbon savings (e.g. 15% for the case above).

Seeking other funding from existing sources of funding (e.g. ECO) helps to ensure synergies and additionality

It is very important to ensure, before a project goes ahead and is fully funded by the LBTH Carbon Offset Fund that synergies have been explored. Any contribution from other schemes would help to reduce funding required from LBTH and enable these funds to save carbon elsewhere. However, seeking synergies should be a relatively simple process and should not paralyse investment: overestimating the success of Green Deal and ECO has been the cause of inaction in the past. It should also be noted that some buildings which would be targeted by the Carbon Offset Fund are not eligible for ECO funding (e.g. schools, libraries, leisure centre, etc.).

5.2 Carbon Offset Price and Carbon Offset Ratio: a critical combination

5.2.1 Carbon Offset Price

Unit

The Carbon Offset Price (COP) is the rate at which the shortfall between the actual regulated CO_2 emissions and the target regulated CO_2 emissions should be paid. It is expressed as £/tonne CO_2.

Generally two approaches can be followed:

- The Carbon Offset Price applies to the 30-year CO_2 emission shortfall;
- The Carbon Offset Price applies to the annual CO_2 emission shortfall. In that case, the rate needs to be multiplied by 30 to account for the 30-year period (convention generally used) over which the residual emissions will need to be compensated.

The Carbon Offset Prices referred to in this report always factor in the 30-year offset period

For clarity and simplicity, and as we have noticed an element of confusion in a few Carbon Offset studies and calculations during our literature research, this report will always refer to the Carbon Offset Price which needs to be applied to the **annual** residual CO_2 emissions.

Rationale

Two types of approaches have been used so far to establish Carbon Offset Prices.

The first approach focuses on ensuring that the Carbon Offset Price would not represent a disproportionate burden for developers. The view is that developers should pay no more to procure off-site carbon savings than other sectors pay to meet comparable savings obligations. Using the non-traded carbon price appraisal values (2012 prices) for a home built in 2017 which is required to abate 30 years of carbon, a simple average for the carbon price in the period 2017-46 would give approximately £60/tCO_2 when discounted by 3.5% over 30 years, i.e. £1,800/tCO_2 over the 30-year period.

The second approach focuses on ensuring that the Carbon Offset Price is sufficient to fund carbon saving measures locally. Most Local Authorities which have followed this approach have considered the costs of a range of appropriate measures while others have used the cost of PVs required to offset 1 tonne of CO_2 to establish their Carbon Offset Price.

Carbon price should be acceptable to developers

Carbon price should be sufficient to fund local carbon savings

Both approaches can be understood and a satisfactory Carbon Offset Price level should seek to balance these two objectives.

Administration and management costs

Collecting payments, managing the Carbon Offset Fund and delivering projects costs money. Although it is essential to keep these administration and management costs to a minimum, it is important to allow for sufficient funds to be allocated to these activities, otherwise the fund will be poorly managed which may affect efficiency, transparency and the quality of strategic decisions. Most local authorities have adopted a figure of 15% for administration and management costs.

Comment on the 30-year convention for residual carbon emissions

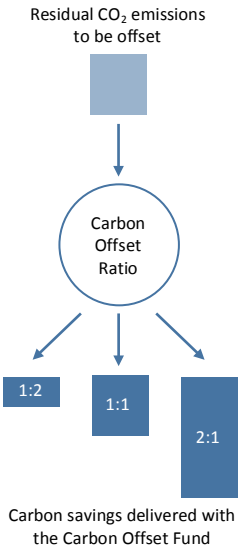
The convention is to consider that the residual emissions need to be offset for a period of 30 years and that annual residual emissions multiplied by 30 can be considered as 'lifetime residual CO_2 emissions'. This is because a 30-year period is considered to be broadly representative of the lifetime of on-site technologies and the period beyond which the electricity grid will be substantially decarbonised.

Although this report follows this convention, there could be merits in considering the lifetime of the building itself and applying different durations / factors to reflect different building types as residential developments for example are likely to have a significantly longer lifetime (e.g. 60 years) and less improvements over the years compared to an office building.

Comment on the decarbonisation of the grid

As grid-supplied electricity is expected to be decarbonised over the next decades, some are of the view that it should be taken into account as the residual carbon emissions would reduce over time. Although this can be understood and done, it is currently considered that the level of uncertainty is too significant for us to make a clear recommendation.

5.2.2 Carbon Offset Ratio



Carbon savings delivered with the Carbon Offset Fund

The Carbon Offset Ratio (COR) is the ratio between the lifetime carbon savings achieved by a measure funded by the Carbon Offset Fund and the lifetime residual CO_2 emissions to be offset. If several measures are funded on a project, they can be combined into a project specific Carbon Offset Ratio.

- A 1:1 Carbon Offset ratio means that the carbon savings delivered by the Carbon Offset Fund are equivalent to the residual CO_2 emissions which need to be offset.
- A 2:1 Carbon Offset ratio means that the carbon savings delivered by the Carbon Offset Fund are twice the CO_2 emissions which need to be offset.
- A 1:2 Carbon Offset ratio means that the carbon savings delivered by the Carbon Offset Fund are half of the CO_2 emissions which need to be offset.

The Carbon Offset Ratio which can be achieved is very closely related to the carbon price: a high carbon price would enable a high carbon ratio while a low carbon price would reduce the Carbon Offset Ratio.

In reality, projects supported by the LBTH Carbon Offset Fund will deliver CO_2 savings at a range of costs and therefore a range of Carbon Offset Ratios.

If the measures funded have the single objective of reducing carbon there is an incentive for the Carbon Offset Ratio to be a key performance indicator of the Carbon Offset Fund and to be as high as possible. However, if the Carbon Offset Fund helps to deliver other benefits (e.g. reduction of fuel poverty, comprehensive refurbishment of a School, etc.) it may be acceptable for the Carbon Offset Ratio to be low.

5.2.3 Short term vs long-term strategy

Historically the most simple and cost efficient improvement measures have been addressed through mechanisms such as CERT, the Green Deal and ECO. For example, a large percentage of cavity wall and loft insulation work has already been completed. These mechanisms have significant merits but they all considered the cost efficiency of carbon saving measures as the main selection criterion. The level of Green Deal finance accessible was also limited by the 'golden rule': energy bill savings had to exceed Green Deal repayments in the first year.

The risk with this approach is that it is more suitable for the short term than the long term: over time, carbon saving measures will become more complex and less cost efficient, and will be the ones for which the uptake rates have been slow so far. Using the same example as before, where cavity wall and loft insulation work has not been completed, it is likely to be because it is more problematic, and therefore more costly. Creating packages of improvements with a mix of simple and complex improvements could be more cost efficient in the long term.

Moreover, other criteria could form part of the project selection process (e.g. fuel poverty, comfort, health) and would help to achieve other LBTH objectives beyond reducing carbon emissions.

We think that this choice is critical and should influence the Carbon Offset Ratio requirements. For example, the Carbon Offset Ratio could be reduced from 1:1 to 1:4 if the project addresses carbon emissions through a comprehensive improvement package which also addresses one or more of a selection of LBTH criteria to be agreed.

It is therefore not proposed to make the Carbon Offset Ratio a limiting criterion for project support in order not to prevent comprehensive packages delivering wider benefits to be funded. The LBTH Carbon Offset Fund should have an overall Carbon Offset Ratio objective of 1:1 but should be able to accommodate a certain element of higher cost of carbon projects in their portfolio of Carbon Offset Solutions.

5.2.4 Example: deep retrofits vs cost efficient measures

The ambition of LBTH in terms of Carbon Offset Ratio will have a significant impact on which package of measures can be funded.

Data gathered by the BRE from actual domestic retrofits and shown in Figure 10 below shows that carbon reductions of between 30 and 50% can be achieved for less than £5,000, and that further carbon reductions would become less cost-effective.

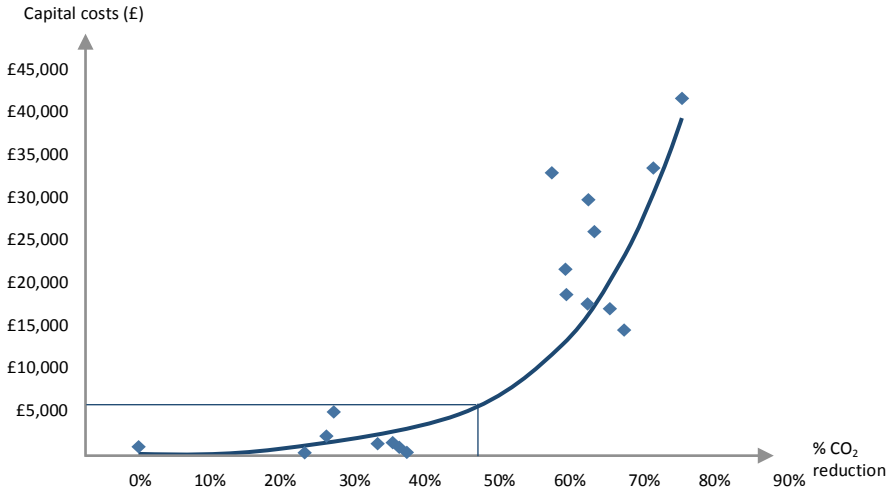


Figure 12: Cost and effect of actual domestic retrofits (Source: BRE)

However, in its recently published report, the Intergovernmental Panel on Climate Change (IPCC) highlighted that:

- studies have repeatedly indicated the important distinction between conventional 'shallow' retrofits, often reducing energy use by only 10–30%, and 'deep' retrofits reducing energy used by 50% or more relative to baseline conditions;
- there is a potential risk for shallow retrofits to result in lower levels of energy efficiency and higher medium term mitigation costs when compared to performance based policies promoting deep retrofits;
- there is sufficient evidence that deep retrofits can be cost effective (see figure below). While the cost range expands with very large savings, there are many examples that indicate that deep retrofits do not necessarily need to cost more in specific cost terms than the shallow retrofits - i.e. their cost - effectiveness can remain at equally attractive levels for best practices.

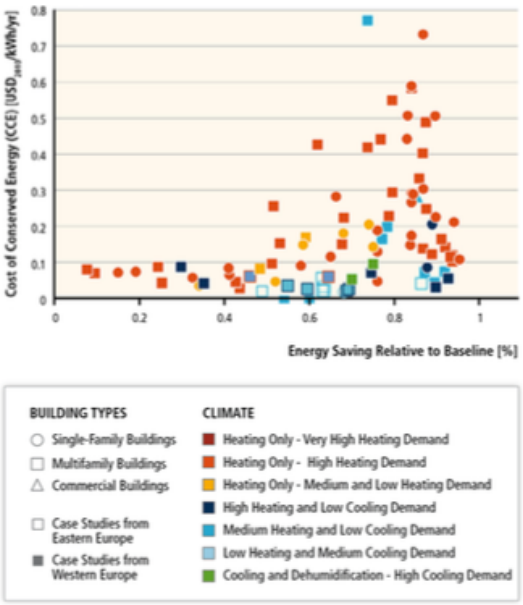


Figure 13: Cost of conserved energy as a function of energy saving in percent for European retrofitted buildings by building type and climate zone (Source: IPCC)

Some middle-sized cities in Europe (e.g. Bolzano in Italy and Innsbruck in Austria) are developing district refurbishment plans and will use the EnerPHit Standard as the basis for large-scale refurbishments (respectively 36,000 m^2 in Bolzano and 66,500 m^2 in Innsbruck) clearly preferring deep energy efficiency retrofits to cost-focused solutions only.

The UKGBC is also supporting the principle of home energy efficiency being a national infrastructure priority. They recommend targeting 1 million deep energy efficiency retrofits a year citing benefits beyond carbon reductions including growth and local jobs, fuel poverty and improved comfort.

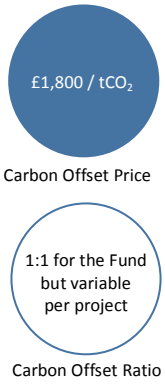
5.2.5 The risk with cost competition for carbon savings

One of the main risks associated with competition with other organisations delivering carbon savings is that those of them whose objectives are driven by financial return are likely to offer very low Carbon Offset Prices or very high Carbon Offset Ratios compared with what could be achieved with projects that deliver wider public good and/or are more innovative.

It is therefore very important for the London Borough of Tower Hamlets to structure and articulate the specific advantages of the LBTH Carbon Offset Fund compared with other Carbon Offset organisations.

5.2.6 Carbon Offset Price and Carbon Offset Ratio: a critical combination

As demonstrated in this section, the combination of the Carbon Offset Price and the Carbon Offset Ratio is critical as it will determine both the revenues into the Carbon Offset Fund and the type of carbon saving measures which can be funded with it.



In summary, we recommend the following:

- The **Carbon Offset Price** should be set primarily to reflect the need to offset residual emissions from proposed developments at a price which is competitive and does not represent a significant burden for the developer. It is important that the Carbon Offset Price is fair and attractive. The GLA recommendation to use a Carbon Offset Price of £1,800/tonne seems appropriate.
- The **Carbon Offset Ratio** should reflect LBTH's priorities. Although the Carbon Offset Fund should have an overall target of 1:1 as an average across all projects and measures funded, the ratio should be allowed to be less than 1:1, depending on the project.

We think that the above approach is clear and fair: the Carbon Offset Price should be sufficiently high to enable a range of carbon saving measures but it should not impose on applicants a carbon price which is too high and not attractive.

Flexibility with the Carbon Offset Ratio does not restrict LBTH to delivering only the most cost-efficient and short term projects and enables the Council to decide to allocate funding towards longer term objectives (e.g. deep retrofit of a school), other Council's priorities (e.g. fuel poverty) and accelerate innovative energy efficiency projects.

5.3 Allocating carbon savings and credits

There are four different approaches to allocate carbon savings:

1. If the Carbon Offset Fund has funded all works necessary to deliver the carbon savings, it can obviously claim the **full carbon savings**.
2. If the Carbon Offset Fund has only partially contributed to the carbon savings, the most logical technique is '**proportionate shares**': carbon savings achieved on a project are divided and allocated to the funders according to their financial contributions. For instance if the refurbishment of a tower block is funded in equal proportions by ECO and the Carbon Offset Fund, the Carbon Offset Fund would be able to claim 50% of the estimated carbon savings;
3. A variant to the above technique when the other contribution is from the beneficiary who does not account for the carbon savings is called '**proportionate shares by subsidy**';
4. Another technique in the case of partial funding is the '**full carbon claim through gap funding**' technique. If it can be demonstrated that the project would not have happened without gap funding provided by the Carbon Offset Fund, one could argue that the Fund could claim the full carbon credits. However, we think that this technique would not be robust and could lead to double carbon accounting.

We recommend to adopt the first two techniques to ensure that carbon accounting is fair, transparent and robust.

5.4 Collection of payments

5.4.1 Section 106 contribution

Section 106 of the Town and Country Planning Act of 1990 allows the developer to enter into an agreement with the Council so that planning permission can be granted to a development that would not otherwise be acceptable. The amount of the contribution must be negotiated between the developer and the Council. Section 106 agreements have commonly been the mechanism through which payments have been made to Carbon Offset Funds.

CLG Circular 05/05 and regulation 122 provide guidance to Local Authorities on the use of planning obligations and set out five tests that must be met. Planning obligations should be relevant to planning, necessary to make the proposed development acceptable in planning terms, directly related to the proposed development, fairly and reasonably related in scale and kind to the proposed development and reasonable in all other respects.

	Suitable mechanism?
s106	✓

The effect of regulation 122 is that one cannot, by way of a reason for planning permission, rely on an obligation unless the obligation meets the tests in regulation 122. Milton Keynes Council had obtained legal advice to confirm the validity of its approach:

"I consider an obligation which provided for financial contributions to a Carbon Offset Fund meets regulation 122. This is because one can properly reason that a planning policy is being met by the obligation which, consequently, is necessary to make the development acceptable as otherwise the policy would be breached. Further, the obligation is directly related to the development as it relates to its carbon footprint and is fairly and reasonably related in scale and kind to the development as it (the contribution) is geared to the size of the development."

It should be noted that there are also constraints with s106 agreements including the limitation on project 'pooling' and the fact that they are subject to specific negotiations and to viability limitations.

5.4.2 Community Infrastructure Levy (CIL)

Under the Planning Act of 2008, Local Authorities are also now allowed to introduce a Community Infrastructure Levy (CIL) which is levied against a wider range of developments using a specific tariff schedule based on a fee per m^2 of development. CIL has to be used on infrastructure projects listed on the Local Authority CIL Reg. 123 list.

	Suitable mechanism?
CIL	✗

CIL is not considered to be an appropriate mechanism for collecting carbon offset payments, for the following reasons:

- CIL is a fixed charge per m^2 and does not account for the varying performance of developments in terms of carbon emissions;
- CIL is not charged on affordable housing or charitable premises;
- CIL is not charged on refurbishments if there is no increase in square footage;
- CIL must be spent on new infrastructure, not retrofits.

5.4.3 Power of Wellbeing

	Suitable mechanism?
Power of Wellbeing	?

The Power of Wellbeing was introduced through the Local Government Act 2000 in order to promote innovation in the way that Local Authorities provide services. It enables them to do '*anything they consider likely to promote the economic, social and environmental well-being of their area unless explicitly prohibited elsewhere in legislation*'.

Although s106 seems a more appropriate mechanism at this stage to collect payments into the LBTH Carbon Offset Fund, exploring whether the Power of Wellbeing could provide the basis for the Carbon Offset Fund in the future may be useful.

5.4.4 Payment to a separate legal entity

Depending on the payment collection mechanism used and on the legal structure of the Carbon Offset Fund, there may be opportunities for funds to be paid into the Carbon Offset Fund so that the fund manager can be in control of its own budget. For example, if a Company Limited by Guarantee (CLG) was set up, it could potentially receive direct contribution from s106 agreements.

5.4.5 *Relationship with CIL*

It is essential to ensure that carbon saving measures funded by the Carbon Offset Fund through s106 contributions are not funded separately by CIL. LBTH legal department should ensure that these measures are not on the CIL Reg.123 list. For example a large PV system (>50kW may be considered as an 'infrastructure project', qualify for CIL funding and therefore should not be funded by the LBTH Carbon Offset Fund. On the other hand a smaller system could be funded by the Carbon Offset Fund.

5.5 Timing of payments and indexation

In terms of timing of payments, there are broadly 3 options: payment on commencement of the works, payment on completion of the works or a 50% / 50% split.

A payment on commencement of the works has been assumed. This would enable resources to be mobilised on commencement of the works and carbon saving projects to be significantly progressed, and ideally delivered, before completion.

A 100% payment on completion would prevent any investment on carbon saving projects before a development is completed: residual CO_2 emissions would therefore not be offset for a number of years until the Carbon Offset projects are delivered.

In terms of indexation, the most commonly used indices to link payment to inflation are the BIS Construction Price and Cost Indices (formerly known as BERR Construction Price and Cost Indices). The BCIS Price Adjustment Formulae are used in conjunction with the Formal Methods of adjusting building and engineering contracts to allow for changes in the costs of labour, plant and materials. The BCIS Indices are based on general building costs.

5.6 Process for identifying projects

The general principles associated with project identification and selection are summarised in this section. More details are provided in Section 8.0.

5.6.1 *Eligibility criteria*

Our recommendation is to adopt the following minimum eligibility criteria for Carbon Offset Solutions:

C1 The measures funded by the Carbon Offset Fund must deliver carbon savings in the London Borough of Tower Hamlets;

C2 Operational carbon saving must be delivered within 3 years from the allocation of the funds;

C3 All works and activities associated with funded measures must be legally entitled to receive funding from LBTH and observe applicable limitations that apply to all funds raised through s106 payments;

C4 All works and activities associated with funded measures must comply with the applicable legislation.

5.6.2 *General considerations for project selection and analysis*

Beyond compliance with these eligibility criteria, it is essential that the project analysis undertaken by the London Borough of Tower Hamlets and the potential application process followed by external applicants in the future follow the same structure and methodology. This evidence is critical not only to ensure the appropriate allocation of the funds but also to document this process so that any potential challenge can be dealt with.

The essential elements of the analysis/application should be:

1. Absolute energy consumption/carbon emissions[3], (DECs, EPCs, Carbon Offset Databases,);
2. Energy consumption/carbon emissions relative to benchmarks (DEFRA Energy Consumption Guides, Carbon Trust guides and CIBSE TM46);
3. Potential carbon reduction measures and their projected lifetime (DECs, EPCs, advisory reports, TM44 air conditioning reports);
4. Capital & administrative costs of measures to be funded;
5. Contribution allocated from LBTH Carbon Offset Fund and other programmes (e.g. ECO, RHI);
6. Predicted carbon savings;
7. Predicted financial savings;
8. Financial and carbon offset ratios;
9. Verification process (e.g. DECs, SAP/EPCs, data-logging);
10. Non energy/carbon based considerations (e.g. building lifetime, fuel poverty, community use of buildings, building vacancy for retrofit works, building maintenance schedules, job creation, comfort, etc.).

In all cases, the methodology used to establish key criteria for evaluation should be clearly recorded and be consistent between projects. To ensure consistency between analysis and applications, the methodology used to establish baseline carbon emissions and targeted carbon emissions could be imposed by LBTH. For example, the use of accredited Part L softwares (SAP or SBEM models) and the set of in-use factors used by ECO could be mandatory.

The use of other methodologies may also be allowed if the applicant can justify that they will be more accurate than the national calculation methodology. In this case, the submission of both calculations (using the standard and bespoke methodologies) may have to be required. Using standard methodologies would also ensure consistency with other carbon saving programmes (e.g. ECO which uses RdSAP or SBEM).

An example of a pro forma to be completed and submitted in support of any application in the future has been prepared and can be found in Appendix C.

Regardless of the approach that is selected, all funded projects should comply with good practice environmental procedures and a letter of commitment should be signed by the recipient of the funds prior to the works. The LBTH Carbon Offset Fund could issue credit notes to beneficiaries / delivery partners as evidence of the funding ring-fenced for the project. Funds would then be released on an agreed payment schedule and certification would be provided to developers once complete.

The project selection process will take into account LBTH priorities including tackling fuel poverty, reducing operational energy use and CO_2 emissions and offering value for money.

[3] *The DCLG carbon factors are recommended (e.g. 0.519 kgCO_2/kWh/yr for electricity and 0.216 kgCO_2/kWh for gas).*

5.7 Delivering the projects

5.7.1 General approach

One of the core principles of the LBTH Carbon Offset Fund is that the responsibility for delivering the carbon savings is transferred from the applicant/developer to the London Borough of Tower Hamlets. Although LBTH will therefore retain high level responsibility for ensuring the savings are delivered, it is recommended that one of the three management strategies outlined below is adopted:

1. **LBTH retain full responsibility** for project managing the complete portfolio of carbon saving projects internally. This approach was popular with many of the local authorities who took part in the benchmarking review as it minimises administrative costs while allowing LBTH to retain control over the implementation process. Provided sufficient human resources are available internally this is a logical approach that offers a simple way to begin delivering carbon reduction projects. The main issues associated with this approach are the amount of time that may be required to manage and implement projects, particularly if the fund grows significantly.
2. **Implementation could be outsourced** as a complete package to a third party. This approach was taken in Milton Keynes where the National Energy Foundation (NEF) manages delivery of projects on behalf of Milton Keynes Council. This approach has the advantage that projects can be identified and prioritised on a purely technical basis. While the administrative costs of this approach are likely to be higher, employing a not-for-profit organization such as the NEF provides a level of reassurance that the delivery organisation has an ethical interest in using the fund efficiently to achieve carbon reductions.
3. **LBTH retain overall control of the implementation programme, with third party organisations brought in to assist** with more technical and time consuming aspects of programme delivery on an as-needed basis. Significant parts of the programme delivery could be outsourced to organisations such as RE:FIT and RE:NEW, who have extensive experience in implementing low energy retrofits and a framework of contractors to carry out the necessary work.

For more information about the management of the Fund itself, please refer to Section 11.0.

5.7.2 The type of carbon saving measures should inform the approach selected

When deciding which approach is most appropriate, there is value in considering the nature of the various carbon reduction measures that are expected to be funded.

The following carbon reduction measures are technically complex, even at a specification level, and may therefore be most effectively dealt with by specialist external contractors:

- Improving the thermal envelope of a building;
- Benchmarking, upgrading and automating lighting systems;
- Adjusting domestic hot water thermostats and ensuring cylinders are properly insulated;
- Upgrading heating systems and controls;
- Installing flue gas heat recovery systems;
- Installing building management systems;
- Inspecting and optimising air conditioning systems;
- Installing IT power management software.

Some carbon reduction measures may be more appropriate for direct management by LBTH:

- Lighting retrofit programmes;
- Installation of photovoltaic systems;

- Energy management training;
- Energy benchmark competitions between public buildings.

5.7.3 *Delivery process*

The general process that would typically be employed by an organisation to implement an energy or carbon reduction project is outlined below. It is recommended that priority is placed on completing a small number of pilot projects by LBTH to gain experience and to demonstrate the benefits of the Carbon Offset Fund.

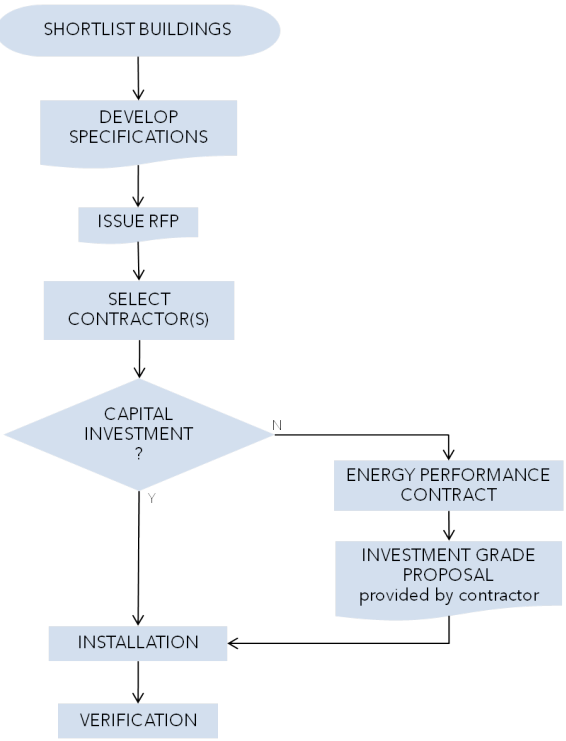


Figure 14: Typical delivery process

The importance of developing a robust specification for the carbon reduction works should not be underestimated as this is a critical step in the process. It will generally dictate the final carbon reduction that is achieved and help to minimise the performance gap between predicted and actual carbon savings. This will often be a relatively technical step in the process and there may be value in seeking external assistance, particularly for the first few projects.

When seeking external assistance, or engaging with an Energy Company through an Energy Performance Contract, LBTH should maintain sight of long term carbon emissions reduction targets and wider benefits (e.g. fuel poverty, air quality) as it may have a longer term interest in the overall carbon reduction achieved and in delivering wider benefits than any external parties. Specifications should be meticulously developed to achieve the best potential long term carbon reductions based on the financial and technical limitations.

The flowchart also indicates that there is potential for using some of the carbon offset funding to supplement energy performance contracts, rather than being used purely for capital investments. The provider of the energy performance contract, usually an Energy Company, would typically cover some or all of the capital cost of a retrofit in exchange for receiving a share of the financial savings delivered by the project. This approach could allow the carbon offset fund to be used as leverage to achieve greater overall carbon reductions than if the fund were used solely for capital investments.

Energy Companies could be expected to finance the most cot effective energy and carbon reduction measures, while the LBTH Carbon Offset Fund could be used to ensure any remaining opportunities for carbon reduction (especially those with wider benefits) are still considered.

5.7.4 *Potential delivery partners*

Partnering with the Greater London Authority's RE:NEW and RE-FIT programmes could significantly help to deliver carbon saving measures. Although LBTH will still be responsible for issuing RFP's and selecting contractors, in accordance with LBTH Procurement Policy, RE:NEW and RE:FIT both have contractor frameworks already in place.

RE:FIT Suppliers:	RE:NEW Suppliers:
Bouygues Energies & Services FM (UK) Ltd British Gas Trading Ltd	Axis Breyer Group Plc
COFELY Ltd	British Gas Climate Energy Services Ltd
EDF Energy Customers Plc	Carillion Energy Services
E.ON Energy Solutions Ltd	Enterprise
Honeywell Control Systems Ltd	Groundwork London
Imtech Technical Services Ltd	Lakehouse Contracts Ltd
MCW MITIE TFM Ltd	Osborne Energy
Norland Managed Services Ltd	United House Ltd
Skanska Construction UK Ltd	Warm Zones CIC
Willmott Dixon Energy Services Ltd	Willmott Dixon Partnerships

For more information about project delivery, please refer to Appendix D.

5.8 Verification

The verification system is a crucial component of the carbon saving strategy as it will enable the Fund Manager to:

- assess investment opportunities;
- perform due diligence on investments;
- monitor the efficacy of various Carbon Offset Solutions so that underperformance can be addressed.

However it is important that the best balance is found between creating these assurances while avoiding overly burdensome reporting and monitoring processes. A set of clear, consistent methodologies is therefore necessary to ensure efficiency and consistency. Two types of verification can be undertaken: ***ex ante*** and ***ex post*** processes.

5.8.1 *Ex ante verifications*

Completion of the works

ex ante verification

(calculations)

Ex ante verification arrangements apply where measures are determined in advance against criteria and are deemed to deliver set carbon savings. For example, carbon savings under ECO are calculated using a version of the National Calculation Methodology. The current methodologies for assessing carbon savings under Part L of the Building Regulations corrected with 'in-use factors' as applied for ECO assessments are therefore recommended for *ex ante* verifications (e.g. SAP calculations for domestic retrofits and Dynamic Simulation Modelling (DSM) for non-domestic retrofits).

'Initial' Part L calculations would be submitted as part of the specific project funding application and would establish the specific achievable cost per tonne of lifetime CO_2. Independent and qualified people should carry out the *ex ante* verifications to ensure good quality, unbiased measurements. Applicants may be allowed to use another methodology with adequate justification.

5.8.2 *Ex post verifications*

ex post verification

(calculations and optional measurements)

Ex post verification arrangements apply where the impact of measures are tested at a real, practical level and would involve measuring the delivery of saving. Although a detailed *ex post* verification is not envisaged for practical reasons on each project, each recipient of any funds should be required to provide written confirmation and photographic evidence that the works have been undertaken to a satisfactory quality standard and to provide 'final' calculations highlighting any discrepancy with the 'initial' calculations.

All projects should also agree to participate in any monitoring of the project by LBTH to enable any potential in-depth analysis of the actual carbon/cost efficiency of abatement measures.

5.8.3 *Liability*

In the event that the expected carbon savings were not delivered the organisation responsible should be responsible for dealing with any short fall and incentivised to do this, for example through financial penalties.

However, it is important that the liability for failing to deliver the level of CO_2 reduction is too onerous in order not to discourage more ambitious / complex carbon saving projects.

5.9 Other LBTH objectives

The concept of 'convergence' is used by the London Legacy Development Corporation in the Offset Solutions Study associated with their Legacy Communities Scheme. It highlights the fact that carbon saving initiatives often have wider benefits (e.g. fuel poverty, new jobs, new skills, etc.).

Identifying this potential for 'convergence' with other LBTH objectives will be part of the project delivery analysis, with projects that deliver other 'objectives' being given greater priority. Current other LBTH objectives for consideration include:

1. Reduction of fuel poverty
2. Reduction in public expenditure on energy
3. Air quality impacts
4. Health benefits
5. Job creation
6. Skills development
7. Biodiversity enhancements

Thorough the delivery of carbon offsetting projects there are wider benefits, than carbon savings, that can be realised for the community living and working in Tower Hamlets.

Setting up a successful LBTH Carbon Offset Fund and running it in harmony with other existing schemes will secure positive outcomes for LBTH and could be targeted towards the more vulnerable households or the public buildings (e.g. Schools) in most desperate need of a refurbishment.

6.0

BENCHMARKING REVIEW

6.0 BENCHMARKING REVIEW

A benchmarking study of different Local Authorities' Carbon Offset Funds has been undertaken in order to establish current practices in relation to local carbon offsetting and gather lessons learnt. Between May and July 2014 interviews were held with the following local authorities:

- Brighton & Hove City Council;
- London Borough of Croydon;
- London Borough of Hackney;
- London Borough of Hounslow;
- London Borough of Islington;
- London Legacy Development Corporation;
- Milton Keynes Council;
- London Borough of Southwark;
- Westminster City Council.

This section summarises the responses received. A quick view matrix can be found in Appendix A and accompanies this section. It is a factual comparison and summary of the key elements of different Carbon Offset Funds.

More local authorities were contacted following our literature review. However, Lambeth Council and Reigate & Banstead have confirmed they will not be taking their Carbon Offset Fund forward for now. Other Local Authorities operating a Carbon Offset Fund have also been contacted but unfortunately their feedback could not be obtained at this stage.

6.1 Methodology

The Benchmarking Review of the existing Carbon offset Funds operated in the UK and those in formation has been carried out in three phases.

Phase 1 – Desktop study of existing funds

Phase 1 included a desktop study of existing Carbon Offset Fund studies and data. This literature research led to the preparation of an initial comparison matrix which highlighted the discrepancy of information available between the various schemes and informed the preparation of the questionnaire used during the interview (please refer to Appendix B for a copy of the questionnaire).

Documents reviewed as part of the literature research have been referenced and the list can be found in the Bibliography (Section 14.0).

Phase 2 – Local Authorities Interviews

A combination of face-to-face and telephone interviews were held during Phase 2. The interviews followed the structure of the questionnaire in order to ensure that the information gathered would be as consistent as possible. As the interviewees were the officers operating or preparing the Carbon Offset Funds within their respective Local Authorities, they had direct experience of the challenges associated with the implementation of the fund, which constituted a very valuable feedback for the London Borough of Tower Hamlets.

It should be noted that critical information gathered during the interviews is confidential as the aim of this benchmarking study was not to analyse a specific Carbon Offset Fund but rather to contribute to the design and implementation of a future Carbon Offset Fund by the London Borough of Tower Hamlets. Therefore, when necessary, feedback from Local Authorities has been anonymised.

Phase 3 – Consolidating Data

Phase 3 consisted in the consolidation of the data gathered during phases 1 and 2 and its analysis. The following documents were prepared:

- a written synopsis of each interview (which has not been included as part of this report as it constitutes background and confidential information);
- an A3 Benchmarking Matrix of fund features to enable a 'like-for-like' comparison;
- a qualitative analysis drawing the pertinent points and lessons learned through the Benchmarking Process.

6.2 Comparison matrix

One of the findings of the initial literature research undertaken was that the quality of information was very disparate and that this lack of homogeneity prevented us from having a clear picture of the different approaches adopted across the Local Authorities which are at the forefront of Carbon Offset Funds in the UK.

Therefore, our aim was to enable a 'like-for-like' comparison of the following considerations/parameters across the nine Carbon Offset Funds discussed in detail during the interviews:

- **Status of fund:** adopted or in formation, key dates;
- **Cost of carbon**: £/tonne CO_2;
- **Basis for cost of carbon:** specific study, benchmark, cost review process;
- **Satisfaction with the cost of carbon**: record of any challenges from developers, feasibility of delivering carbon saving projects within the same budget;
- **Relevant planning policies and approach:** policies, carbon reduction requirements (regulated and/or unregulated), applicability to residential and/or commercial, to major and/or minor applications;
- **Mechanism used to obtain contribution:** s106 or Community Infrastructure Levy (CIL);
- **Payment terms**;
- **Fund management**: responsibility, accountability, administration costs;
- **Carbon saving projects delivery process**: responsibility, identification of projects, measures funded, CO_2 reporting.

Please refer to Appendix A for an A3 version of the Matrix reproduced below.

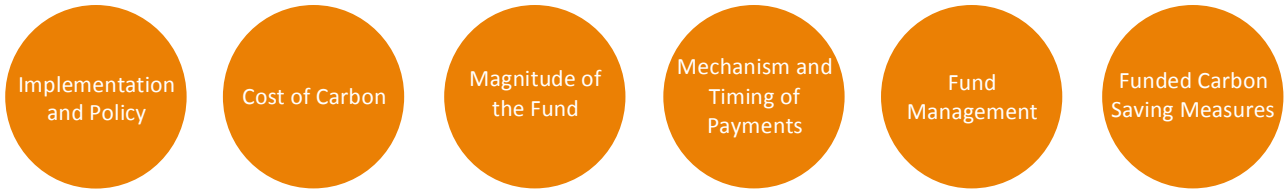
Project number	20140055
Project name	LBTH Carbon Offset Solutions Study
Document	Carbon Offset Fund Benchmarking Matrix
Tab	Simplified Matrix
Revision	E

Etude

	Brighton & Hove	Croydon	Hackney	Hounslow	Islington	Milton Keynes	Southwark	Westminster	LLDC *(acting as Developer)*	LLDC *(acting as Local Planning Authority)*
Status of Fund	Awaiting adoption in 2015.	In operation	Awaiting adoption	Awaiting adoption.	In operation	In operation since 2008.	Awaiting approval	In operation	In operation	Awaiting adoption
Cost / tonne CO2 (over 30 years)	£1,000	£1,380	£1,800	£1,800 (expected - not set yet)	£920	£200	£1,380	£7,560	£1,380	£1,800 (expected - not set yet)
What is the cost based on?	Costs of retrofitting from BRE study.	GLA recommendation.	GLA recommendation	GLA recommendation	The cost of installing solid wall insulation.	Schemes and measures available.	GLA	Arup study. Accounts for measures applicable to Westminster.	Original price for Allowable Solutions from CLG.	GLA recommendation.
How often will this be reviewed?	3 yearly due to limited resources.	Likely in line with GLA	In line with the Zero Carbon Hub recommendations.	In line with the Zero Carbon Hub recommendations.	No set time-frame.	It has not been reviewed since the policy was implemenated in 2008.	Likely in line with GLA.	Every 2 years.	It is anticipated that the Carbon Offset Price will remain at £1,380/tonne.	
Has this been challenged?	The policy has not been implemented. Not challenged at consultation stage.	No.	No.	No.	No. The terms have been informally challenged.	No.	Policy not in force.	Negotiations always happen.		
Happy with this cost?	Probably too low to deliver.	Yes - it keeps things straightforward. Croydon's priority is existing stock and getting money in to improve it.	Feel it should be higher - but not time or resource to conduct a study.	Feel it is robust.	Yes.	Aware it should be refreshed.	Yes (though accepted it's probably too low for a tonne for tonne offset).	Yes.		
Relevant Policies / Commitments	[illegible] Sustainable Buildings, pg 161. City Plan Core Policy 7 (CP7), pg 164 and 165 [illegible]	London Plan	DMLP s.106 SPD	[illegible] SPD on Planning Obligations (to be refreshed) Planning Guidance Note (to be [illegible]	Core Strategy Environmental Design SPD	Sustainable Construction Policy D4	Core strategy - adopted Draft SPD - expected adoption late 2014	London Plan Westminster's City Plan - Policy S40	Planning application for the Legacy Communities Scheme and associated planning obligations.	London Plan Westminster's City Plan - Policy S40
Residential / Commercial	Residential and commercial	Residential and commercial	Residential and commercial	Residential and commercial	Residential and commercial.	Residential and commercial	Residential and commercial	Residential and commercial	Residential and commercial	Residential and commercial
Carbon reductions required	Related to CfSH and BREEAM: Minor - CSH Level 4 / Very Good Major - CSH Level 5 / Excellent	London Plan	London Plan	London Plan Resi - CSH Level 4 on-site Non-resi commercial and new build - BREEAM Excellent	100%	100%	London Plan	40% (LP) 20% on-site renewables.	Full' Fabric Energy Efficiency Standard and Carbon Compliance Level as set by the Zero Carbon Hub	
Applicable to Major / Minor applications	Major and minor.	Major.	Major. Minor from 2016	Major.	Major and minor (only new build residential for minor developments).	Major.	Major	Major	Legacy Communities Scheme only.	
Regulated / Unregulated	Regulated and unregulated.	Regulated	Regulated	Regulated	Regulated and unregulated.	Regulated and unregulated.	Regulated	Regulated	Regulated	Regulated
S.106	s.106 used.	S.106 is use. No problems.	s.106 will be used.	s.106 used	s.106 used.	s.106 used	s.106 used.	s.106 used.	s.106 used.	s.106 used.
CIL	CIL is not adopted. Ex	CIL is adopted and has not been affected. District heating removed from Reg 123	CIL not adopted.	CIL not affected.	CIL not adopted.	Not implemented.	CIL not affected.	CIL not adopted.	No	
Payment terms (e.g. 50% on commencement - 50% on completion)	On completion.	On completion.	On completion. For larger regeneration projects stage payments negotiated.	On completion.	At commencement.	On completion.	Not specified.	Negotiable.		
Managed by who?	Not decided. May use a Green Deal Partnership that has already been set up to streamline costs	Internally. Two boards - s.106 board and Energy and Carbon management board.	Internally managed. Overseen by Environment Sustainability Board.	Not decided. Likely to be internal.	Internally. By s.106 team and the Energy Services team.	Externally. National Energy Foundation.	Internally. Sustainable Services Team.	Internally.	Internally.	Internally.
Accountability	Not decided. Partial funding likely due to costs.	Internal public sector audit and governance.	A report will be issued yearly setting out contributions to schemes and the associated % offset.	Pre-established reporting procedures.	Tonne for tonne approach is not required.	Carbon Offset Fund Board (Milton Keynes, NEF, HEA). They meet to discuss how the fund is spent. Independent annual audit.	Quarterly on-line report Annual report detailing where s.106 and CIL money has been spent.	RE:FIT model used.	RE:FIT and RE:NEW frameworks and models likely to be used.	RE:FIT and RE:NEW frameworks and models likely to be used.
Administration cost (e.g. x% management fee)	Expected to be 10%.	Lean. Piggy back on other projects.	Expected to be 5%.	Not adding administration fee.	15%.	10% taken from monies collected.	Approximately 3% but not set currently.	5% management fee included.		
Who delivers the projects?	Housing associations Developer Landlord through contribution to renewable energy grants Private householders directly, through subsidy.	Contract manager within council, if delivered by third party.	Delivery of projects to be managed internally by the council.	Through existing pipelines on existing projects.	No projects have been delivered at this point in time.	NEF.	Council	Either developer or the Council.	LLDC through RE:NEW and RE:FIT	LLDC through RE:NEW and RE:FIT
Types of projects identified	Not specified.	Residential projects only for receipt of funding.	Community level schemes Not targetting refurbishments.	Existing projects within the council - e.g. fuel poor, the elderly.	Existing stock.	Mainly residential energy efficiency improvements	Likely council owned buildings.			
How are projects identified?	Application to the fund SESP (a Green Deal Partnership) May create a portfolio of identified projects. Likely to prioritise the fuel poor.	No systematic approach - opportunistic. Largely dependent on whether additional funding can be drawn.	Prospective projects will be given the opportunity to present their funding opportunity to the councils Environmental Sustainability Board.	Existing projects.	Working on this.	1) Incoming applications 2) Targetting projects / marketing	Not confirmed.			
What measures are funded?	District heating (until CIL comes in) Retrofit - domestic and commercial Renewables	Loft insulation Cavity wall insulation Fit and forget measures	Community energy schemes - PV External wall insulation LEDs Tree Planting Behaviour change	Refurbishments (residential and commercial) Renewables (building scale).	Energy efficiency improvements.	Energy efficiency measures mainly. In theory, anything that delivers CO2 savings.			- Focus on projects close to the LLDC boundaries (e.g. Bromley-by-Bow) - Focus on education projects - Behaviour projects included - Water efficiency improvements included	- Focus on projects close to the LLDC boundaries (e.g. Bromley-by-Bow) - Focus on education projects - Behaviour projects included - Water efficiency improvements included
How is CO_2 accounted for?	Existing studies and methodologies will be used (e.g. EST, IBE, ZCH, government documents).		Using nationally recognised benchmarks.	Approach still being decided.	Unknown.	Standard published figures from DECC.				

6.3 Analysis

The qualitative analysis of the literature research and the interviews has been split into six different themes:



6.4 Implementation and Policy

6.4.1 Stage of development of the Carbon Offset Fund

Of the nine Local Authorities interviewed, five had Carbon Offset Funds that are currently in operation and receiving money. The other four funds are currently in advanced stages of development awaiting adoption.

A key concern cited by three of the funds was the uncertainty surrounding carbon policies and in particular the Housing Standards Review. These risks are discussed in section 3.2 of the report. Their recommendation was to set up the Carbon Offset Fund despite this uncertainty. According to them, a relevant and robust strategy would be to set the cost of carbon at the level recommended by the GLA (i.e. £60/tonne over 30 years equivalent to £1,800/tonne), apply it to both residential and commercial applications and focus on regulated carbon emissions only.

6.4.2 Policy

Policies need to be robust enough to be able to stand up to challenges, yet flexible enough to be able to respond to changes that may occur in the future. One Local Authority said they structured the policy document in order to safeguard the requirements they were asking for in the face of any future changes to national policy.

Core Strategy and Local Plan documents (which are more difficult to update) are generally not too specific in their requirements. Accompanying Supplementary Planning Documents (SPDs) appear to be used to elaborate on the Carbon Offsetting policy as updating a SPD is a quicker process. Developing a specific and simple SPD (or addendum to an existing SPD) on the Carbon Offset Fund may therefore be useful for the London Borough of Tower Hamlets.

A recommendation of one of the Planning Officers interviewed was to assess 'As Built' carbon emissions from developments and retrospectively apply Carbon Offset payments where those carbon emissions were not met in the 'As Built' design.

6.4.3 Technical policy considerations

One key recommendation given was to be very clear about:

- which carbon emissions are applicable to the policy (i.e. as designed, as built, embodied carbon etc.) as this can avoid protracted discussions later on;
- how refurbishments and retrofits will be treated, i.e. what will the baseline be? e.g. a Local Authority chose to ask developers to model the pre-refurbishment CO_2 emissions against Part L in order to establish a baseline.

Generally only regulated emissions were included in the CO_2 calculations, however three Local Authorities have included unregulated energy in their policies. One of them recommended the inclusion of unregulated energy as this is the only true view of a building's actual carbon impact. Conversely, another Local Authority specifically recommended not including unregulated energy as it would make it more complicated and less in line with current Government policy.

6.4.4 *Internal co-operation*

A lack of understanding of the purpose of the Carbon Offset Fund, its operation and benefits is a key issue

A commonly cited challenge was internal resistance within the Local Authorities themselves, particularly during the early stages of a fund's development. A lack of understanding of the purpose of the Carbon Offset Fund, its operation and its significant benefits appears to be the main reason. Getting other Officers (particularly from Development Control) and Members (e.g. Planning Committee) on board required training and explanation. Time associated with these activities needs to be considered but is seen as crucial for the success of the Carbon Offset Fund.

Milton Keynes was one of the Local Authorities who experienced this challenge and they reacted pro-actively by running training days. Ultimately the problem was overcome and they have been successfully running the fund for seven years now, collecting over £2 million and improving 8,000 homes.

6.5 Cost of carbon (£/tonne CO_2)

Costs of carbon for the offset fund contributions varied across the various Local Authorities and ranged from £200/tonne of CO_2 (Milton Keynes) to £7,560/tonne CO_2 (Westminster).

The average cost of carbon across the Local Authorities with carbon reduction policies focusing on regulated carbon is £2,550/tonne CO_2

Four of the funds interviewed are using the GLA previously recommended cost of £1,380/tonne CO_2 over 30 years, with two updating this now to the more recent recommendation of £1,800/tonne CO_2 over 30 years. The other four funds generated their own cost of carbon. These were based on the anticipated cost of retrofitting energy efficiency measures appropriate to the locality. These costs came in at £200/tonne, £920/tonne, £1,000/tonne and £7,560/tonne of CO_2. Overall, the average cost of carbon across the eight local authorities is £1,935/tonne.

The price of carbon should be viewed in relation to carbon reductions required by the London Borough of Tower Hamlets. The two lowest carbon prices were set by Local Authorities asking for the highest carbon emissions reductions – Milton Keynes (£200/tonne) and Islington (£920/tonne) which both require 100% of regulated and unregulated carbon to be offset. The average cost of carbon across the six local authorities with carbon reductions focusing on regulated CO_2 emissions only is £2,5550/tonne.

The highest cost of carbon was set by Westminster City Council and is based on work by Arup in 2013 and 2014. High land values, the importance of commercial development and the fact that a very large percentage of buildings within Westminster are listed or are in conservation areas (limiting the options available for retrofit) appear to be the key reasons behind the high cost of carbon.

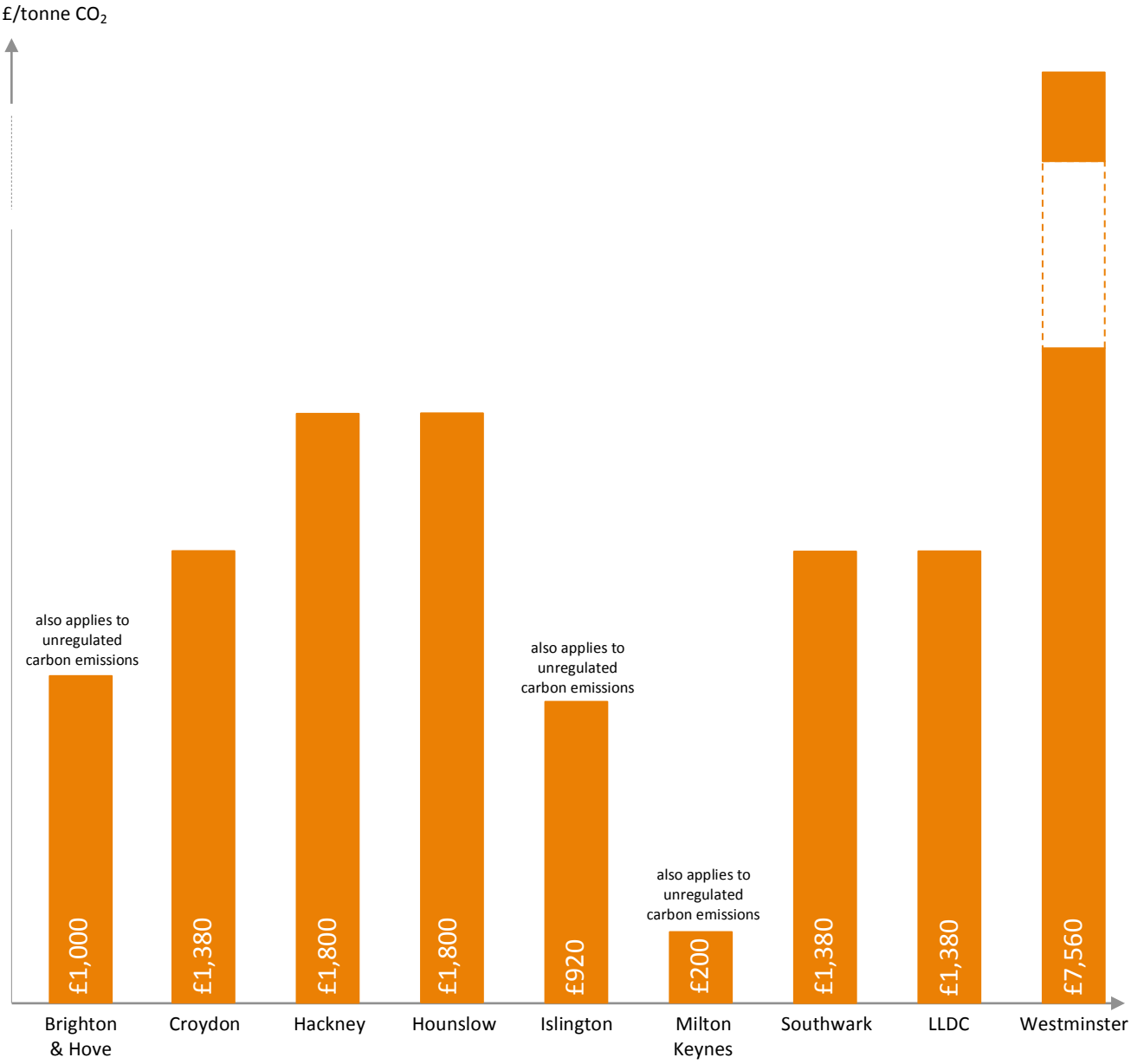


Figure 15: Carbon Offset Prices across the 9 Local Authorities interviewed

Almost all of the Local Authorities felt their cost was too low to achieve a Carbon Offset Ratio of 1:1 (i.e. to be able to deliver a tonne for tonne carbon saving). However there were other factors that took precedence. These included:

- Not having a robust evidence base for carbon saving measures;
- A lack of resource or budget for developing a local cost;
- The risk of disincentivising development in the area;
- The wish to keep things simple and 'challenge free', due to the resources required to deal with potential challenges from developers;
- The potential to adversely impact the delivery of affordable housing (a priority for most local authorities);

- The wish to get the Carbon Offset Fund to operate quickly in order to start delivering carbon savings.

One recommendation was that the price of carbon should be balanced against the London Borough of Tower Hamlets' other priorities and targets. For example, if improving the existing building stock is a priority, a lower price of carbon may mean it is easier and quicker to get money into the fund to spend it on stock improvements. If the priority is to increase the energy generated by on-site renewable energy systems, then there would be more incentive to ask for a higher price of carbon.

Another recommendation was that if a local price of carbon was to be developed, it should be tested in terms of the impact it would have on CIL and s106 payments.

Where the cost of carbon was in line with the GLA recommendation, there were no objections from developers. Local Authorities which asked for higher costs of carbon, or higher carbon reduction targets, were most likely to enter into negotiation processes and require a robust evidence base as a justification.

The general consensus was that a local cost of carbon allows Local Authorities the flexibility to meet their needs within the specific set of constraints that are relevant to them but that a regional government recommended cost is generally likely to face a reduced level opposition from developers and hence allows for smoother delivery of funds into the Carbon Offset Fund and therefore of carbon saving projects.

Note: *it should be noted that two Local Authorities which have not been interviewed have set carbon prices at a rate higher than the one recommended by the GLA (i.e. £1,800/tonne): the London Borough of Enfield use a carbon price of £2,250/tonne and the London Borough of Lewisham a carbon price of £3,120/tonne.*

6.6 Magnitude of the Fund

6.6.1 Forecasting

Forecasting of receivable funds was generally not done by Local Authorities.

Forecasting of receivable fund was generally not done by Local Authorities due to uncertainties

Where forecasting was done it has been found that monies collected were significantly less than forecast due to any combination of the following factors: recession affecting development, unforeseen negotiations about s106 contributions, housing delivery targets not being met. Some Local Authorities felt that undertaking a forecasting exercise would not be worthwhile due to the uncertainties involved.

One Local Authority with carbon reduction targets similar to the London Plan commented that over the course of the 25% reduction in CO_2 emissions target (within the London Plan) developments steadily came to be able to meet that target easily. They therefore anticipated the same would happen with the 35%/40% target – possibly meaning that very little money would actually enter the fund.

6.6.2 Minor Developments

Most Local Authorities did not include minor developments/applications in their Carbon Off-setting policy. However three London boroughs have included them / will be including them in the future.

The London Borough of Islington includes minor developments and operates a flat rate scheme for simplicity (any flat or house that does not meet the carbon reduction target is required to pay £1,000 or £1,500 respectively). It has been simple and straightforward to implement, receiving little opposition and has provided a steady stream of investment into

the fund which can help save carbon elsewhere (e.g. through the London Borough of Islington's energy efficient retrofits carried out by the Housing team).

Brighton and Hove City Council's policy also covers minor developments and this has been worthwhile for them since a significant proportion of development in Brighton is classed as a minor application.

6.7 Mechanism and Timing of Payments

6.7.1 Planning Obligations Section 106 and the Community Infrastructure Levy (CIL)

Planning Obligations Section 106 is being used by all Local Authorities as the mechanism for securing payments from developers. It is seen as the only mechanism available.

Planning Obligations Section 106 is being used by all Local Authorities with a Carbon Offset Fund despite its limitations

The limitations of Section 106 were cited by some. In particular, the limitation on pooling different s106 contributions for use towards one project (currently understood to be 5) potentially limits the scale of projects that can be funded from the Carbon Offset Fund, unless other funding is secured simultaneously.

Another drawback of using s106 is that it can be eroded by the negotiation process. Developers can challenge the viability right up until the point of payment. So, there is a risk that the monies expected will be reduced.

The Community Infrastructure Levy (CIL) does not appear to be a suitable mechanism for collecting payments for a Carbon Offset Fund since it cannot depend on the project's specific carbon emissions shortfall. However, it is worthwhile considering how the CIL sits alongside the Carbon Offset Fund to ensure LBTH's aims and priorities are met. Any projects on the Reg.123 list for CIL cannot be funded by s106, and only 'infrastructure' projects can be funded by CIL. The London Borough of Croydon took the decision to remove district heating from their CIL Reg.123 list and therefore district heating can be funded by their Carbon Offset Fund.

Milton Keynes have adopted a particular approach: money collected by the Council through the Milton Keynes Tariff and Section 106 contributions is given to the National Energy Foundation (NEF), a non-for-profit organisation who manages the offset fund and delivers projects. NEF reports quarterly on money received from the Carbon Offset Fund, other money funding received and money invested in carbon saving projects.

6.7.2 Timing of Payment

Most funds reviewed in the Benchmarking Review require payment on completion, though some ask for payment on commencement. It was found that payment on commencement attracted more negotiations. However they allowed funds to be received earlier and therefore spent on projects sooner.

Payment on completion can result in monies being received years later. Would waiting two or three years (or more) for payments into the fund be acceptable? If it is, then payment on completion may allow a smoother process with less discussion.

6.7.3 Timeframe for spending collected funds

This is likely to be in line with Section 106 rules and therefore funds would have to be spent within 5 years unless negotiated otherwise.

6.8 Fund Management

6.8.1 Internal or External?

Opinions over whether to manage funds internally or externally were split. Five funds are currently in operation, and only one of these is managed externally – the Milton Keynes fund.

The benefits of the fund being managed externally for Milton Keynes is that they have teamed up with the National Energy Foundation (NEF) whose core business is delivering energy efficiency improvements through retrofits. In this respect, they have skills and expertise that Milton Keynes may not have readily available internally. They have also delegated the task of finding projects to spend the money on – a frequently cited challenge.

However, some Local Authorities clearly expressed their preference to keep the management of the Fund internal in order to retain control over where the money is spent. The ability to align spending with political objectives was cited by one officer as an important and positive factor, along with the ability to fund other Council's objectives / projects.

The four funds which are not yet in operation are generally undecided as to whether to keep the management internal or external. Setting up a third party not-for-profit organisation was considered as an interesting proposition to some.

It appears from our literature review that Southampton City Council's view is that predicted income should influence the management setup. Smaller revenues allow a simpler management structure. There is also a greater incentive to keep administration and management costs low when the fund itself is small. However, they also noted that the fund should develop in a fundamentally simple way that allows for easy expansion as the fund increases in size.

6.8.2 Accountability

Most Local Authorities follow pre-established reporting procedures for accountability, through an annual report as a minimum. One Local Authority produces quarterly interim reports.

Westminster City Council have chosen to use the RE:FIT model set up by the GLA in most cases. The advantage of this is that there are pre-established means of estimating and reporting CO_2 savings, costs and life expectancy of measures, in one auditable package.

The approach recommended by the Milton Keynes Carbon Offset Fund review is a two-tiered governance and reporting structure. Milton Keynes Council has a Carbon Offset Fund board that meets regularly to decide how funds are spent. The fund is also subject to an annual audit by an independent third party.

6.8.3 Administration Costs

The funds in operation did not have data available for the actual time and cost involved in managing the fund. Time consuming aspects of running the funds were cited to be:

- Setting up the policy;
- Educating and bringing on board other Council Officers, particularly Planning Officers and Senior Members;
- Negotiations with developers objecting to costs or carbon reduction targets - the experience from the various funds showed that where negotiations were not common, the costs involved in getting the money into the fund were minimal;

- Identification of projects to spend the money on - in almost all cases, whether the funds were up and running or not, the most time-consuming element of running the fund was the identification of projects.

Recommendations for reducing the time spent on managing the Carbon Offset Funds included:

- Setting the carbon reduction price and targets at a level where applicants are unlikely to object;
- Direct initial funding towards existing projects already being run within the Council;
- Allowing external parties to apply for funding.

The Milton Keynes fund has two ways of identifying projects – through direct application for funds from the building owner, and through identification of suitable projects and direct marketing towards them. In their experience, it is far quicker and more cost efficient where interested building owners make a direct application. The overheads and time spent in identifying projects, getting agreement from building owners, getting the project off the ground is significant and they recommended that this should not be underestimated.

Most Local Authorities have allocated between 10% and 15% of their Carbon Offset budget to administration and management costs

It seems that most Local Authorities have allocated between 10% and 15% of their fund budgets towards administration and management issues, regardless of whether it is managed internally or by a third party. However, there are few details publicly distributed regarding the actual costs of Carbon Offset Fund administration and management. The London Borough of Sutton charges an additional 10% fee to cover administrative costs. The Reigate and Banstead fund proposed to fold several administrative fees into their carbon price: a 5% administration fee to cover the costs of administering the s106 process and a 10% project management fee. Southampton City Council estimates the cost of appointing an external fund manager to be 10-15%, depending on the size of the scheme. The management strategy must be long term, as the marketing, delivery and project timelines will be long term as well.

6.8.4 Flexibility

As the fund is likely to be small and grow in importance and scale over time, it is recommended that the Management set-up is flexible: it should rely initially on existing frameworks, mechanisms and delivery/verification processes and gradually develop its own framework. The administration and management costs are therefore likely to be smaller in scale initially but larger in proportion compared to a larger fund.

6.9 Carbon Reduction Measures

6.9.1 *Project Identification*

The identification of projects for the delivery of carbon savings was cited as one of the biggest challenges of the Carbon Offset Funds. Four main approaches appear to be used:

The identification of projects is one of the biggest challenges for Local Authorities

Figure 16: Approaches to project identification by existing Carbon Offset Funds

The first approach whereby the money was used to support other projects already underway in the Council proved to be popular. This is because the projects were already mobilised and little additional resource was needed to direct funds towards them. This approach seemed to happen organically when no other method for allocating money was set up.

Where teams sought to identify projects to spend money on, this appeared to be far more challenging. Getting buy-in from private landlords, homeowners or occupants could be difficult, particularly where only partial funding was offered. One Local Authority recommended that time involved in getting a project mobilised should not be underestimated. A key recommendation was to ensure that the Carbon Offset Fund is offering something that recipients want to take advantage of, and that it sits well alongside existing schemes. For example, an offer that supplements the Green Deal could be very compelling. One of the challenges faced by Local Authorities was that a large percentage of cavity wall insulation had already been done through the CERT and CESP schemes, and therefore remaining wall insulation measures tended to be hard-to-treat or expensive.

Some funds accepted applications for funding from external parties, and this approach was also popular. The applicants were already on board hence many of the difficulties associated with convincing them were overcome.

Finally, some funds allowed applicants/developers to propose and undertake carbon abatement measures themselves. The main justification for this was to enable projects to be delivered quickly.

The desktop study revealed that the London Legacy Development Corporation held discussions with stakeholders to identify priority projects towards which to target funding. Projects that received support were found to be schools and Local Authority public buildings, homes with fuel poverty issues, decentralised energy, projects targeted at SMEs, projects going beyond building energy efficiency (e.g. behaviour change) and projects delivering wider benefits such as job creation.

Most funds were not too pre-occupied with achieving a Carbon Offset Ratio of 1:1 (i.e. delivering carbon savings tonne-for-tonne) however this was a key objective for two of the Local Authorities interviewed.

6.9.2 *Types of Measures Funded*

CO_2 reduction measures most commonly funded included energy efficiency retrofit measures such as cavity wall insulation, loft insulation and easy-fit measures such as draught proofing and low energy lighting. Renewable energy technologies were also popular in theory, although in practice less had been installed presumably due to other funding mechanisms (e.g. FiTs) being available and successful.

Most Local Authorities found street lighting was receiving funding from other sources. Tree planting was discounted by most Local Authorities although actively included by one. Behavioural change projects were also mostly discounted, but not in all cases.

Some Local Authorities have set a clear focus on where the money should be spent. For example, the London Borough of Hackney are looking at funding community level projects, and Milton Keynes are focusing on domestic retrofitting.

None of the funds spoken to had strict assessment criteria when it came to awarding funding, as they were all primarily concerned with delivering carbon savings.

6.9.3 *Additionality*

There was no common approach on how the subject of additionality is handled.

One fund said there were no additionality clauses in their agreements, and that they did not actively avoid funding measures that could be funded through other means.

Most funds operated partial funding which complemented other funding streams. Apportioning CO_2 savings was done mostly on a case by case basis: in some cases, when a grant from the Carbon Offset Fund was seen as the key to unlock a project, full CO_2 savings credits were taken. In other cases, only partial credit was taken.

6.10 Key recommendations for LBTH

Based on the concepts explained in section 5.0 and on the literature research and interviews summarised in this section, the main recommendations for LBTH Carbon Offset Fund are as follows:

Cost of carbon: £1,800 / tonne (i.e. £60 / tonne over 30 years);

Basis for cost of carbon: GLA recommended price;

Relevant planning policies and approach: DMD 29 focusing on regulated carbon emissions only, applicable to residential and commercial, minor and major planning applications;

Mechanism to obtain contribution: s106;

Payment terms: 100% of contribution on commencement of development;

Fund management principles: clarity, accountability, transparency, controlled and monitored administration costs;

Carbon saving projects delivery should be a structured process including the identification of projects. *Ex ante* and *ex post* verifications should be mandatory and post-occupancy monitoring should be possible.

7.0

ASSESSING THE CARBON OFFSET BUDGET

7.0 FORECASTING THE CARBON OFFSET BUDGET

The aim of this section is to forecast the financial resources which could become available to fund Carbon Offset Solutions in the London Borough of Tower Hamlets in the next 20 years. Although some of the interviews carried out as part of the benchmarking review advised against assessing the potential resources given the associated uncertainty, it was considered necessary in order to measure the potential scale of the Carbon Offset programme which could be developed over the next few years. However, the advice was certainly appropriate and it is very important to consider the figures in this section as indicative as they are subject to many uncertainties. The growth plan on which this forecast is based will particularly be subject to change over the coming years.

A simple 'Carbon Offset budget calculator' has therefore been developed and will enable LBTH to change key assumptions easily and re-assess the potential future financial resources.

7.1 Caution

This section aims at estimating the quantity of 'residual' CO_2 emissions and hence Carbon Offsetting contributions over the next 20 years. It is very important to note that this assessment is based on a number of assumptions and that ultimately, these figures will only be confirmed when the actual planning applications will be submitted, the associated Carbon Offset contributions agreed, and the planning consents implemented.

It should also be noted that all financial figures in this section are undiscounted. Inflation has not been taken into account in any of these calculations.

7.2 Methodology

The approach to estimating the budget likely to be available has therefore been split into three different concepts:

- the **theoretical budget**, which is the main focus of this section, is based on statistical planning figures at a borough-wide level and represents the projected budget which could be available for Carbon Offset Solutions;
- the **actual budget** also covered in this section, is based on actual planning applications and s106 agreements between the applicants and LBTH. Although it still incorporates a degree of uncertainty associated with the timescale of implementation which could become significant if the economic environment deteriorates, this budget will be much more certain than the above 'theoretical budget';
- finally, the **confirmed budget** is the actual s106 money paid by the applicants and therefore represents available cash resources to fund Carbon Offset Solutions.

Although the distinction above may seem complex, it was considered to be a balanced approach which avoids two risks of over-simplification. An over-optimistic approach to the budget available for Carbon Offset Solutions would be based purely on the 'theoretical budget' and would expose LBTH to significant cash / debt issues if the confirmed budget differs from the predictions. A short term approach based purely on the confirmed budget would be significantly less risky but could fail to assess the likely scale of the budget over the next 20 years and therefore underestimate the very significant opportunities for strategic decisions and alliances over this period.

7.3 Sources of revenues

Potential sources of revenues are split up into four categories:

1. **'Planning'** - Revenues secured through the planning process when a scheme does not comply with LBTH planning policy and needs to offset the residual carbon emissions through a contribution to the LBTH Carbon Offset Fund;
2. **'Olympic Legacy'** - The London Legacy Development Corporation (LLDC) has set up a Carbon Offset Fund which has received payments and will continue to do so as a result of the Legacy Communities Scheme. The LLDC have indicated that they are currently seeking Carbon Offset Solutions to fund within the four 'Olympic' boroughs, which includes the London Borough of Tower Hamlets;
3. **'Energy savings'** – Part of the energy savings achieved by improvements could be used to finance improvements on other buildings through the fund using the mechanism of a 'revolving fund'. This would only apply where the Carbon Offset Solutions projects would reduce energy bills paid by the Council and therefore lead to savings on LBTH's budget.
4. **'Others'** – Contributions from energy efficiency funds or charitable donations could be targeted once the fund is operational and delivers improvements. In a changing landscape for Carbon Offsetting, a successful Carbon Offset Solutions system in Tower Hamlets delivering actual carbon savings and benefits to the local community could appeal to various organisations required to or wanting to offset operational carbon emissions, e.g. large corporations based in Canary Wharf.

7.3.1 Planning

LBTH Managing Development Document Policy DM29 sets out carbon reduction requirements as follows:

> *Development will be required to be accompanied by an Energy Assessment to demonstrate its compliance with the following:*
>
> ***Residential development***
>
Year	***Improvement over 2010 Building Regulations***
2011-2013	*35% CO_2 emissions reduction*
2013-2016	*50% CO_2 emissions reduction*
2016	*Zero Carbon*

> ***Non-residential development***
>
Year	***Improvement over 2010 Building Regulations***
2011-2013	*35% CO_2 emissions reduction*
2013-2016	*50% CO_2 emissions reduction*
2016-2019	*As per building regulations*
2019	*Zero Carbon*

This policy currently applies to all major planning applications and we have assumed the following initial correction factors:

- only 75% of the planning applications will be implemented;
- 50% of all applications for residential development in 2015-2020 will comply with DM29 with on-site measures and connected heat and will therefore not contribute to the LBTH Carbon Offset Fund;

- 25% of all applications for non-residential development in 2015-2020 will comply with DM29 with on-site measures and connected heat and will therefore not contribute to the LBTH Carbon Offset Fund. This proportion will rise to 50% after 2020.

Financial contributions from 'Planning' were included in our estimate of the theoretical budget likely to be available to LBTH for Carbon Offset Solutions

It was assumed that the need to comply with Policy DM29 will generate direct payments into the fund through s106 agreements for all developments until 2020 and thereafter only for non-residential development for the period 2021-2034.

Financial contributions from 'Planning' were included in our estimate of the theoretical budget likely to be available to LBTH for Carbon Offset Solutions.

7.3.2 Legacy Communities Scheme Carbon Offset Fund

The London Legacy Development Corporation (LLDC) has prepared an Offset Solutions Study in August 2013 which investigated the potential Offset Fund build-up associated with the development that will come forward as part of the LLDC's Legacy Communities Scheme. It indicates an estimated cumulative build-up for the period between 2015 and 2031 of approximately £7.7m.

*Financial contributions from 'the LCS Carbon Offset Fund' were **not** included in our estimate of the theoretical budget likely to be available to LBTH for Carbon Offset Solutions*

The actual resources of the LCS Carbon Offset Fund are currently understood to be in the region of £218,000 rising to approximately £645,000 over the 2015-2016 period. LLDC will be allocating this potential resource of £645,000 to priority projects within the four 'Olympic' boroughs and is currently working with partners to identify projects.

However, financial contributions from 'the LCS Carbon Offset Fund' were not included in our estimate of the theoretical budget likely to be available to LBTH for Carbon Offset Solutions pending discussions between LBTH and the LLDC.

7.3.3 Energy savings

In a future phase of development of the LBTH Carbon Offset Fund, it could be decided to 'recycle' the energy savings achieved as a result of some Carbon Offset Solutions projects in order to fund more measures elsewhere in the Borough. For instance, if annual energy bill savings of £15,000 were to be achieved through the energy efficient retrofit of a library, an equivalent sum of money could contribute to the Carbon Offset Fund each year for a given period of time.

*Financial contributions from 'Energy savings' were **not** included in our estimate of the theoretical budget likely to be available to LBTH for Carbon Offset Solutions*

The challenge of this approach is associated with the need to quantify actual energy savings in the future with the inherent variability of energy consumption and bills (weather, occupancy, changes of use, etc.). However there are international standards which could provide a robust framework: the International Performance Measurement and Verification Protocol (IPMVP®) defines standard terms and suggests best practice for quantifying the results of energy efficiency investments. This approach could be of significant interest in the future: it could help the LBTH Carbon Offset Fund to drive down the overall cost of delivering carbon savings and therefore could help the fund to compete with other Carbon Offset Solution providers in the future.

However, financial contributions from 'Energy savings' were not included in our estimate of the theoretical budget likely to be available to LBTH for Carbon Offset Solutions at this stage.

7.3.4 Others

Contributions from businesses based in Tower Hamlets wanting to offset their carbon emissions, or voluntary contributions from organisations, individuals and environmental charities could be two additional sources of revenues for the LBTH Carbon Offset Fund. However, only a successful and robust Offset Fund with a track record of delivering carbon savings and wider benefits to the local community effectively is likely to attract such contributions.

Therefore, at this stage, these financial contributions were not included in our estimate of the theoretical budget likely to be available to LBTH for Carbon Offset Solutions.

7.4 Key parameters

Beyond the 'correction factors' covered in Section 7.3, the revenues into the Carbon Offset Fund will depend on three key parameters:

- How much development will happen in LBTH over the next 20 years?
- How much residual carbon will require offsetting?
- What will the price of carbon be?

As the latter has been the subject of a comprehensive benchmarking review which has concluded that a price of £1,800/tonne of CO_2 was appropriate, this section focuses on the first two elements.

7.4.1 Assessing the quantum of development in Tower Hamlets over the next 20 years

The initial assessment of the quantum of development in Tower Hamlets over the next 20 years was carried out using Tower Hamlets Planning for Population Growth Capacity Assessment and the associated and updated SHLAA figures from 2013. However, it was considered that this approach would add another level of uncertainty to this study and the use of historic data was preferred.

Figures from LBTH Annual Monitoring Report and data from Acolaid (LBTH planning monitoring system) were used to estimate the average number of planning consents in Tower Hamlets and the associated floor space by category.

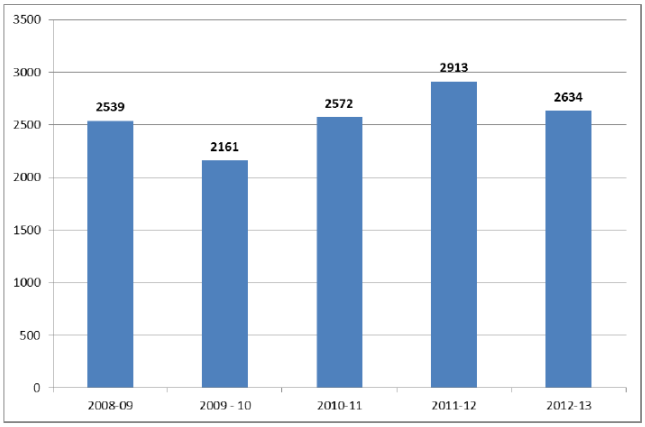


Figure 17: Total planning applications received (all categories) (Source: LBTH)

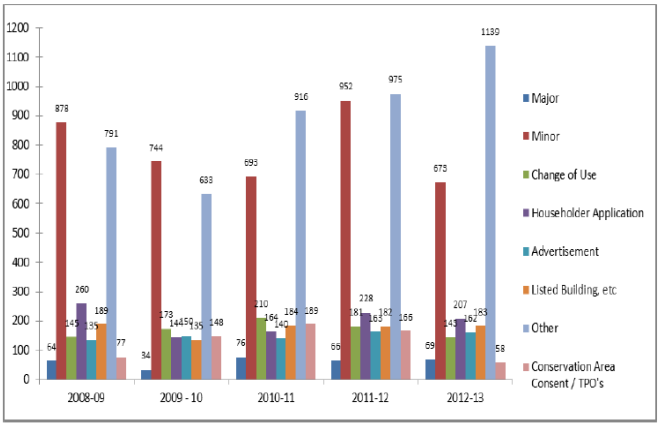


Figure 18: Planning applications lodged by type (Source: LBTH)

As it can be seen from the table below which compiles the results of data derived from Acolaid, the quantum of floor space being granted planning consent for in Tower Hamlets varies significantly year-on-year making it difficult to predict future evolution. Therefore, these numbers have been averaged to represent the approximate quantum of development which will be granted planning consent over the period 2015-2034. This is clearly a simplification but was considered acceptable given the aim of this section: estimate the scale of the financial resources likely to be available for Carbon Offset Solutions over the next 20 years.

The assessment has been set up so that it can easily be updated with revised figures.

Use	Unit	Average	2010	2011	2012	2013	Source
Residential	sqm	**230,523**	14,111	262,482	256,704	388,794	Estimated figures based on Acolaid
Office	sqm	**89,141**	98,881	47,148	70,291	140,243	Estimated figures based on Acolaid
General industry	sqm	**30,268**	2,941	62,566	13,731	41,835	Estimated figures based on Acolaid
Retail	sqm	**14,285**	14,985	20,670	10,873	10,612	Estimated figures based on Acolaid
Leisure	sqm	**1,835**	3,431	0	0	3,908	Estimated figures based on Acolaid
Hotel	sqm	**83,724**	36,812	167,716	88,027	42,342	Estimated figures based on Acolaid
Education and community	sqm	**34,623**	39,166	57,545	10,276	31,503	Estimated figures based on Acolaid

Table 1: Estimates of consented floorspace in Tower Hamlets (Source: Acolaid)

An initial test on the accuracy of the above data was carried out. For instance, the quantum of residential development being granted planning consent was compared to the LBTH housing trajectory and confirmed that the floor area indicated in the above table appeared realistic. However, further testing is recommended.

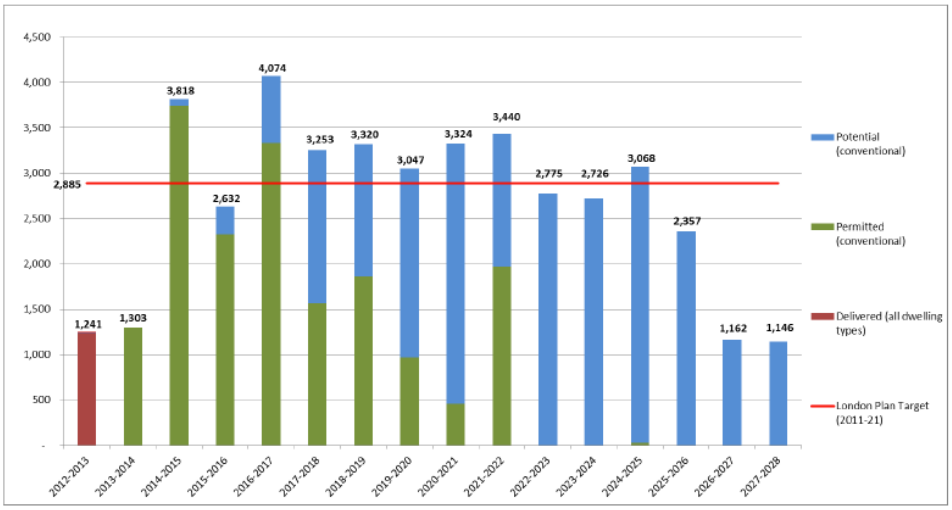


Figure 19: Housing trajectory (Source: LBTH)

Table 1 above represents the total floor space by category which is likely to obtain planning consent. A number of these planning consents will not be implemented which led to the introduction of a '*planning consent implementation correction factor*' of 75%.

The timescales within which the planning consent are likely to be implemented also needed to be estimated to determine when the associated financial resources are likely to become available. The following assumptions were made:

Use	Average number of years between consent and completion
Residential	3 years
Office	4 years
General industry	2 years
Retail	2 years
Leisure	4 years
Hotel	4 years
Education and community	3 years

Table 2: Average number of years between planning consent and completion (Estimates)

It was also assumed that 100% of the financial resources associated with Carbon Offset obligations would be available to LBTH on commencement.

7.4.2 *Assessing carbon performance and carbon shortfall*

The carbon shortfall is the difference between an actual carbon performance and a targeted performance and represents the 'residual' CO_2 emissions to be offset. The approach focuses on 'regulated' carbon emissions (i.e. heating, domestic hot water, cooling, lighting, fans and pumps) as they are the subject of planning policy and Building Regulations. 'Unregulated' carbon emissions (e.g. IT, process, appliances) are excluded.

Carbon performance is to be understood in the context of this study as the difference between regulated CO_2 emissions as estimated by accredited Part L energy modelling tools and regulated CO_2 emissions targets as estimated by the same tools, with 'in-use factors' as per the Green Deal and ECO methodologies.

Two carbon emission levels will define the carbon shortfall and therefore the residual carbon emissions to offset:

- the level of regulated carbon performance required by LBTH policy;
- the level of predicted on-site regulated carbon performance targeted by the specific development.

The difference between these two levels represents the carbon shortfall.

It has been assumed that the actual average Building / Dwelling Emission Rate which will be achieved by the proposed development will gradually improve over the next 6 years. The table below summarises the current and anticipated levels of carbon shortfall over the next 20 years (the date refers to the date of the planning application).

Use	Annual averages for 2015-2016					Annual averages for 2017-2020					Annual averages for 2021-2034				
	Average TER* [$kgCO_2/m^2/yr$]	Average DMD 29 target [$kgCO_2/m^2/yr$]	Average improvement over TER [%]	Average DER [$kgCO_2/m^2/yr$]	Average shortfall [$kgCO_2/m^2/yr$]	Average TER* [$kgCO_2/m^2/yr$]	Average DMD 29 target [$kgCO_2/m^2/yr$]	Average improvement over TER [%]	Average DER [$kgCO_2/m^2/yr$]	Average shortfall [$kgCO_2/m^2/yr$]	Average TER* [$kgCO_2/m^2/yr$]	Average DMD 29 target [$kgCO_2/m^2/yr$]	Average improvement over TER [%]	Average DER [$kgCO_2/m^2/yr$]	Average shortfall [$kgCO_2/m^2/yr$]
Residential*	15.00	7.50	30%	10.50	3.00	15.00	7.50	40%	9.00	1.50	12.00	12.00	0%	12.00	0.00
Office**	20.00	10.00	25%	15.00	5.00	20.00	10.00	30%	14.00	4.00	16.00	10.00	20%	12.80	2.80
General industry**	15.00	7.50	10%	13.50	6.00	15.00	7.50	15%	12.75	5.25	13.50	7.50	15%	11.48	3.98
Retail	40.00	20.00	10%	36.00	16.00	40.00	20.00	15%	34.00	14.00	36.00	20.00	15%	30.60	10.60
Leisure	50.00	25.00	40%	30.00	5.00	50.00	25.00	45%	27.50	2.50	30.00	25.00	10%	27.00	2.00
Hotel**	50.00	25.00	40%	30.00	5.00	50.00	25.00	45%	27.50	2.50	30.00	25.00	10%	27.00	2.00
Education and community	20.00	10.00	25%	15.00	5.00	20.00	10.00	30%	14.00	4.00	15.00	10.00	20%	12.00	2.00

Table 3: Estimated carbon shortfall over the 3 key periods: 2015-2016, 2017-2020 and 2021-2034 (Estimates)

7.5 Assessing the budgets

7.5.1 *Annual 'residual' CO_2 emissions and financial value*

The data summarised in the previous sections was combined to identify, for each of the key periods, the total likely residual carbon emissions in each category. The '*proportion of area concerned*' is a combination of the correction factors explained in section 7.3: that only 75% of the planning consents will be implemented and that only a proportion of the developments will fail to achieve the targets on site.

2015-2016

Use	Unit	Annual averages for 2015-2016				
		Area submitted for planning	Proportion of area concerned	Average shortfall [$kgCO_2/m^2/yr$]	Total shortfall to be offset [t CO_2/yr]	Annual carbon offset contribution
Residential*	sqm	230,000	38%	3.00	259	£465,750
Office**	sqm	89,000	56%	5.00	250	£450,563
General industry**	sqm	30,000	56%	6.00	101	£182,250
Retail	sqm	14,000	56%	16.00	126	£226,800
Leisure	sqm	2,000	56%	5.00	6	£10,125
Hotel**	sqm	83,000	56%	5.00	233	£420,188
Education and community	sqm	34,000	56%	5.00	96	£172,125
					Total	£1,927,800

2017-2020

Use	Unit	Annual averages for 2017-2020				
		Area submitted for planning	Proportion of area concerned	Average shortfall [$kgCO_2/m^2/yr$]	Total shortfall to be offset [t CO_2/yr]	Annual carbon offset contribution
Residential*	sqm	230,000	38%	1.50	129	£232,875
Office**	sqm	89,000	56%	4.00	200	£360,450
General industry**	sqm	30,000	56%	5.25	89	£159,469
Retail	sqm	14,000	56%	14.00	110	£198,450
Leisure	sqm	2,000	56%	2.50	3	£5,063
Hotel**	sqm	83,000	56%	2.50	117	£210,094
Education and community	sqm	34,000	56%	4.00	77	£137,700
					Total	£1,304,100

2021-2034

Use	Unit	Annual averages for 2021-2034				
		Area submitted for planning	Proportion of area concerned	Average shortfall [$kgCO_2/m^2/yr$]	Total shortfall to be offset [t CO_2/yr]	Annual carbon offset contribution
Residential*	sqm	230,000	0%	0.00	0	£0
Office**	sqm	89,000	38%	2.80	93	£168,210
General industry**	sqm	30,000	38%	3.98	45	£80,494
Retail	sqm	14,000	38%	10.60	56	£100,170
Leisure	sqm	2,000	38%	2.00	2	£2,700
Hotel**	sqm	83,000	38%	2.00	62	£112,050
Education and community	sqm	34,000	38%	2.00	26	£45,900
					Total	£509,524

Table 4: Estimated annual CO_2 emissions shortfall and associated financial value of carbon offsets which could be secured by LBTH for carbon offset projects

7.5.2 *Payment analysis*

During the initial stage, all residual CO_2 emissions identified in Table 4 above will have to be offset through a s106 payment into LBTH Carbon Offset Fund.

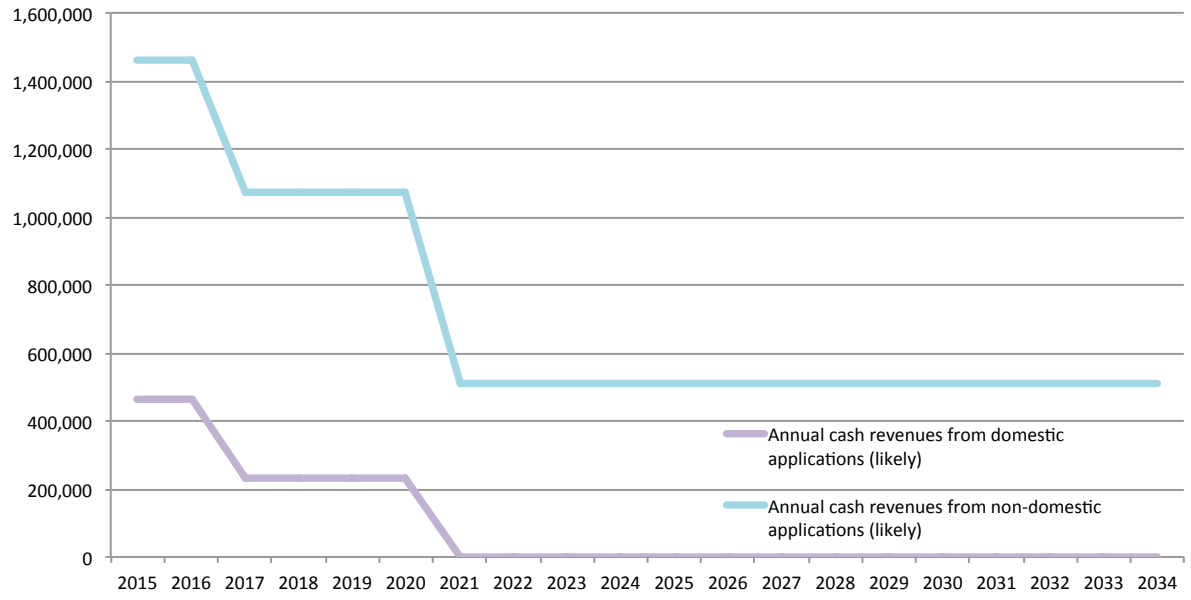


Figure 20: Estimated annual undiscounted cash revenues for Carbon Offset Solutions in Tower Hamlets (2015-2034)

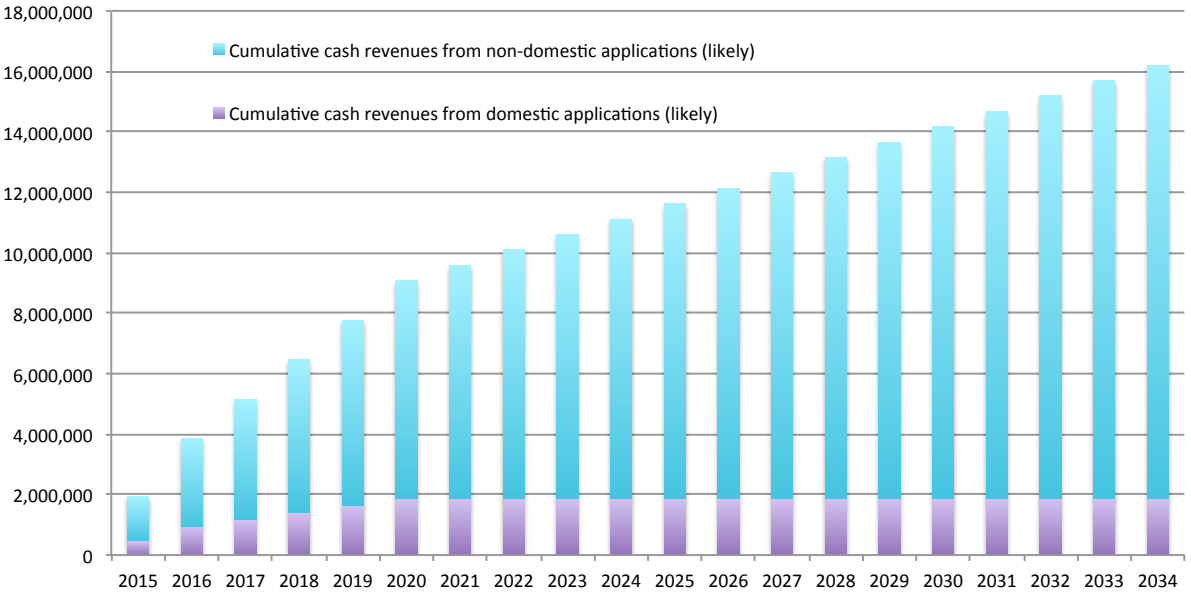


Figure 21: Estimated cumulative undiscounted cash revenues for Carbon Offset Solutions (2015-2034)

The total financial resources which would be generated by development in Tower Hamlets and available to LBTH for carbon offset projects over the period 2015-2034 are estimated to be in the region of £16.2m.

7.5.3 *Actual budget*

The actual budget is based on actual planning applications and s106 agreements between applicants and LBTH. Based on information provided by LBTH, the current 'Actual' Budget of the LBTH Carbon Offset Fund is approximately £6m.

7.6 The revenue calculator

As this section relies significantly on assumptions and parameters, a 'revenue calculator', linked to the other spreadsheets, has been developed and is provided as part of this study. A snapshot is provided below. Parameters (e.g. average quantum of development) can be easily changed.

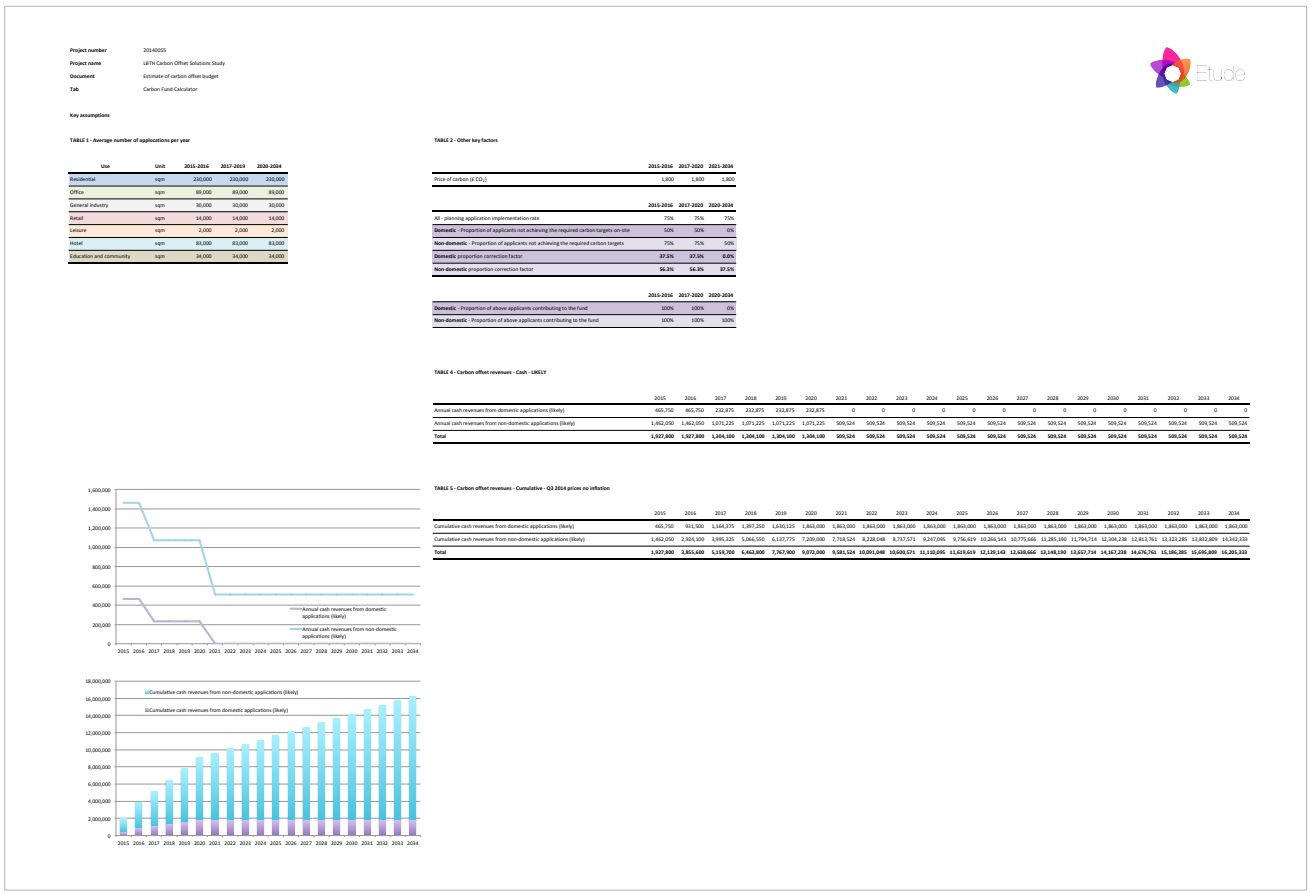


Figure 22: Snapshot of the 'Carbon Offset Revenue Calculator' developed as part of this study

7.7 Towards an evolving budget

This section attempts to quantify the approximate budget likely to be available to the London Borough of Tower Hamlets for Carbon Offset Solutions over the next 20 years. Although it does rely on a number of correction factors and assumptions this exercise is beneficial as it provides an indication of the scale of the potential budget. Our estimate of the theoretical budget available to the London Borough of Tower Hamlets for Carbon Offset Solutions indicates that an annual budget of £0.5-£2m should be available annually. This fund would need to offset approximately 10,000 tonnes CO_2 over the 2015-2034 period, with an approximate 10%/90% split between domestic and non-domestic CO_2 emissions.

Our recommendation is to assume this scale of budget and implement best practice principles and procedures for its management from the outset. Over time, with a proven track record, additional resources could be accessed (e.g. voluntary contributions) and the fund could be used as a revolving fund to finance energy savings. It could also invest in carbon reduction projects through other means than the simple and direct grants assumed at this stage: for instance through debt finance (in the form of loans) and equity investments.

8.0

IDENTIFYING AND ESTIMATING POTENTIAL CARBON SAVING OPPORTUNITIES IN TOWER HAMLETS

8.0 IDENTIFYING AND ESTIMATING POTENTIAL CARBON SAVING OPPORTUNITIES IN TOWER HAMLETS

This section focuses on carbon saving opportunities and carbon mitigation methods in Tower Hamlets which could be financed by the Carbon Offset Fund. It reviews their type, average cost and average carbon impact. The two key objectives of this section are:

- to establish a set of carbon and cost benchmarks which through data post-processing and modelling could enhance the GIS mapping tool and the databases covered in Sections 9.0 and 10.0 with information about carbon saving potential and the likely associated budget;
- to determine which carbon saving measures should be prioritised among the measures that have been proposed and implemented through previous and current carbon saving programmes in the UK.

In deciding what measures should be funded the current approaches tend to focus on best value for money and therefore on the measures which achieve the best rate of £/kgCO_2 saved over their lifetime. However, as mentioned previously there are also other factors which should influence whether a particular measure is an attractive choice for LBTH. Among other considerations is the potential for these measures to lead to positive second order effects (e.g. coherence with other policies like fuel poverty) or negative second order effects (e.g. disruption or impact on other services).

8.1 Carbon saving measures in other offset schemes

Carbon Offset Funds have been set up by a number of Local Authorities in the UK with varying levels of detail given on the types of carbon offset measures that can be funded. These Carbon Offset schemes have been analysed in Section 6.0.

A comprehensive list of measures currently funded can be found below:

- Domestic retrofits;
- Non-domestic retrofits;
- Cavity wall, loft and solid wall insulation;
- Other fabric improvements;
- Boilers and heating controls;
- Low or Zero Carbon technologies including renewable energy systems;
- Community based renewable energy schemes (e.g. schools, social housing, community buildings);
- District heating with CHP and/or renewable energy;
- Tree Planting Schemes;
- Behavioural change, energy audits and energy advice schemes (including initiatives on fuel poverty);
- Transport initiatives.

The above carbon saving measures considered in this report have been split up into two categories: **locational measures**, which are based on specific buildings and areas, and **general measures**, which could be implemented almost anywhere in the borough.

- Locational measures include domestic retrofits, non-domestic retrofits, community scale renewable energy generation and connections to district heating;
- General measures include tree planting and LED street lighting upgrade.

Each carbon saving measure is discussed and approximate cost and carbon benchmarks are provided in sections 8.2 to 8.8. Potential methodologies for estimating and mapping possible measures are also discussed.

8.2 Domestic Buildings Retrofit

This section includes a number of types of domestic retrofit measures for energy efficiency and renewable energy generation which could be funded via the LBTH Carbon Offset scheme.

It should be noted that other mechanisms have targeted domestic energy efficiency improvements in the UK both nationally (e.g. CERT, ECO and Green Deal) and locally (RE:NEW). These schemes hold important lessons for the LBTH Carbon Offset Fund if it was to target domestic retrofits as a priority.

8.2.1 Key Measures, Costs and Carbon Reductions

Information from the Green Deal Impact Assessment carried out by DECC in 2012 and from the Energy Saving Trust's Housing Energy Model were used to inform the following table of retrofit measures for the domestic sector, with estimates of installation costs and potential carbon savings. It should be noted that these costs are only indicative as they would be heavily dependent on the size of the property or other parameters such as number of windows – e.g. solid wall insulation or replacement glazing.

The Green Deal Impact Assessment also suggests '*in use*' factors, which take account of imperfect installation, incorrect modelling assumptions on U-values before and after, increased comfort levels and incorrect usage of new systems. These '*in use*' factors reduce the carbon impact and therefore the cost efficiency of the associated measures and have been taken into account.

Measure	Installation Cost/unit	Lifetime (years)	Annual Energy Saving (kWh)	Cost per lifetime CO_2 (£/tCO_2)	In Use Factor
Internal SWI	£5,041	40	5494	£127	25-33%
External SWI	£9,590	40	5494	£242	25-33%
CWI – easy to treat	£578	40	2673	£30	35%
CWI – hard to treat	£1,953	40	2673	£101	35%
Loft Insulation (150 to 250 mm)	£403	40	499	£112	35%
Condensing gas boiler (G to A)	£2,597	12	1962	£612	25%
Floor insulation	£715	40	1084	£91	15%
Flat roof insulation	£1,050	10	2752	£211	15%
Double Glazing (old single to A)	£4,500	10	2280	£1,096	15%
Secondary Glazing	£1,250	10	1657	£419	15%

High performance door	£1,000	10	317	£1,752	15%
Draught proofing	£119	20	649	£50	15%
Flue gas heat recovery	£400	20	666	£166	10%
Heating controls	£450	10	495	£505	50%
Hot water cylinder insulation	£30	10	417	£39	15%
Lighting systems and fittings	£40	5	97	£458	-
Cylinder thermostat	£300	10	2169	£76	10%
New or replacement storage heaters	£350	10	1083	£179	10%
Replacement warm-air unit	£1,750	10	433	£2,245	10%
Solar water heating*	£4,500	10	1336	£1,871	0%

** excluding revenues from RHIs*

Table 5: Domestic retrofit measures (Source: DECC)

The above table seems to suggest that a Carbon Offset Price of £60/tonne over 30 years would be insufficient to fund most of the carbon saving measures above. However, it is very difficult to estimate the cost of combined measures or the impact of economies of scale. There is not enough data available yet to enable this exercise. It is nevertheless important to note that there is a very significant difference in cost efficiency between various measures.

8.2.2 Assessing the cost impact of domestic retrofit measures on the housing stock in Tower Hamlets

In order to estimate the potential for Carbon Offsetting in the existing domestic sector in Tower Hamlets and therefore an appropriate set of cost and carbon benchmarks, an understanding of the existing domestic stock in the area is required. This work has been undertaken and is summarised in section 9.0.

Benchmark Estimation

The simplest way of estimating the size and location of the Carbon Offset opportunities in the housing stock would have been to assume that the Green Deal costs and carbon savings summarised in section 8.2.1 are standard across the stock. The main benefit of this approach is the lack of need for any further modelling work. This methodology was not adopted though as it was considered that the margin of error would be too high, leading to a potential underestimation of the cost of offsetting 1 tonne of carbon through domestic retrofits.

Energy Modelling

The data on the housing stock from the EPC, Census and NROSH databases (see Section 9.0 for further details) provide enough detail to be able to match housing typologies with dwellings included in the English Housing Survey. This has been reformatted for use in a simple energy model by CAR Ltd in the Cambridge Housing Model (CHM), an open Excel based implementation of the Government's SAP energy model.

Representative dwellings have therefore been identified based on their EPC rating, age, type and bed spaces and reflecting the dwellings types in Tower Hamlets. Due to the flexible nature of the CHM, a new section for domestic retrofit was added where the impact of each

retrofit measure was assessed. This has also relied on data from the *Energy Saving Trust's* (EST) *Housing Energy Model* (HEM) project which included marginal costs for most of the key retrofit measures above, as well as typical details for each.

Modelled energy use has then been produced for the housing stock showing the impact of different retrofit measures and has led to the following benchmarks.

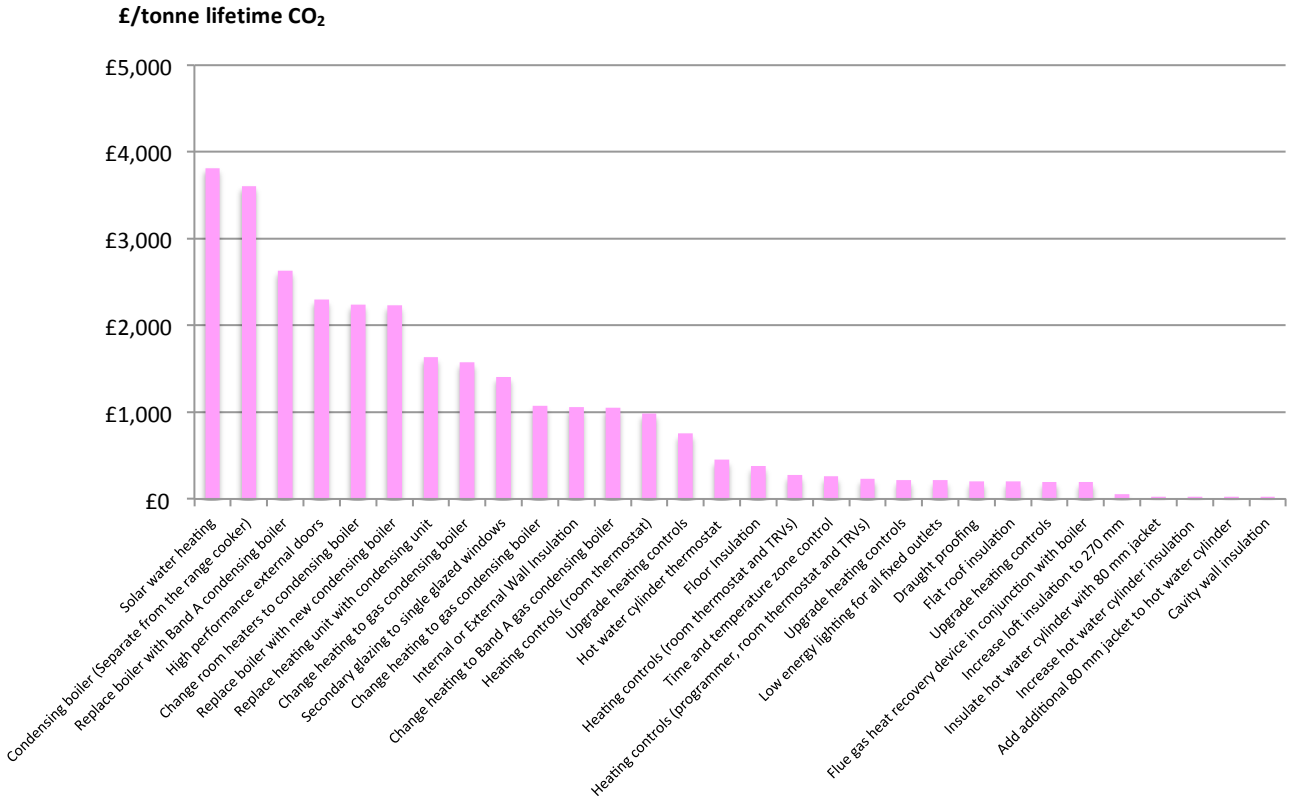


Figure 24: Estimated cost per carbon saved over the lifetime of a number of domestic retrofit measures in Tower Hamlets

The least cost effective recommendation analysed was replacing single glazed windows with double glazing, which had an average CO_2 reduction of 3%, while being one of the more expensive improvement options. It had a cost range per tCO_2 saved over the lifetime of £11,885-£23,410 and therefore was not included in the figure above.

The top 10 recommendations for cost effectiveness are shown in the table below, including details of the indicative costs (using data from the EPCs on costs), potential CO_2 savings, payback period and cost effectiveness.

	Description	Indicative Installation Cost	CO_2 Saving inc. In Use Factor (tCO_2/year)	% CO_2 Saving	Payback Period (years)	Cost per tCO_2 over lifetime (£/tCO_2)
1	Cavity wall insulation	£100-£300	0.30	11.6%	3-10	£11-£33
2	Increase hot water cylinder insulation	£15-£36	0.10	3.1%	2-3	£18-£36
3	Increase loft insulation to 270 mm	£100-£350	0.21	7.7%	8-27	£25-£88
4	Flue gas heat recovery device in conjunction with boiler	£900	0.30	12.4%	29	£193-£193
5	Upgrade heating controls	£350-£450	0.24	9.7%	14-18	£172-£222
6	Flat roof insulation	£850-£1500	0.89	28.2%	11-20	£145-£256
7	Draught proofing	£80-£120	0.03	0.7%	26-39	£162-£243
8	Low energy lighting for all fixed outlets	£55-£80	0.08	4.0%	5-7	£175-£255
9	Floor Insulation	£800-£1200	0.07	3.9%	93-139	£303-£454
10	Hot water cylinder thermostat	£200-£400	0.10	2.5%	26-52	£300-£601

Table 6: Top 10 recommendations (by cost efficiency)

The majority of domestic retrofits would involve multiple measures though, and they may interact in a complex way leading to overall savings which are lower than the sum of the individual measures. On the other hand, it is normally more cost effective to implement energy savings measures at the same time as the property is undergoing other maintenance or repair work. A number of combination of options were therefore also modelled but care has been taken to model only compatible combination of options. Please refer to section 9.4 for more details.

Energy efficiency measures will continue to advance and the cost effectiveness will change over time. The list of measures and the order of priority will be continually revised to ensure the appropriate and best value for money measures are proposed for the projects. The types of measures included in the carbon offsetting projects will evolve as other initiatives are completed, such as Decent Homes, and other Council priorities and objectives are identified, such as air quality impacts.

8.2.3 Identifying the most suitable domestic projects

The recommended approach is to target clusters of properties where the potential carbon saving is the greatest. Figure 25 provides a good example of how the Carbon Offset Database explained in Section 9.0 can be used to identify appropriate buildings. Data points located toward the top of the graph have the greatest potential for carbon reductions and should therefore be prioritised.

The GIS mapping tool explained in Section 10.0 can be used to cross reference the property's geographical location with the potential for carbon reduction. Where several properties with high potential for carbon reduction converge it may be possible to achieve an economy of scale by grouping several retrofit projects together. Furthermore, these properties may act as markers for similar properties in the same area, for which EPC data was not available.

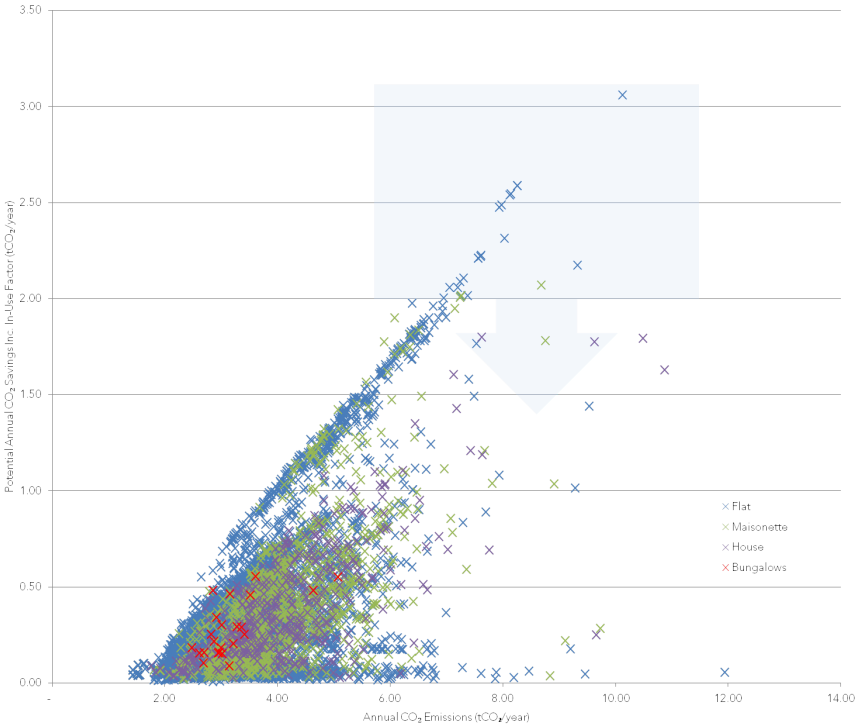


Figure 25: Identification of domestic buildings with highest potential for carbon reduction

Once a group of properties has been selected, they can be checked against the eligibilty criteria outlined in section 5.6.1 and cross-referenced with the remaining elements for analysis listed in section 5.6.2 to further refine the selection and create a shortlist of projects to be completed.

For more information about project identification, please refer to Appendix E.

8.2.4 *Note on the Home Energy Efficiency Database (HEED)*

The Energy Saving Trust has developed a Home Energy Efficiency Database (HEED) which assesses the energy efficiency measures installed across the UK as a result of some of the national schemes (e.g. CERT, CESP, etc.). It is recommended that any works associated with the LBTH Carbon Offset Solutions Study is linked with the HEED.

8.3 Retrofit in Non-Domestic Buildings

8.3.1 *Key Measures, Costs and Carbon Reductions*

As part of the Non Domestic Green Deal analysis carried out by DECC in 2011 the impact of a range of interventions was calculated considering a number of key building types across the stock. The numbers were based on simple calculations rather than detailed modelling for the buildings. Table 7 below shows the unit cost per measure, as well as the cost per lifetime CO_2 emitted in brackets.

	Heating Upgrade	Heating Controls	Chiller Upgrade	Building Management System	Lighting Upgrade	Lighting Controls	Wall Insulation	Roof Insulation	Double Glazing
Small office	£1700 (£75/t)	£560 (£82/t)	-	-	£326 (£31/t)	-	-	£1300 (£85/t)	£5994 (£376/t)
Medium Office (wholly occupied by one organisation)	£14700 (£55/t)	-	-	£17311 (£97/t)	£10434 (£31/t)	£111302 (£97/t)	-	£11000 (£136/t)	-
Large office including data centre	-	-	£60000 (£56/t)	-	-	£507389 (£122/t)	-	-	-
School in one medium sized building	-	-	£1500 (£253/t)	-	£874 (£38/t)	£9323 (£121/t)	-	-	-
Medium multiple building school	£6800 (£43/t)	-	-	£4515 (£72/t)	£1277 (£27/t)	£13621 (£86/t)	-	£13000 (£64/t)	-
Surgery (small building)	£3300 (£56/t)	£1750 (£56/t)	-	£1690 (£81/t)	£8641 (£97/t)	-	-	£3000 (£27/t)	-
Hospital (large building)	-	-	£13806 (£29/t)	-	£3779 (£9/t)	£40315 (£29/t)	-	£52000 (£99/t)	-
Hotels and catering - Hotel in listed building	-	£3000 (£25/t)	-	-	£45075 (£58/t)	-	£49140 (£141/t)	£7500 (£14/t)	-
Air conditioned prestige hotel	-	-	-	-	£120201 (£58/t)	-	-	-	-
Small food shop	£1700 (£54/t)	£3000 (£483/t)	-	-	£15456 (£69/t)	-	-	£1100 (£162/t)	£9600 (£204/t)
Medium sized store	-	-	£10047 (£99/t)	-	£20252 (£81/t)	-	-	-	-
Medium department store	-	-	-	£23310 (£134/t)	£85061 (£81/t)	-	£3675 (£20/t)	£11000 (£76/t)	-
Large supermarket	-	-	£142838 (£109/t)	-	£122399 (£29/t)	-	-	-	-
Medium sized leisure centre with swimming pool	£14700 (£17/t)	-	-	£18963 (£55/t)	-	-	-	-	-
Heated warehouse - medium size. No cooling	-	-	-	£5610 (£55/t)	-	£2000 (£23/t)	£20250 (£18/t)	£59400 (£71/t)	-
Small industrial unit (light manufacturing)	-	-	-	£2044 (£62/t)	-	£500 (£24/t)	£36450 (£173/t)	£11880 (£62/t)	-
Medium industrial unit	£52260 (£119/t)	-	-	£10407 (£55/t)	-	£2000 (£19/t)	£121500 (£124/t)	£59400 (£39/t)	-

Table 7: Non domestic retrofit measures by building type, showing the unit installation cost, with the cost per lifetime tCO_2 shown in brackets (Source: DECC)

Other carbon saving measures (e.g. server optimisation, voltage optimisation) are possible but have not been included in the table above as they are not included in the Green Deal.

A cost analysis of the cost efficiency of the Olympic Delivery Authority investment through RE:FIT (which focused on schools) concluded that the average cost of energy improvements to schools (including lighting improvements, space heating controls, computer room power management and server room optimisation) over 12 schools was £38,000 per school and delivered 727 tonnes CO_2 per school (i.e. £52/tonne CO_2).

8.3.2 Developing an approach which is specific to Tower Hamlets

Modelling opportunities for retrofit in the non-domestic building stock is difficult, particularly due to the lack of good data at a building level. For public buildings, there is a greater level of data available due to the introduction of mandatory EPCs (Energy Performance Certificates) and DECs (Display Energy Certificates). There is no similar building level database of energy use in the private sector.

Public Buildings

Figures from the Tower Hamlets Carbon Management Plan shows that the borough contains the following number of 'public' buildings:

- 63 primary schools;
- 14 secondary schools;
- 6 special schools;
- 10 Council office buildings;
- 12 community centres;
- 4 Idea stores;
- 5 libraries;
- 7 leisure centres.

All these public buildings have a DEC (Display Energy Certificate) with its associated advisory report. A Display Energy Certificate can be produced by a trained assessor, who will use a software tool to identify, categorise and give recommendations with short, medium and long paybacks, giving an indication of whether their impact will be low, medium or high.

There have been some criticisms in the past of recommendations given as part of these reports as they can be too generic. However they could form part of an early stage assessment, highlighting which buildings in a certain area are the most in need of energy efficiency improvements. More detailed on-site assessment would be necessary to assess the actual potential for carbon savings. At this initial stage, the recommendations for each building can be linked to the benchmark measure savings and costs in Table 8, in order to assess the carbon impact of various measures and their associated costs.

Private Buildings

In the non-domestic sector the main data available is the Valuation Office Agency commercial rates data, which provides details of floor space and internal uses. It could be possible to use benchmarks based on energy use per floor area to give estimates of building energy use in the borough, and identify areas of high energy use. Estimates of potential energy savings may be made using the DECC benchmarks above. However, this 'benchmarking approach' appears to be too generic and has not been adopted.

8.3.3 Recommendation

Our recommendation is to focus on retrofitting public sector buildings (e.g. libraries, leisure facilities, council offices) and schools. Improving those buildings will be a clear benefit for the communities they serve and help to reduce energy bills. In addition, those building are those for which the quality of the energy data is most appropriate.

8.3.4 Identifying the most suitable non-domestic schools and public sector buildings

As explained in more details in Section 9.0, data on actual energy consumption available for non-domestic buildings is of good quality, due in large part to the availability of Display Energy Certificates. It therefore provides greater confidence in the reported energy consumption and carbon emissions, and permits more detailed analysis than is possible for domestic buildings. Plotting annual heating energy consumption against annual electrical energy consumption allows some of the benchmarks outlined in Section 9.5.2 to be applied to the data. This provides a clear indication of both the current performance of the buildings relative to one another, and also relative to the best practice benchmarks.

Figure 26, for example, illustrates that none of the LBTH libraries currently meet the Carbon Trust's best practice benchmark for libraries. To meet the benchmark heating energy consumption must be less than or equal to 133 kWh/m^2/year while electrical energy consumption must be less than or equal to 32kWh/m^2/year, as indicated by the area within the light blue rectangle on the scatter plot.

The electricity consumption of two of these libraries is over seven times greater than the recommended benchmark. This may be the result of electricity being used for space heating, the amount of which could have been significantly underestimated by the methodology used to create Display Energy Certificates. Regardless of the cause, this example clearly demonstrates that these buildings would be worth considering for LBTH Carbon Offset Funded energy/carbon reduction measures to bring their performance well within the recommended levels.

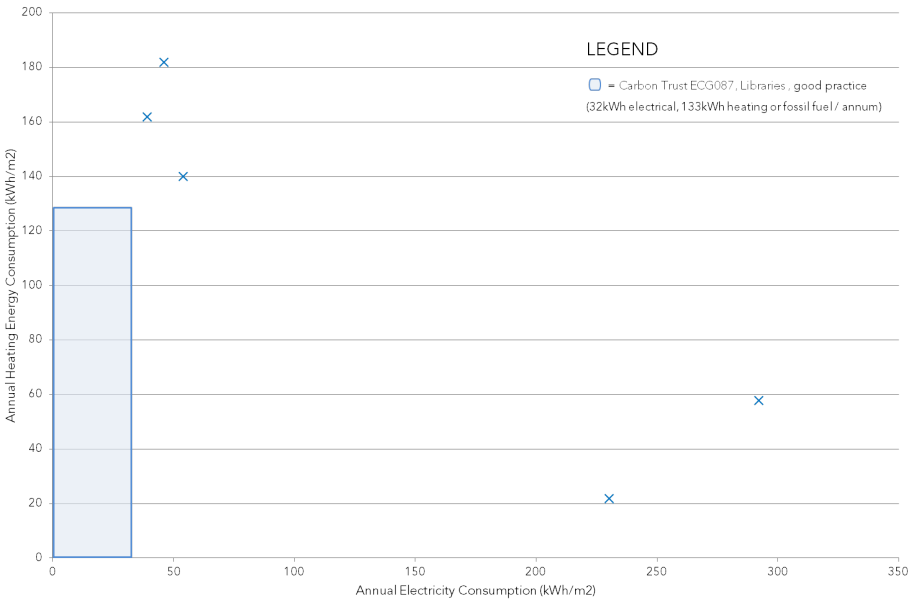


Figure 26: Heating and electrical energy consumption of LBTH libraries relative to the Carbon Trust's best practice benchmark level for libraries

While benchmarking can be useful where the necessary data is available, the general approach to reduce energy and carbon emissions in the non-domestic buildings should be to target those with the greatest emissions first, as indicated by the arrows in Figure 27, a scatter plot of annual heating and electrical energy consumption per square metre.

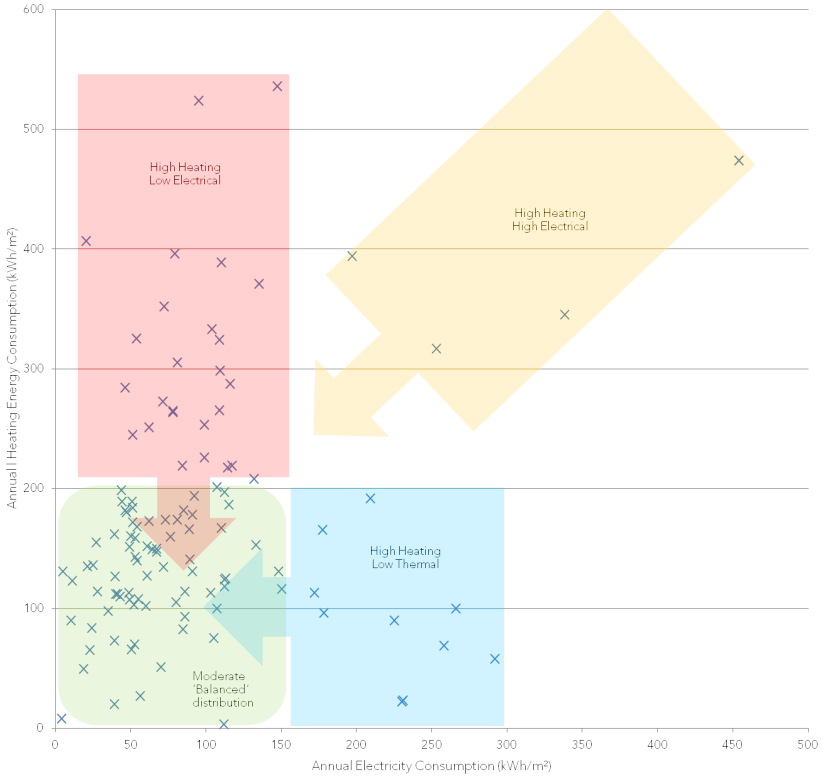


Figure 27: Heating and electrical energy consumption for non-domestic buildings

Figure 27 also highlights four distinct patterns of energy consumption:

1. High heating and electrical energy demand (orange);
2. High electrical and low heating energy demand (blue);
3. High heating and low electrical energy demand (red);
4. Moderate balanced thermal and electrical energy demand (green).

These groups are useful when identifying buildings for retrofit as the relative ratio of heating to electrical energy consumption may provide some indication of potential retrofit measures.

Buildings with high electrical and heating energy consumption such as the London Chest Hospital (474 kWh/m^2/year heating, 454 kWh/m^2/year electrical) may have inherently high energy consumption due to their primary function, and this may be challenging to resolve. Other causes could however be responsible, such as a culture of indifference toward energy consumption, combined with poor energy management practices, generally poor levels of energy efficiency or technical faults in energy consuming systems.

Buildings with high electricity consumption and low heating demand may provide straightforward opportunities for carbon reduction as retrofit measures to reduce electricity consumption are often less intrusive than measures required to achieve similar savings by reducing thermal energy demand, with the exception of optimising heating control systems. Reductions in electricity consumption are also immediately quantifiable, enabling tracking of associated reductions in carbon attributable to electricity generation.

Data points exhibiting high heating energy consumption but low electrical energy demand may be indicative of a building with low occupancy/utilisation and poor thermal performance due to heating control strategy, heating system efficiency or deficiencies in the thermal envelope.

The final group of buildings in Figure 27 exhibits a relatively modest and fairly balanced level of heating and electrical energy consumption. While these buildings may still offer a significant overall opportunity for energy and carbon reduction, the data suggests these buildings may be less of a priority.

8.3.5 *Recommended list of projects*

A shortlist of the non-domestic properties that fall into the three categories of high energy consumption described in the previous section is provided in Table 8. The relatively high energy consumption of these buildings suggests that a site visit and/or energy audit may be warranted to better determine the cause of high energy demand, with a view to using Carbon Offset Funding to reduce their carbon emissions.

Property	Heating Energy Demand (kWh/m^2/year)	Electrical Energy Demand (kWh/m^2/year)
St Georges Leisure Centre*	524	95
Mile End Leisure Centre*	371	135
Tiller Leisure Centre*	389	110
York Hall	324	109
Toby Club	287	116
Chrisp Street Idea Store	58	292
Settles Street Job Centre	219	117
Albert Jacob House	90	225
Commercial Road Jobcentre Plus	201	107
John Orwell Sports Centre	219	84
Whitechapel Road Idea Store	22	230
Morpeth Secondary School	345	338
Guardian Angels School	536	147
St Johns C Of E Primary School	317	253
Marion Richardson School	333	104
Phoenix School	407	20
St Edmunds Primary School	299	109
Harbinger Primary School	325	54
Culloden Primary School	265	109
Cyril Jackson Primary School	100	266
Stephen Hawking Primary School	253	99
Sir William Burrough Primary School	273	71
Halley Primary School	264	78
Columbia Primary School	284	46
London Chest Hospital*	474	454

Millwall Fire Station	394	197
Shadwell Fire Station	396	79
Roman Road London Fire Brigade	352	72
Bethnal Green Police Station	192	209
Bow Fire Station	265	78
Queen Mary University Of London	165	177
London Metropolitan University	208	132
Mile End Hospital	217	114
Wapping Police Station	226	99
Poplar Fire Station	251	62
Ruston Street Clinic	245	51
Trinity House	113	172
Museum In Docklands No 1 Warehouse	96	178
Limehouse Police Station	116	150
Dunbridge St. Primary Care Trust Centre	23	231

** buildings with high energy demand*

Table 8: Non-domestic properties with high heating or electrical energy consumption

Priority Projects of Council buildings which could be delivered under the Re:Fit programmer are set out in Table 9.

Property	Heating Energy Demand (kWh/m^2/year)	Electrical Energy Demand (kWh/m^2/year)
Poplar Mortuary	354	238
Shadwell Centre	63	144
Whitechapel Idea Store	236	-
Albert Jacob House	174	145
John Onslow Building (Formerly Gladstone Place)	125	103
Brady Arts Centre	33	169
82 Russia Lane	63	108
Pritchards Road Centre	114	-
Bethnall Green Library	36	141
Bancroft Library	51	170

Table 9: Non-domestic Council owned properties with high heating or electrical energy consumption

For more information about the energy and carbon database, please refer to Section 9.0.

8.4 Connection to a District Heating Network

There are two operating district heating networks in the London Borough of Tower Hamlets: the Barkantine District Heating Network and the Olympic Park District Energy System (OPDES) which also serves other boroughs. The three energy centres feeding those networks are the King's Yard energy centre and the Westfield Stratford City in the Olympic Park and the Barkantine Energy Centre on the Isle of Dogs. Both of these schemes were designed with expansion in mind.

8.4.1 Costs of connection

The costs of connection to a District Heating Network are split into two main categories: infrastructure cost and building costs. The infrastructure cost depends highly on the location of the building to be connected in relation to the nearest branch of the network.

The costs in Table 9 assume that there is no pre-existing network in an area, and use estimates for infrastructure cost based on typical densities of development in different housing types.

Dwelling type	(DHN) Infrastructure cost	(DHN) Branch Cost	(Building) HIU and heat meter	Total Cost (per dwelling)	Conversion from Electric Heating (if necessary)
Small terrace	£2,135	£1,912	£2,300	**£6,347**	£3,500
Medium/large terrace	£2,135	£2,255	£2,300	**£6,690**	£3,500
Semi-detached dense	£2,719	£2,598	£2,300	**£7,617**	£4,500
Semi-detached less dense	£2,719	£3,198	£2,300	**£8,217**	£4,500
Converted Flat	£712	£7,52	£2,300	**£3,764**	£2,500
Low rise flat	£1,500	£1,500	£2,300	**£5,300**	£2,500
High rise flat	£1,000	£1,500	£2,300	**£4,800**	£2,500

Table 9: The costs of connection to a District Heating scheme and conversion from electric heating, if necessary (source: Poyry)

Identifying the potential carbon savings associated with a connection to one of these two District Heat Networks is difficult as the carbon content of the heat provided is not publically available. It also depends on the size of the dwelling, its heating system, level of heating consumption, and current heating fuel.

It has been assumed at this stage that connecting to a heat network would save between 0.2 and 1.4 tonnes of CO_2 per year and per unit compared to a conventional heating system. Assuming an average of 0.8 tCO_2 annually over a 25 year lifetime, this leads to an average cost per lifetime CO_2 comprised between £250 and £500/tCO_2 of connecting to an existing network.

8.4.2 Future Networks

At present there is still scope for expansion of the existing heat networks in Tower Hamlets. However, in the future there may be a case to build new district heating schemes to cover other sections of the borough. Ramboll carried out a study of the Tower Hamlets area in 2011. This identified and ranked areas in LBTH with potential for district heating (see w 21).

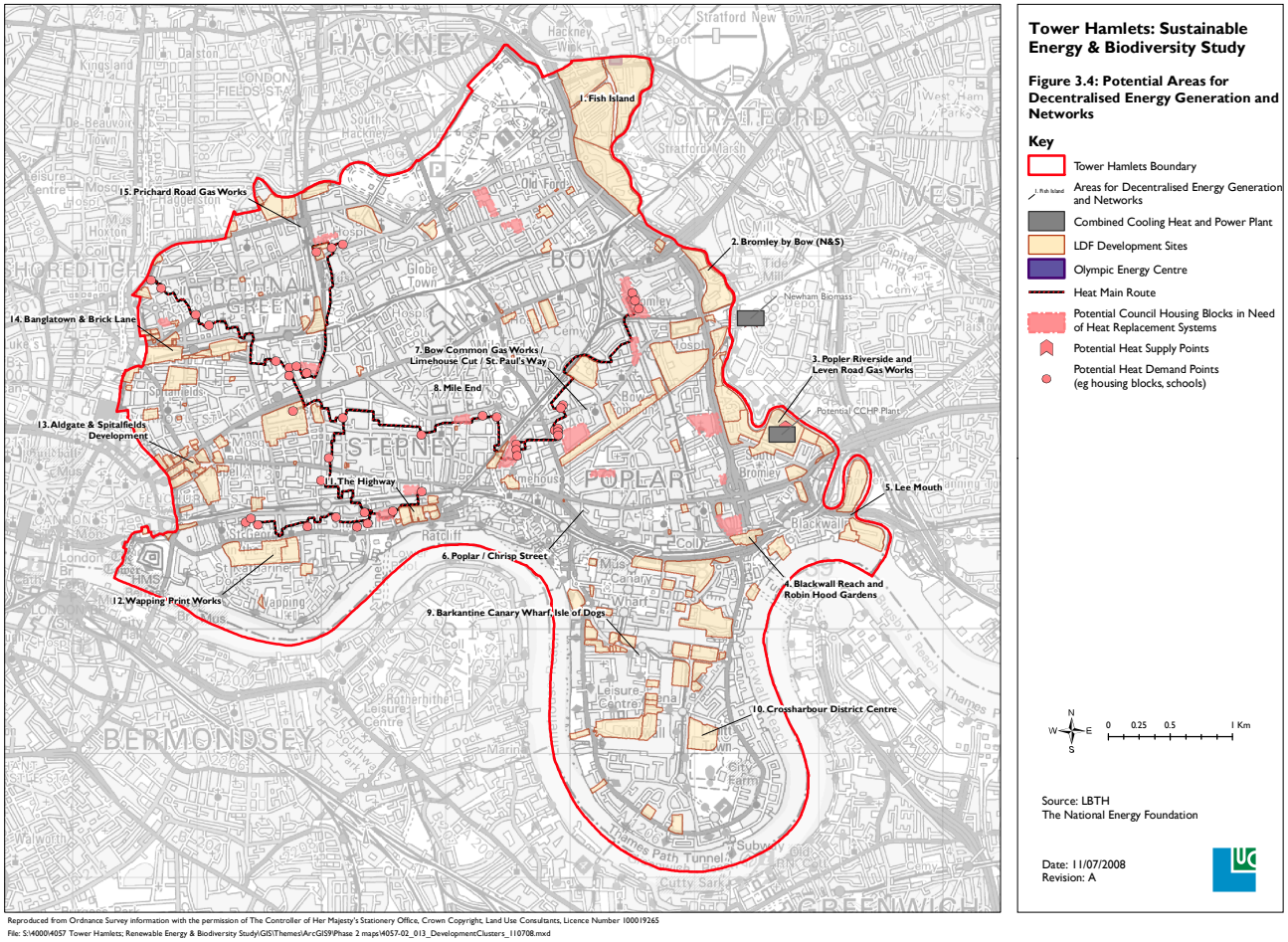


Figure 28: Potential District Heating Networks in Tower Hamlets (networks shown as a black line, with potential heat loads shown in pink) (Source: LBTH and the National Energy Foundation)

The likelihood of these projects going forward was ranked as follows:

2. Stepney - High
4. Mile End - High
3. Aldgate/ Whitechapel - High
6. Bethnal Green - High
7. Blackwall - High
8. Canary Wharf - Medium
1. Bromley by Bow - Medium
5. Wapping – Medium

However, given the uncertainty regarding the delivery of these networks and the fact that they could be funded through the Community Infrastructure Levy (CIL) it is recommended that the Carbon Offset fund does not contribute to these large infrastructure projects.

8.4.3 *Suitability for the LBTH Carbon Offset Fund*

The decision to fund District Energy Systems through the LBTH Carbon Offset Fund should be taken carefully:

- Firstly the works funded should be clarified: connections to an existing District Energy Network are likely to be significantly less capital intensive compared to a new District Energy generation plan and distribution network. It is likely to be preferable to support many smaller initiatives than a large single investment.
- Secondly the State Aid rules limitations should be considered as the beneficiary of the funding may be a private organisation. Section 106 rules may also prohibit the use of s106 funds for these purposes.

8.5 Renewable Energy Generation

In other Carbon Offset Funds, 'community scale' renewable energy generation schemes have been supported, such as PV arrays on schools. These provide potentially large carbon savings in a single location with a single installer and owner, and could therefore be attractive projects for the LBTH Carbon Offset Fund.

The potential issue with these renewable technologies is that there are a number of funding mechanisms (e.g. FiTs and RHIs) which are already successfully supporting the uptake of these technologies.

8.5.1 *Solar Photovoltaics*

Typical costs for solar arrays have reduced significantly over the last few years. Table 10 below shows the most recent data published by DECC in 2013 based on information from the Microgeneration Certification Scheme database for solar schemes receiving the Feed-In-Tariff. This cost includes the cost of equipment, direct costs of mounting and connecting the panels, but does not include warranties, or any other materials and works.

The typical energy generated by an array of a given size can be calculated using basic assumptions on the panel orientation, tilt, and shading. An example of this type of calculator is used in SAP. The estimated costs and carbon savings using these methods were compared with costs estimated by suppliers for an actual array proposed for a school, with good matching.

Cost and carbon saving estimates were produced for four different PV array sizes which would be suitable for installation on a building such as a school or community building.

PV Array Size (kWp)	Estimated Panel Area (m^2)	Estimated Installation Cost (£)	Estimated Energy Generated (kWh/year)	Offset CO_2 (tCO_2/year)	Lifetime (years)	Cost per Lifetime CO_2 (£/tCO_2)
5	35	£7,850	4,200	2.1	20-25	£167
10	70	£15,700	8,500	4.4	20-25	£160
25	175	£33,250	21,400	11.1	20-25	£134
50	350	£66,500	42,900	22.1	20-25	£134

Table 10: Indicative costs for PV arrays (Source DECC)

Given the likely focus of the Carbon Offset Fund on public buildings and schools during the first phase, the above benchmarks could be used to consider the feasibility of implementing PVs.

Future phases of the Carbon Offset Fund could also target other building types, potentially including private householders and businesses.

8.5.2 *Solar water heating*

Solar water heating is included as a domestic retrofit carbon abatement measure. It could potentially be applicable to non-domestic building but the assessment cannot be as generic as PVs as they rely on a suitable hot water load.

8.5.3 *Wind*

As building mounted turbines have not performed well in London over the last few years, it was decided not to include them in this appraisal.

8.6 Tree Planting

Tree planting has been suggested as a possible carbon offset measure in only a few of the previous carbon offset schemes. Urban tree planting has a variety of benefits to a local area, including:

- Carbon sequestration;
- Reduced Urban Heat Island (UHI);
- Improved urban biodiversity;
- Improved local air quality (e.g. reduced local levels of SO_2, NO_2, and particulates).

8.6.1 *Costs and Carbon Savings*

For this study, figures estimating the carbon savings and total installation costs for urban trees in both street and park settings were determined based on a review of available literature. Total carbon sequestration data for trees was found in the *Forestry Commission Woodland Carbon Code Carbon Lookup Table*, which provides total cumulative carbon sequestration for a range of tree types and planting scenarios. Installation costs were found in a paper by *Natural England* which described a cost benefit analysis of urban trees in terms of both carbon sequestration and air quality impacts. Four tree types were included: Lime (street), Cherry (street), Maritime Pine (park), and Oak (park).

Tree Type	Lifetime (years)	Installation Cost	Cumulative Carbon Sequestration at End of Life per stem (tCO_2e/stem)	Cost per tCO_2 (£/tCO_2e)
Lime	195	£2,150	0.28	£7,796
Cherry	28	£2,017	0.20	£10,140
Maritime Pine	95	£463	0.07	£6,680
Oak	195	£559	0.48	£1,157

Table 11: Total lifetime Carbon sequestration per tree planted

8.6.2 *Suitability for the LBTH Carbon Offset Fund*

Tree planting represents a relatively high cost per tCO_2 saved and it is therefore not recommended for inclusion in the first phase of Carbon Offset Solutions projects which could be funded by LBTH.

8.7 LED Street Lighting Replacement

LED street lighting can achieve much greater efficiency than existing technologies, such as high pressure sodium lighting. As well as the lamps, great progress has been made in controlling street lights using Central Management Systems (CMS). This allows remote switching or dimming for individual lamps at any time, controlled centrally, as well as remote monitoring of lamp operation and maintenance requirements. Market prices of LED lamp technology have been decreasing markedly over recent years.

8.7.1 *Costs and carbon savings*

Using projections from a report prepared by the Scottish Futures Trust and Arup in 2012 the following costs and potential savings for a range of different lamp sizes were estimated. These are conservative estimates, based on the minimum saving compared to existing conventional technologies, and not taking into account any reductions in energy use due to greater use of dimming or the Central Management System.

	Lantern Cost + CMS@£65 (£/unit)	Estimated Minimum LED energy saving (kWh/year)	CO_2 Saving ($kgCO_2$/year)	Lifetime (years)	Cost per lifetime CO_2 (£/tCO_2)
LED Lantern + CMS (3,000 lm)	£280	41.5	22.6	20	£476
LED Lantern + CMS (5,000 lm)	£329	78.9	42.9	20	£308
LED Lantern + CMS (7,000 lm)	£382	132.9	72.3	20	£219
LED Lantern + CMS (11,000 lm)	£487	195.2	106.2	20	£199
LED Lantern + CMS (18,000 lm)	£487	261.6	142.3	20	£148
LED Lantern + CMS (30,000 lm)	£514	299.0	162.7	20	£138

Table 12: Approximate costs and carbon savings for a range of LED lamp types (analysis based on Scottish Futures Trust)

8.7.2 *Suitability for the LBTH Carbon Offset Fund*

A programme of street lighting improvement is already under way in the London Borough of Tower Hamlets. Therefore it is not recommended to include LED Street Lighting in the list of measures funded by the LBTH Carbon Offset Fund at present.

8.8 Other Measures

Other Carbon Offset schemes also include a number of offset measures that have less tangible/auditable carbon savings, but which can be beneficial and worthy of inclusion.

It is envisaged that in the early stages of the scheme, measures with more tangible carbon saving opportunities will be prioritised, with the opportunity to expand the range of measures at a later date. These could include:

- ***Behavioural change and energy advice schemes:*** The Carbon Offset Fund could be used to set up advice centres to engage with local people and businesses and encourage them to save energy through behavioural changes. This could run effectively in parallel with the retrofit schemes, and could have the effect of increasing the carbon savings achieved from retrofit measures by decreasing the performance gap.
- ***Carbon Audits:*** a Green Deal assessment costs around £100 for a household, which may prove a barrier to entry for some householders. For dwellings which may not be eligible for other measures included in the LBTH Carbon Offset scheme, funds could be provided to carry out carbon audits, with the aim of boosting uptake of other schemes. Carbon audits could also be targeted towards SMEs.
- ***Monitoring schemes:*** the Carbon Offset Fund could allocate resources to long term studies of retrofit measures. This would be useful for assessing the relative success of each measure and prioritising future allocation of funds, but also in providing greater understanding of low carbon schemes.
- ***Carbon saving competitions:*** LBTH could open up pots of funding for the general public to come up with their own ideas for reducing energy use in the borough, encouraging greater engagement and awareness of the Carbon Offset Fund. This could include local community projects, or ideas for apps that people can use in their homes and daily lives to save carbon (e.g. monitoring energy use and sharing it);
- ***Transport:*** While funds could be spent to upgrade the LBTH fleet of vehicles thereby reducing direct emissions, carbon savings from general transport in the borough are harder to analyse. Barclays Hire bikes are already available in the borough, and there are a number of car sharing schemes (e.g. ZipCar) that are present. The installation of electric car charging ports may encourage uptake of electric cars.
- ***And also:*** installation of smart appliances, investment in Energy-from-Waste plants (e.g. Anaerobic Digestion and Pyrolysis/Gasification plants), embodied carbon initiatives, etc.

Where direct carbon offsets cannot be measured, Key Performance Indicators (KPIs) should be carefully drawn up to provide measurable metrics of success for each scheme type in order to ensure that the offset fund is being used effectively. This could include measures such as number of households reached in advice or carbon audit schemes.

8.9 Conclusion and recommendations

8.9.1 *Types of projects to be funded*

Based on the review summarised in this section and particularly on the need for the first projects funded by the Carbon Offset Fund to be beneficial to the community, be simple to deliver, achieve tangible results and not raise legal or fairness issues in terms of private initiative funding, it is recommended to allocate funding to the following types of projects:

1. Domestic retrofitting of social housing with a particular emphasis on affordable warmth and fuel poverty;
2. Non-domestic retrofitting of public buildings;
3. Extension of existing decentralised energy schemes (subject to State aid rules restrictions);
4. Community renewable energy projects, particularly PVs.

In the future, we recommend that the scope of projects eligible for funding is expanded to include other carbon saving programmes (see section 8.8) including behaviour change and communication campaigns, Carbon Audits (domestic users and SMEs) and projects which deliver community benefits (e.g. local job creation, skill development).

8.9.2 *Cost efficiency of carbon saving measures - Overview*

The table below summarises the cost efficiency range of the measures recommended above:

	Cost per lifetime CO_2 (£/tCO_2)
1. Domestic retrofit	£22-£3,800
2. Non-domestic retrofit	£24-£485
3. Connection to existing district heating networks	£250-£500
4. Community renewable energy projects	£134-£167

Table 13: Summary of approximate cost efficiency (£/per lifetime CO_2) of measures covered in this section

The cost range for options 3 and 4 is relatively narrow and the complexity of identifying projects for these options is reduced. Domestic and non-domestic retrofits offer a far greater range and degree of complexity. Two 'Carbon Offset Solutions' databases have therefore been developed to assist LBTH in the identification of relevant projects. Please refer to Sections 9.0 and 10.0 for further details.

8.9.3 *Carbon Offset Price and Carbon Offset Ratio: is £60/tonne over 30 years sufficient?*

In order to achieve a Carbon Offset Ratio of 1:1 or less, the cost per lifetime CO_2 of the funded carbon saving measures should be less than £60/tCO_2. When compared to the figures in Table 13, it is obvious that a Carbon Offset Ratio of 1:1 cannot be achieved for every measure. However, the following factors should be noted:

- there is currently a lack of data available to estimate accurately the impact on cost efficiency of a combination of measures or of economies of scale;
- using the cost efficiency of measures as the only criterion introduces a risk of undertaking works which are cost efficient rather than those which are necessary.

Our recommendation is to use the Carbon Offset Ratio of 1:1 as an overall target for the fund as a whole but not to require a Carbon Offset Ratio of 1:1 on each project in order for a broader range of projects to be funded which could bring significant carbon savings (e.g. deep retrofits rather than shallow retrofits) as well as additional benefits not captured by the Carbon Offset Ratio (e.g. reduction of fuel poverty, improvement of a community centre, etc.).

Allowing a flexible Carbon Offset Ratio also enables the Carbon Offset Price to be set (at least initially) at £60/tonne CO_2 over 30 years, which is the carbon offset price currently recommended by the GLA.

Should evidence demonstrate that this Carbon Offset Price is not sufficient to deliver a Carbon Offset Ratio of 1:1 overall across a variety of projects, the LBTH Carbon Offset Fund Strategic Board/Panel will be able to adjust it and demonstrate the justification for the new price with specific evidence and feedback based on the initial phases.

9.0

ASSESSING AND VISUALISING ENERGY PERFORMANCE OF BUILDINGS AND CARBON SAVING POTENTIAL OF RETROFITS IN TOWER HAMLETS

9.0 ASSESSING AND VISUALISING ENERGY PERFORMANCE OF BUILDINGS AND CARBON SAVING POTENTIAL OF RETROFITS IN TOWER HAMLETS

It is clear from the analysis in the previous sections that domestic and non-domestic retrofits could be the main beneficiaries of the LBTH Carbon Offset Fund. However the complexity and diversity of the works involved in retrofits are significant compared with projects aiming at increasing the number of connections onto an existing District Heat Network or of PV installations:

- the scope of 'energy efficient retrofits' can vary significantly between the insulation of the hot water cylinder to the 'deep' energy efficient retrofit of a dwelling/non-domestic building to EnerPhit standards;
- the impact of individual measures as well as the possible combination of measures depend on the specific characteristics of the property: size, current energy performance, insulation standard, heating system, etc;
- the practicality of delivering the work could vary significantly;
- their cost efficiency (£/lifetime CO_2) can vary significantly.

The approach to domestic and non-domestic retrofits tends to be project-led rather than the result of a strategic approach

Currently the approach to domestic and non-domestic retrofits therefore tends to be project-led: a building is put forward for retrofit and if considered suitable, a package of improvements is agreed and can be supported by one or several national or local funding and delivery mechanisms (e.g. ECO, Re:NEW, Re:FIT).

Even if this approach has its merits, most importantly the rapid delivery of carbon savings, the lack of strategy behind the allocation of funds towards a particular project over another project is a significant issue. Some of the questions which could be asked include:

- *Should this school really have received funding for an energy efficient retrofit if it is not in the bottom 25% of the worst performing schools in the borough from an energy point of view?*
- *Should this apartment block have received this level of funding when an apartment block located closer to a major development site would have equally needed it?*
- *Was it appropriate to fund 'only' external wall insulation improvements instead of a deeper retrofit involving a combination of measures?*
- *Does the allocation of the funds take into account other LBTH priorities (e.g. reducing fuel poverty, job creation)?*

Generally, an ad-hoc approach to refurbishments either by project or by carbon saving measures does not represent a satisfactory strategy to make the best possible use of the resources received by the LBTH Carbon Offset Fund. In addition, developing a robust strategy in terms of domestic and non-domestic building retrofit can be a significant advantage to ensure the sustainable success of the fund with an established, robust and structured process.

Developing a robust strategy to energy efficient retrofits can be very effective at saving carbon and attract significant funding, particularly from 2016

We have therefore developed three tools to inform this strategy: the **GIS mapping tool** which now includes key data on energy and carbon saving potential for a large sample of properties (8,000+ domestic properties and 120+ public buildings), the **Domestic Carbon Offset Solutions database** which provides a detailed assessment of the modelled impact of a number of suitable individual measures and combination of measures for the 8,000+ domestic properties and the **Non-domestic Carbon Offset Solutions database** which provides a detailed assessment of the estimated impact of a number of suitable individual measures and combination of measures for the 120+ public buildings.

Our objective has been to improve the understanding of the energy performance of the borough's building stock at a strategic level and provide an evidence base for Carbon Offset decisions.

These databases could also potentially be one of the key components of a '**Local database of Carbon Offset Solutions projects**' an other parties could be encouraged to fund projects from this local database, either directly, through third-party providers or through the London Borough of Tower Hamlets Carbon Offset Fund.

9.1 LBTH current GIS Tool

A Geographic Information System (GIS) is a computer system designed to capture, store, manipulate, analyse, manage and present all types of geographical data. GIS maps allow for databases of information to be embedded within a geographical map, which can be visually navigated and provide access to data. The purpose of a GIS tool is to display geographic information in order to inform decision making. It allows users to create interactive queries (user-created searches), analyse information and present the results of all these operations.

The London Borough of Tower Hamlets has implemented a Geographic Information System and the associated spatial data infrastructure. Within the tool, each building is placed as a polygon onto a digital map of Tower Hamlets. Each polygon is able to contain a database of linked information (each known as an attribute), which can either be directly accessed by the user, or used to graphically alter the visual properties of the polygon (e.g. change its colour).

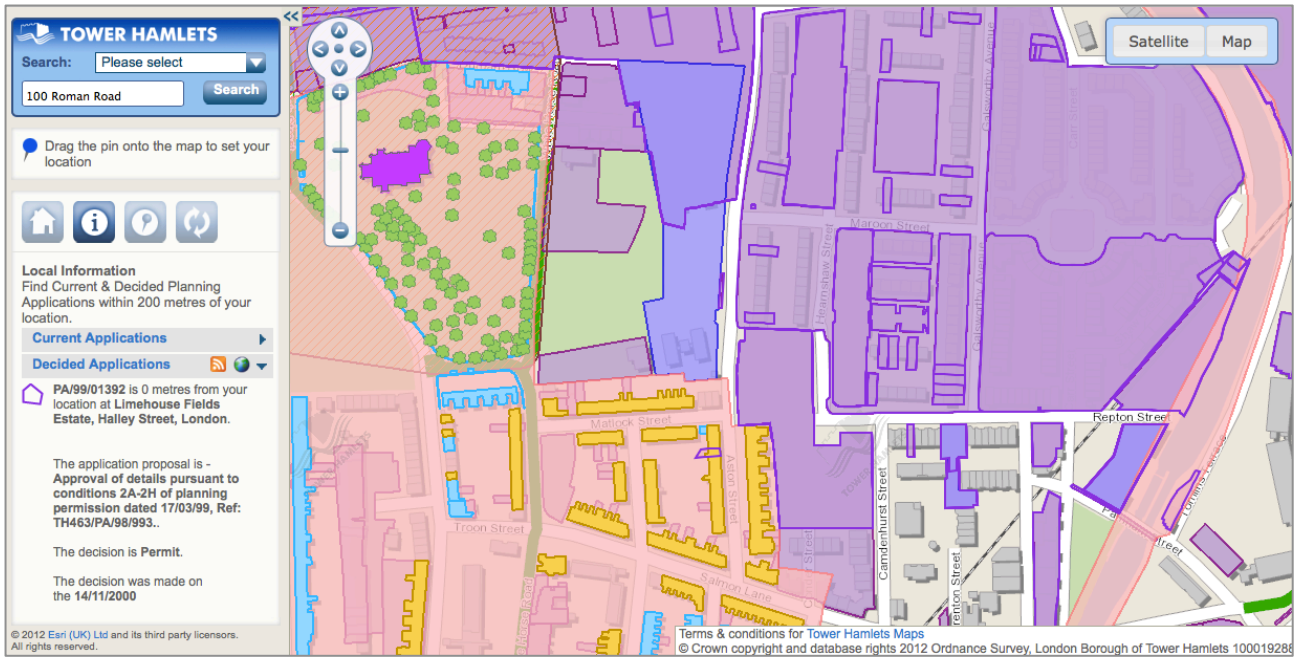


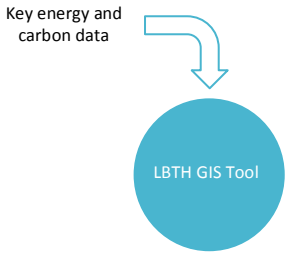
Figure 29: Extract of LBTH GIS tool

LBTH GIS services include technical support and mapping analysis. Technical support covers management of large datasets such as the Local Land and Property Gazeteer (LLPG) and calculating distance measurements. Mapping analysis provides maps of all shapes and sizes. LBTH standard maps can be tailored to specific requirements highlighting buildings, roads, crossings and open spaces and are currently mainly used for planning and development of capital asset.

The LBTH GIS is partially accessible by the public for information about local services including Environment and Planning, Health and Social Services, and Schools.

9.2 Enhancing the GIS Tool to include key energy and carbon data

A key part of the work undertaken for the London Borough of Tower Hamlets Carbon Offset Solutions Study was the proposal to enhance the GIS tool with specific key energy and carbon data. It is anticipated that the GIS mapping tool could therefore serve two additional functions:



- Provide a geographical database of a large sample of non-domestic public buildings and of domestic properties in the social housing sector for the purpose of identifying suitable developments for retrofitting of energy efficiency measures.
- Provide a geographical database of new/future planned developments in Tower Hamlets for the purpose of tracking and forecasting future carbon offsetting payments to the Council.

It is envisaged that the two services above could be linked in order to allow the Council (and potentially developers) to identify refurbishment / carbon reduction opportunities which are local to the proposed new development proposals. In certain cases this could allow the developer to carry out the retrofit / carbon abatement works themselves whilst they have construction resources in the area. This could potentially be more cost effective than to fund a separate contract through the Council.

9.3 Data collection and processing

This section explains how the spatial data infrastructure for domestic properties in the social housing sector and non-domestic public buildings has been developed. This includes an outline of the raw data available, as well as the analysis and processing that has been carried out to generate the final domestic and non-domestic Carbon Offset Solutions databases. The structure of this section is split between domestic and non-domestic buildings, and each data set is outlined in turn. Where data has been identified that could not be gathered due to particular constraints, this has been discussed, and recommendations have been made.

An overview of the data collection and processing work is provided and outlines the measures used for estimating the quality of each data set. It also covers the approach that has been taken for data management. Each of the data sources is then reviewed and the decision-making process that has taken place to generate the final databases is explained.

9.3.1 Scope

The work outlined in this section considers the building stock at a very large scale: there are almost 132,000 properties in the borough. Working at this scale necessitates certain simplifications and limitations, which should be considered when using the results of this study.

The level of detail available in large-scale, disaggregated building data sources is considerably less than that possible from building surveys of a small number of properties. Furthermore, the data has been obtained from a number of different sources. While every effort has been made to ensure that only the most useful and reliable data has been included in this study, the Domestic and Non-Domestic Carbon Offset Solutions databases should only be used as early indicators of buildings with high potentials for carbon offsetting, and any decisions should be made in conjunction with more detailed analysis.

In line with the main Carbon Offset concerns, this section primarily focuses on energy use, carbon dioxide emissions and costs. Whilst other factors which might impact on retrofit

decisions such as fuel poverty may be touched upon, they have not been the main focus of the analysis.

9.3.2 *Data gathering and processing sequence*

The figure below provides an overview of the data gathering process, and introduces the terms used to define the different stages of data processing in this report:

- Firstly, **Raw Data** was collected from a number of different sources, shown in blue below. This refers to data in the original, unprocessed form. A key raw data source was the **Local Land and Property Gazetteer (LLPG)**, shown in green below. This is a central list of properties in Tower Hamlets, and is connected to the borough's GIS structural database.
- The individual sets of raw data were processed, and matched to the entries in the LLPG Database to produce the **LLPG Matched Data**, in orange below; essentially validated data from the different sources that can be connected to LBTH GIS database. Due to the differences in data and approaches to analysis, separate 'LLPG Matched Domestic Data', and 'LLPG Matched Non-Domestic Data' files were created.
- Finally, analysis was undertaken for each of the entries in the LLPG matched databases to create the **Carbon Solutions Databases.** Again, there are two separate files (one for the domestic buildings for which energy modelling was carried out, and one for the non-domestic buildings on which energy benchmarks were applied).

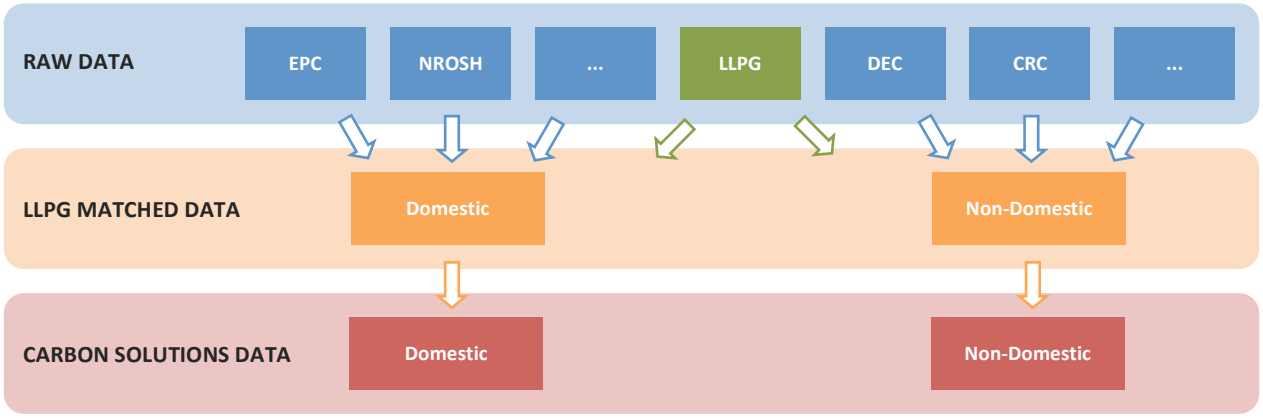


Figure 30: Summary of data processing sequence

9.3.3 *Data collection process*

One of the aims of this study was to develop a tool and two databases which would help the London Borough of Tower Hamlets to make informed decisions on carbon saving projects. Two critical requirements of the tool and database were therefore:

- to provide an estimate of the energy performance of the buildings in Tower Hamlets;
- to estimate the potential for carbon reduction measures, including, where appropriate, their relevance, carbon impact and associated costs.

In order to facilitate this, data collection has been carried out with a focus on three key areas:

- Where available, **energy data for the building stock** has been collected. This includes electricity and fossil-fuel use, as well as energy generated through low/zero carbon (LZC) technologies.

- Information about the **state of the stock** has been gathered, as this is useful for estimating current energy performance, and assessing the likely impact of improvement measures. This has been particularly important in cases where actual energy consumption information (point above) was not publicly available. Data gathered includes variables such as property age, occupancy, built form, and building services.
- Finally, where data on recommendations for building improvements are available (e.g. from **EPC** recommendation reports and **DEC** advisory reports) this has also been gathered.

As our aim was to create a GIS tool and two Carbon Offset Solutions databases which can easily be updated and expanded upon (e.g. every 3 years) a key consideration in selecting the data has been identifying information that can be easily and regularly updated.

Data that is freely available has been downloaded where possible. Most of the raw data files have required at least some processing in order to make them appropriate for the study. Where any processing has been carried out, this is explained. Where data sources have been found that required either (a) payment or (b) significant time to collect, these have not been sought. These data sources are summarised in this report, with cost quotations where available and comments about their relevance.

9.3.4 Quality

Data has been gathered from a large number of sources. The different data sources have been originally collected for varying reasons. Consequently, it is of varying quality, and combining information from different sources presents consistency and quality issues. In order to account for this, the data has been given a rating, from ★ (low quality), to ★★★ (high quality). The rating has been considered using the following three criteria:

Time: Older data may be less valid than more recent data. The importance of this criterion varies depending on the data type though. For instance, as the turnover of the building stock is 1-2% per year, information on the make-up of the building stock is likely to remain relatively accurate for a reasonable amount of time. Conversely, the uptake of some carbon saving measures (e.g. PVs) has changed significantly in recent years, so older data about how many buildings incorporate PV systems may become inaccurate more quickly. A related issue is the fact that data that is regularly updated can be more useful and of a better quality than data from a one-off survey.

Resolution: Ideally, all data would be gathered at the building scale. Unfortunately, for reasons of practicality and privacy, information is not always publicly available at this resolution. Aggregated data is still useful but raises questions of how the information is attributed to individual buildings. For instance, simply dividing postcode-level residential energy use by the number of dwellings in the postcode ignores the variation in energy performance that exists between dwellings.

Trustworthiness of source: This factor is the most difficult to objectively define. However, some data sources (e.g. official government or LBTH statistics) are likely to be more reliable than other sources.

The ratings are intended to reflect the type of data included. For instance, a reliable data source with information for only a single variable (e.g. building age) or covering a single building type may have a higher rating than a less reliable data source with data on a larger number of variables, or that covers the entire building stock.

Additionally, the ratings presented here are for the post-processed data. For instance, some entries in the National Register of Social Housing (NROSH) database have substantial information, while others have very little. In this instance, entries with sufficient information may have three stars, while those with very little may have only one. Alternatively, in the data collected by Ramboll for the London Heat Map study, some of the physical building data appears to be disaggregated and of decent quality. However, much of the energy data

seems to be based on benchmarks. Where this is the case, the energy data has been excluded from the Carbon Offsetting Study, and so the quality rating covers only the included data (i.e. the physical building data).

Overall, the ratings given in this report are subjective but as their assessment is transparent, they can easily be interrogated and amended if necessary.

9.3.5 Required post-processing

Most of the raw data sets gathered were not in a format which could be directly used in the databases and the associated GIS tool. Consequently, a significant degree of raw data post-processing had to be undertaken. The post-processing required for each data set is explained where appropriate in this chapter but in summary it involved:

- isolating Tower Hamlets data from England/UK-wide data;
- re-formatting files that are incompatible with Excel into compatible formats;
- tidying 'unorganised' data (e.g. fixing data in wrong columns, correcting inconsistent formatting, etc.);
- identifying and removing likely false data (e.g. 'zero' or 'default' energy consumption figures in the Display Energy Certificates).

The separate data files have then been combined and entries 'matched' in order to create the domestic, and non-domestic LLPG matched databases. Matching has been carried out primarily using the address data and, where necessary, other factors such as floor area.

9.3.6 Matching the Raw Data to the LLPG

The London Borough of Tower Hamlets is using the LLPG (Local Land and Property Gazetteer) database as the key structural database behind its GIS mapping tools. For this reason, it has been used by Etude as the backbone of the carbon offsetting study data for both domestic and non-domestic buildings. All the other raw datasets have been matched to the LLPG dataset. This means that where data could not be assigned to a specific LLPG entry, it was discarded.

The LLPG contains the full address information for all of the properties in the borough, amounting to 131,913 data points. Consequently, the matching of the separate raw data sets has been significant and complex. The approach taken is detailed below.

Due to the size of the databases used in this study, (131,913 entries in the LLPG and up to 60,000 Tower Hamlets entries in the separate raw databases), matching necessitated both automated and manual processes. Matching was carried out with the addresses, using two key steps:

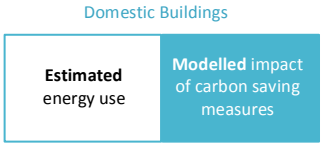
- **Automated Address Matching**: VBA algorithms were written to compare each data point in the LLPG database with each of the points from the other data sets. Checks for certain key words were incorporated, in order to account for variations in spelling and notation (e.g. 'St' instead of 'Street', 'five' instead of '5'). As complete address matching rarely occurred, the VBA algorithm was designed to assign a ranking for each match. Matching was particularly complex with non-domestic buildings due to the very different ways that buildings could be named (e.g. 'Denver Junior School' or 'Denver Jr School' or 'Denver School'). Additionally, as many of the datasets included inconsistent approaches (e.g. "4 Denver Road" in one cell, vs "4" and "Denver Road" in separate cells), the matching also accounted for different numbers of words.
- **Manual Address Matching**: where the automated algorithms determined some, but not complete matching (e.g. "Flat 5, Denver House, EN5" against "No. 5, Denver House, EN5") manual checking was required. The calculated match ranking, explained above, was used to prioritise the order of checking.

In some instances, the level of disaggregation differs between the LLPG and the separate raw datasets. For example, for a block of flats, each apartment might have a separate LLPG data entry whereas a single EPC may have been generated for the entire building, or vice versa. Non one-to-one matches, such as these, have been allowed for in the data matching. In these cases notes have been included to ensure that any analysis does not lead to errors, such as double-counting energy consumption.

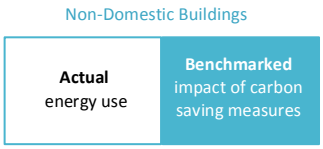
It should be noted that, even with the automated systems, data matching was a very time-consuming process. Consequently, if Tower Hamlets intends to gather or produce large-scale building data in the future, it is strongly recommended to allow for data matching from the outset, by including the LLPG UPRN reference numbers, rather than simply relying on address data.

9.3.7 *Estimating the impact of carbon saving measures*

Finally, the data in the LLPG Matched databases was used to evaluate the opportunities for carbon emission reductions from retrofits in the borough. In an ideal situation, energy modelling (which enables the impact of different changes to be estimated) would be carried out for each building, in conjunction with the benchmarking of actual energy data (accounting for factors such as occupant behaviour which is very difficult to accurately model). However, due to the availability of data, the methods used differed between domestic and non-domestic buildings. They are summarised below.



Domestic Buildings: Actual disaggregated energy data is not available. However, the data from the EPC, Census and NROSH databases provide enough detail to be able to match housing typologies with dwellings included in the English Housing Survey. This has been reformatted for use in a simple energy model by CAR Ltd in the Cambridge Housing Model (CHM), an open Excel based implementation of the Government's SAP energy model.



Non-Domestic Buildings: For a number of the non-domestic buildings in the borough, disaggregated annual energy data has been found. This enables the *actual* (rather than estimated) performance of the buildings to be evaluated. However, unlike the domestic buildings, only limited data is available on the characteristics of the buildings, making energy modelling impractical. Consequently, for the non-domestic buildings, benchmarking has been undertaken instead; comparing each buildings performance to similar ones in the borough and the UK to identify buildings which are performing poorly.

The final Carbon Solution databases are essentially the LLPG matched databases with the results of the analysis described above. All the data sets ('raw', 'matched' and 'carbon solutions') are available.

9.4 Domestic Buildings

This section covers the work carried out on the domestic building stock in Tower Hamlets. Firstly, the different raw data sets are introduced, and the processing carried out for each explained. Data was gathered and processed that eventually was not used in the final Domestic Carbon Offset Solutions Database and GIS tool. However, for completeness, all the sources considered are mentioned in this report. Therefore, the section outlining the different raw data sources is split between data that was eventually used in the Domestic Carbon Offset Solutions Database followed by data that was gathered but discarded; and finally, data that was not gathered.

Next, the resulting combined data set (i.e. the Domestic Carbon Offset Solutions Database) is summarised and the energy modelling carried out on the domestic building data is explained.

9.4.1 Raw Data: Gathered

There is a reasonable level of data available covering the housing stock in England. However, a key issue is privacy/data protection, which means that - especially for actual energy use - data is not available at the individual building scale.

The table below outlines the key data sources that have been gathered and used in the Carbon Offset Solutions Study for the Tower Hamlets residential building stock.

Data	Source	Date	Resolution	Quality	Key Information
EPCs	GLA	New buildings regularly added	Building-scale	up to ★★★	Address; estimated energy use; floor area; improvement recommendations; building envelope
English Housing Survey (EHS)	DCLG	2011-12	Building-scale	★★	Representative dwelling geometry and dimensions, used to supplement EPC data.
National Register of Social Housing (NROSH)*	DCLG originally	Gathered from 2004 to 2011	Building-scale	up to ★★★	Address; dwelling type; no. bedrooms; tenure; construction year
London Heat Map Study**	Ramboll	Gathered in 2010/2011	Building-scale	up to ★★	Address; no. flats; construction year; floor area

Table 14: Summary of databases used for domestic properties
** The level of detail and quality of data varies from building to building.*
*** This source also includes some residential energy data. However, it is from benchmarks/design figures, so has not been used directly for the study. However, as it may be useful for comparing the results of our energy modelling, the numbers have been kept – but with notation to make it clear that these are benchmarks, rather than the result of measurements.*

It should also be noted that the CRC data received from the London Borough of Tower Hamlets (which has building scale actual energy data) includes three entries where utility meters are identified as 'GB 01 Domestic'. These have been checked and have been found to actually be small non-domestic buildings. The error is likely to be due to the way that domestic/non-domestic meters are identified under the sub-national energy statistics. Consequently, this data source does not contribute to the knowledge of the domestic building stock.

Energy Performance Certificates (EPCs)

Energy Performance Certificates provide building-level information on a large number of energy-related variables. Some of the key information include:

- Building address;
- Estimated current and potential energy performance after improvements;
- Estimated energy cost by end use (heating, lighting and hot water);
- Total floor area;
- Key information (e.g. dwelling type, storey, and whether there are flats above/below);
- Internal information (e.g. number of habitable/heated rooms);
- Services information (e.g. main heating type and fuel, secondary heating, hot water generation, renewable energy provision);
- Facade information (e.g. wall, roof, floor and glazing type and an indication of quality);
- Improvement recommendations, ranked by priority, with indicative costs and potential savings.

It is worth noting that whilst the EPCs are useful for gathering information on the building form and estimated energy consumption, the energy data included is modelled, unlike the data presented in the Display Energy Certificates (covering public non-domestic buildings) which refers to actual energy use.

The images below show three key pages from the EPCs as they are viewable online for an example house in Tower Hamlets. The left hand page includes the building address, estimated energy use and floor area information. The middle page includes limited information on the façade (note the comment about "assumed" levels of insulation), and on the right hand side there are some of the simple recommendations for the building.

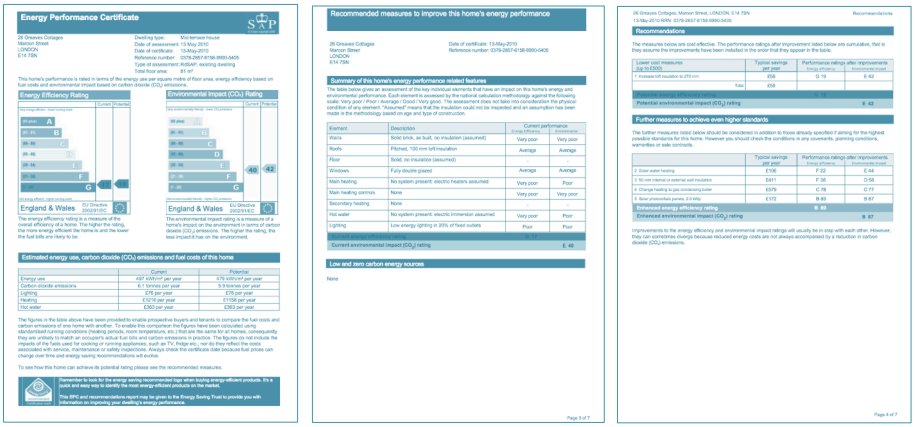


Figure 31: Typical Energy Performance Certificate

The complete EPC dataset for Tower Hamlets has been purchased by LBTH from the GLA in bulk, and includes a significant level of information for each dwelling. The raw file received for Tower Hamlets includes **60,895 data entries**[4].

Approximately **55,000 EPCs** were matched to entries in the LLPG, most of which were assigned a quality rating of ★★★. Further processing was carried out in order to standardise and simplify the textual descriptions used in both the EPC data and the recommendations for improvements.

National Register of Social Housing (NROSH)

The National Register of Social Housing was opened in 2004 by DCLG and discontinued in mid-2011. The data set includes information on almost 5 million social housing properties in England, and is based on information gathered from the registered providers.

As the data has been collected from landlords the data.gov website notes that "*the records […] are of varying quantity and quality with many incomplete, inaccurate or missing records*." However, where the full details are available, this includes - at the individual property level - information on the number of bedrooms, year of construction, building form and, in some instances, data that gives an indication of build quality (e.g. SAP rating, or Decent Homes Standard).

The original files have almost 5 million rows, and cannot be processed in Excel. Consequently, properties in Tower Hamlets were identified using the postcode data first.

[4] *It should be noted that, due to regulations regarding when EPCs should be produced, this includes some instances of multiple EPCs being produced for a single property.*

Processing was also carried out to simplify and standardise some of the wording, remove data errors and tidy inappropriate address information.

In order to deal with the incomplete data, the 'quality' rating has been applied in order to assess the level of data available per building. Where housing information does not include at least the numbers of bedrooms/bed spaces and building age, or the SAP rating, they have been given two stars. Where this information is available, three stars have been given.

Following the matching process, approximately **44,000** properties in the LLPG database have been matched to one or more entries in the LLPG database.

The key item of data used in this study from the NROSH database was the **year of construction**. This is used in the energy modelling to estimate a number of variables concerning construction types and thermal performance of the building envelope. A comparison of the age of construction given for dwellings within the same address showed an inconsistency in the year given. Therefore, where there was an inconsistency, the median age of dwellings in an address was used.

English Housing Survey (EHS)

The English Housing Survey is an annual survey of around 8,000 dwellings across the UK, undertaken by the Department for Communities and Local Government, including a survey of both physical aspects of dwellings and interviews with occupants. This is used to monitor the condition and energy efficiency of housing in England, and understand people's housing circumstances.

The physical survey contains enough information on the dimensions, materials, and building services of the dwellings in question that it is used as the key input data for energy models of the UK housing stock. This has been undertaken for several years now by the Department of Energy and Climate Change (DECC), as a key part of producing statistics on energy use in the domestic sector, published in the *Housing Energy Fact File* and the *Energy Consumption in the UK* national statistics.

For this study, details from the EHS have been used to supplement data from EPCs and NROSH, in particular **building geometry and dimensions**, to allow energy modelling to be carried out. This was achieved by taking the EHS survey results for social rented housing in the London region (877 surveyed dwellings) and categorizing them as one of **39 representative archetypal dwellings**. These representative dwelling types were then matched to dwellings in the EPC database by age band and size band.

9.4.2 Raw Data: Gathered But Not Used

In addition to the data detailed above, some data was downloaded and processed, but not included in the Domestic Carbon Offset Solutions Database database (and therefore in the GIS tool). This is because they are either not directly applicable to the approach we have taken in assessing domestic energy, or they consist of fully aggregated benchmarks. These data sources are discussed below.

Sub National Consumption Statistics

Energy data for domestic buildings in England and Wales is published annually by DECC. At the time of writing, the most recent data release is for 2013.

The data is based on metered energy figures from the utilities providers. The data presented includes the annual domestic gas and electricity use; electricity use is split between economy 7 and standard meters. Assumptions have been made by the utilities companies in order to gather and sort out the data (e.g. a consumption threshold is used to split the data between domestic and non-domestic buildings) and weather correction has been added to the gas figures.

The data is presented at a Lower Layer Super Output Area level (LLSOA). Tower Hamlets includes over 140 LLSOAs, which works out, on average, to 703 homes per zone (with a min/max of 413/1,193 homes).

The data associated with Tower Hamlets was extracted from the raw data. Processing was carried out to deal with incomplete data. For example, the utilities providers' address information is incomplete or missing for some meters. In these instances, the energy figures are 'unallocated', or assigned to 2 or 3 LLSOAs. When this was the case the energy data and meters have been split across them, weighted by the number of households per zone (taken from the 2011 census data). Unallocated energy use is given in the combined data sheet as a separate figure, as this could belong to any of the LLSOAs in Tower Hamlets.

This data is useful for estimating the approximate actual performance of housing in Tower Hamlets - particularly as it is the only source of *actual* energy consumed. However, the high level of aggregation (i.e. the number of homes per LLSOA) makes identifying individual high-energy-consuming homes that are suitable for improvement measures unfeasible. Consequently this dataset has not been used in the study.

Census

The Office of National Statistics has published data from the 2011 Census. Whilst much of the data focuses on social issues and the make-up of the general population, some building-related information is also provided.

The data of interest to this study includes type of dwellings (e.g. flats, houses or bungalows), tenure (e.g. owner-occupied, social housing) and heating fuel. The information on the type of dwellings and heating fuel could be useful in identifying the likely improvement potential for the area, while data on tenure data could be useful both for estimating the likely rebound effect, and for identifying areas where making improvements could be easier as fewer stakeholders would need to get involved.

The highest resolution for which census data is available is aggregated to 'Output Areas' (OAs). This is smaller than the 'LLSOAs' used for the sub-national energy data, mentioned before. As a comparison with the LLSOA figures mentioned previously, OAs correspond to an average of 135 homes, with min/max of 46/466.

Indices of Deprivation

DCLG regularly releases information on the 'Indices of Deprivation' in England. The most recent publication was in 2010, and the next publication is expected to be in summer 2015.

These indices of deprivation consider factors such as income and employment to assess the level of deprivation across the country. While the information is not directly useful in estimating energy use (although studies have shown that household social status does correlate to variations in energy consumption), it may be useful in identifying issues such as fuel poverty, which may be an important consideration when it comes to identifying projects which should be funded as a priority in the borough. This data is published at the scale of LLSOAs. It suggests that in 2010 approximately 40% of the LLSOAs in Tower Hamlets were amongst the 10% most deprived in England.

National Energy Efficiency Data

NEED (the National Energy Efficiency Data) is a data framework for the domestic stock for England & Wales. It includes energy data for homes in England, and publishes aggregated information.

London Heat Map

The data collected by Ramboll for the London Heat Map study covers around 700 buildings in total, including 19 properties identified as 'private residential' (> 149 units or 9,999 m^2)'. It also includes other building types which have dwellings associated with them ('multi-address buildings', 'private commercial' and 'local government estate') but the accompanying report is not explicit about how mixed-use developments are defined, so these have been excluded.

The data is presented at a building level and includes some limited information on building type, as well as some energy use information. For dwellings however, the energy use figures included in this data set are benchmarks (i.e. not based on building-specific modelling, or actual meter readings) and therefore they have been excluded from the analysis.

9.4.3 Raw Data: Not Gathered

Finally, a number of potential further data sources have been identified but not gathered or analysed due to cost or time considerations. These are summarised in the table below and discussed in turn in the following sub-sections.

Data	Source	Time	Resolution	Cost	Key Information
Geo-Information Group Data	GIG	Regularly updated, frequency tbc	Building-scale	£4,000 + VAT for annual license	GIS data: building footprint; height; dwelling type; dwelling age
Online Maps	Google Maps/ Streetview and Bing Maps	Variable	Building-scale	Free, but very labour intensive	Structure; storeys; glazing proportions

Table 15: Summary of unused databases (domestic properties)

Geo-Information Group

The Geo-Information Group sells GIS data on the building stock in the UK. For residential buildings, this includes information on building footprints and heights (based on LiDAR data), both of which could already be included within the Tower Hamlets GIS database. The data also includes information on residential building types (e.g. high-rise apartments, low-rise apartments or terraced houses) and building age (6 categories are included, from 'pre WWI' to 'post 2000' or 'unknown').

This data appears to be provided at a disaggregated level (although this would need to be confirmed) and is likely to be compatible with LBTH's GIS software.

Google Maps / Streetview / Bing Maps

It would be possible to gather some building data through a desktop survey of selected buildings / streets in Tower Hamlets through the freely available online aerial imagery and streetview websites. From these, it should be possible to gather disaggregated, building-level information on variables such as approximate amount of glazing, number of storeys (above ground), and type of building use. Whilst this approach could not gather the same level of data as visiting a site, it would enable the checking of selected information, and help with assessing the potential impact of some variables.

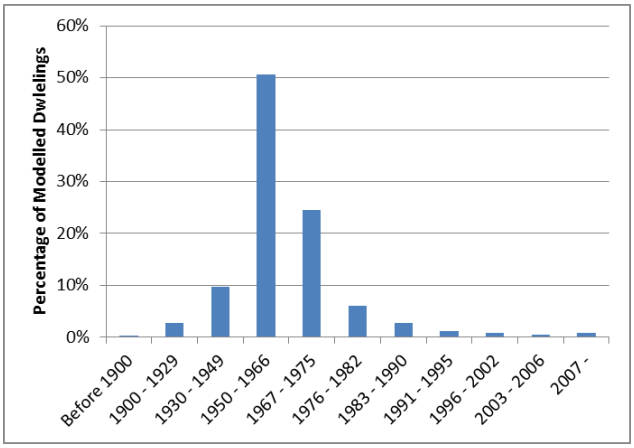
9.4.4 Domestic LLPG Matched Data

The domestic LLPG matched data file consists of the LLPG properties, with information from the matched EPC and NROSH data. These three data sources were selected to be included as they represent good quality information and, together, they provide enough detailed information to enable energy modelling to be carried out at a disaggregated level.

Whilst the LLPG Matched Data file includes all of the available matching, approved EPC and NROSH data, energy modelling was not carried out for all of the properties. For example, if a property has been matched to NROSH data, but does not include an EPC, this property has not been modelled. The approach taken for selecting dwellings to be modelled is outlined below:

- *Does the property have an **EPC**?*
- *Does the EPC include **sufficient information**?* In a few instances, EPCs were found with missing data. Where this would prevent building modelling (e.g. if floor area was missing), the dwelling has been excluded.
- *Is there a matching **NROSH data** point?* The NROSH data provides information on building age, which is useful for estimating fabric thermal performance and, to a lesser extent, plant efficiency. Both are useful for modelling energy use.
- Information necessary to run the model but unavailable at the property level from either the NROSH data or the EPCs was supplemented using data from the **EHS**, in particular typical building geometry and dimensions, split by age and type.

In total, **8,313 properties** in the domestic LLPG matched database included sufficient information for energy modelling. The charts below outline these properties.



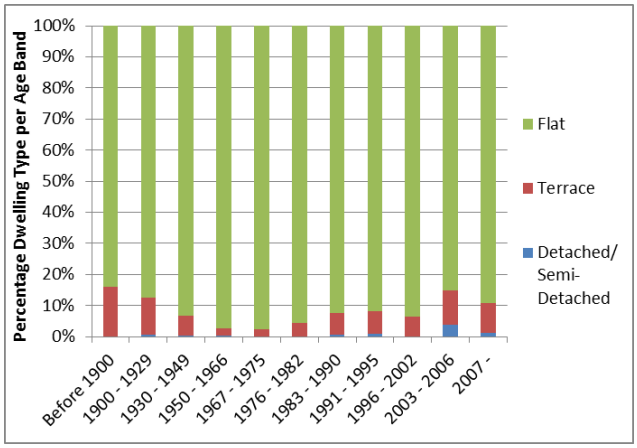


Figure 32: Breakdown of modelled housing by dwelling age and type | Breakdown of modelled housing by dwelling age and type

9.4.5 Domestic Energy Modelling

Energy modelling for the domestic sector is generally carried out with monthly steady-state models such as RdSAP / SAP / BREDEM.

For this study, energy modelling has been carried out using the Cambridge Housing Model (CHM). This is a well established, publicly available[5] SAP-based energy model, and has been used for calculating national domestic energy consumption statistics, including for DECC's annual *'Energy Consumption in the UK'* data release and the *'Housing Energy Fact File'*

[5] https://www.gov.uk/government/publications/cambridge-housing-model-and-user-guide

publication. It uses monthly steady-state calculations to estimate thermal performance, daylighting analysis to estimate artificial lighting requirement, and simple algorithms to estimate other energy uses such as cooking.

This enabled each of the 8,313 properties to be modelled a number of times, taking into consideration different potential options. The calculations carried out for each dwelling are outlined below:

- the **current energy use, carbon dioxide emissions and running costs** were calculated using the known building data.
- the **impact of potential carbon saving measures** (that could be financed through the Carbon Offset Fund) on annual energy use, emissions, and costs were estimated. The improvements were selected from the dwelling's EPC recommendations report, which includes information on likely capital costs for the retrofit measures, and ranks the improvements in order of priority.

  Past studies have often found that in practice the impact of building improvements is often not as high as theoretical calculations. This is due to factors such as the 'rebound' effect (e.g. if home owners use fabric improvements to raise internal temperature, instead of reducing heating consumption). Therefore, in order to account for these effects, 'in-use' adjustment factors were added to ensure that the estimated theoretical savings are realistic.
- The impact of separate building improvements cannot simply be added together. This is due to interaction effects; for instance, higher efficiency lighting typically means reduced internal gains which, in turn, results in increased heating. Furthermore, some improvements would not be done simultaneously (e.g. installing a condensing boiler and a heat pump, or internal and cavity wall insulation). Therefore, **combinations of improvements were also modelled**, with any incompatible improvements removed.

Using the EPC data for the domestic modelling comes with some important caveats. The EPC data was occasionally found to include inconsistencies, for example some dwellings described as terraced properties were also seen to have dwellings above and below and were described in the address as Flats. Where possible, these inconsistencies were worked out, but we are aware that in many cases we had to take the dwelling data on trust. This also applies to the recommendations, where for a number of dwellings the assessor has decided that a very large number of improvements are possible (up to 14), while for some not very dissimilar dwellings, the only recommendation given is to upgrade lighting to low energy bulbs. However, most cases fall between these extremes.

The study takes the view that these recommendations should be the starting point for any further work, and identifying potential focus areas. Before any actual work could commence, further site surveys would be required.

9.4.6 The Domestic Carbon Solutions Database

The Domestic Carbon Solutions Database presents the LLPG entries matched against selected building level data from the NROSH and EPC databases, and the outputs of the CHM modelling, including the carbon offset potential and the associated range of costs.

The database includes:

- 131,913 LLPG entries, broadly representing the domestic dwellings in LBTH;
- 44,290 NROSH entries, representing the social housing stock in LBTH;
- 12,964 EPC entries matched against the LLPG and NROSH entries;
- and finally 8,313 entries where all three datasets had a good match, and there was sufficient data for energy modelling.

This data is now available for 8,313 social housing properties

The building level data provides an overview of the building fabric and services in each dwelling, which are used as the basis for the energy modelling work, and outlines the different improvements that were recommended for each dwelling as potentially viable. The modelling outputs include the following:

- Current modelled energy consumption (kWh/year);
- Current modelled CO_2 emissions (tCO_2/year);
- Modelled energy bill reduction per year (£/year);
- Total potential CO_2 saving (tCO_2/year) including the 'in-use' factors;
- % CO_2 saving;
- Cost per tCO_2 over the average lifetime of the improvements (£/tCO_2) (low, high and midpoint costs are given).

The main benefit of this database is to provide the information above on a dwelling by dwelling basis in order to identify the properties most in need of an energy efficient retrofit.

It can also be used to analyse trends and averages, e.g:

- **The mean saving per dwelling is 0.32 tCO_2 per year, with a mean percentage saving of 13%.**
- **The total potential for improvement across all of the buildings in the study sample (i.e. 8,313) was 2,690 tCO_2 per year.**
- **Extrapolated over all the dwellings in the NROSH database, which approximately represents the social housing stock in LBTH, this could lead to a saving of around 14,330 tCO_2 per year.**

Below is a selection of data visualisation figures which have been derived from the database:

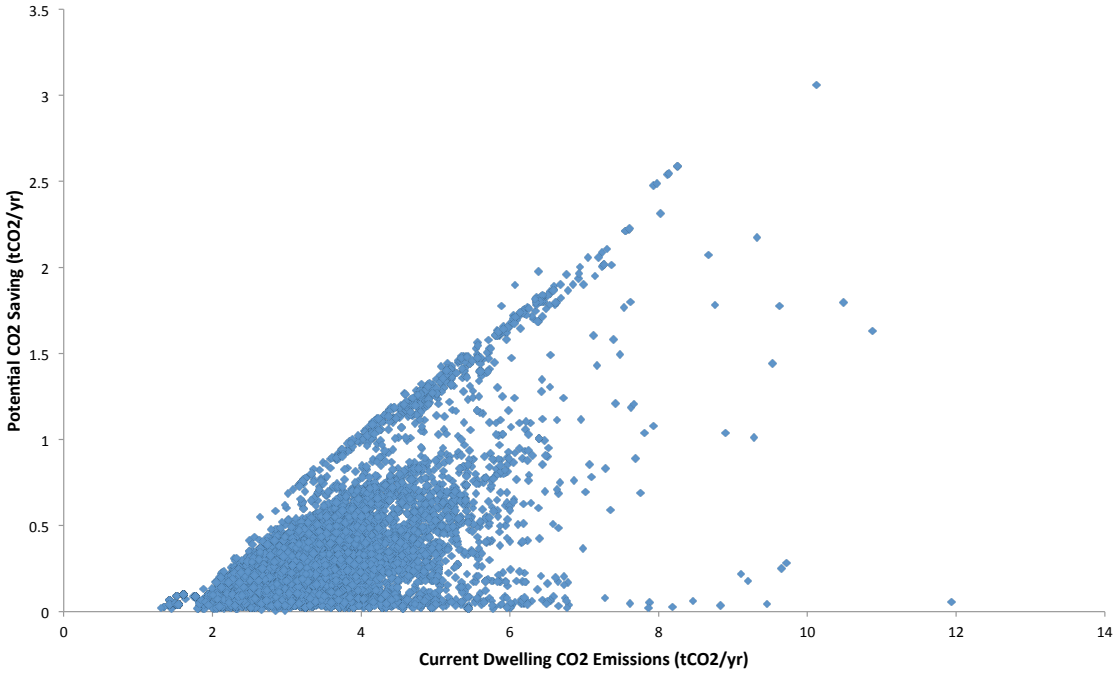


Figure 33: Dwelling CO_2 emissions vs CO_2 saving potential

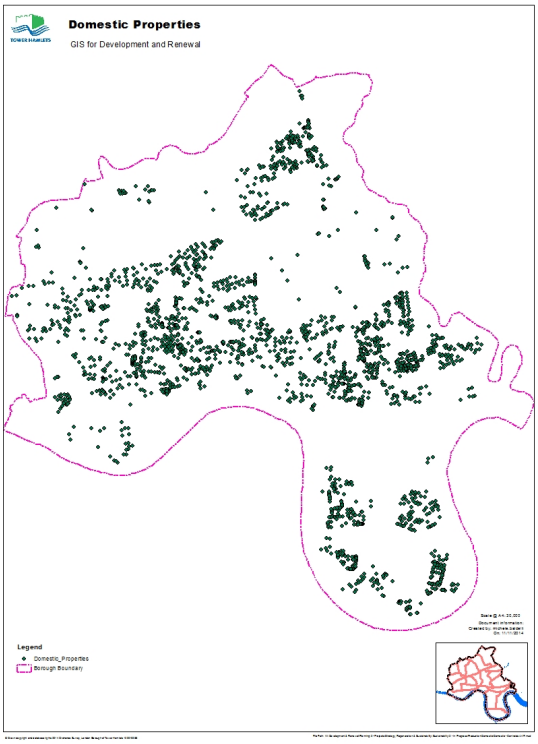


Figure 34: Social Housing – Location of the 8,000+ domestic properties in the database

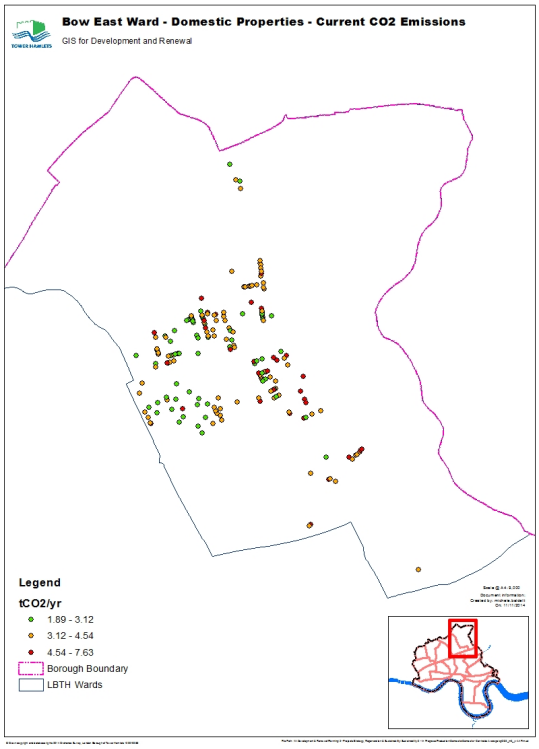


Figure 35: Social Housing – Current CO_2 emissions of domestic properties in the database located in each LBTH Ward (example for Bow East Ward)

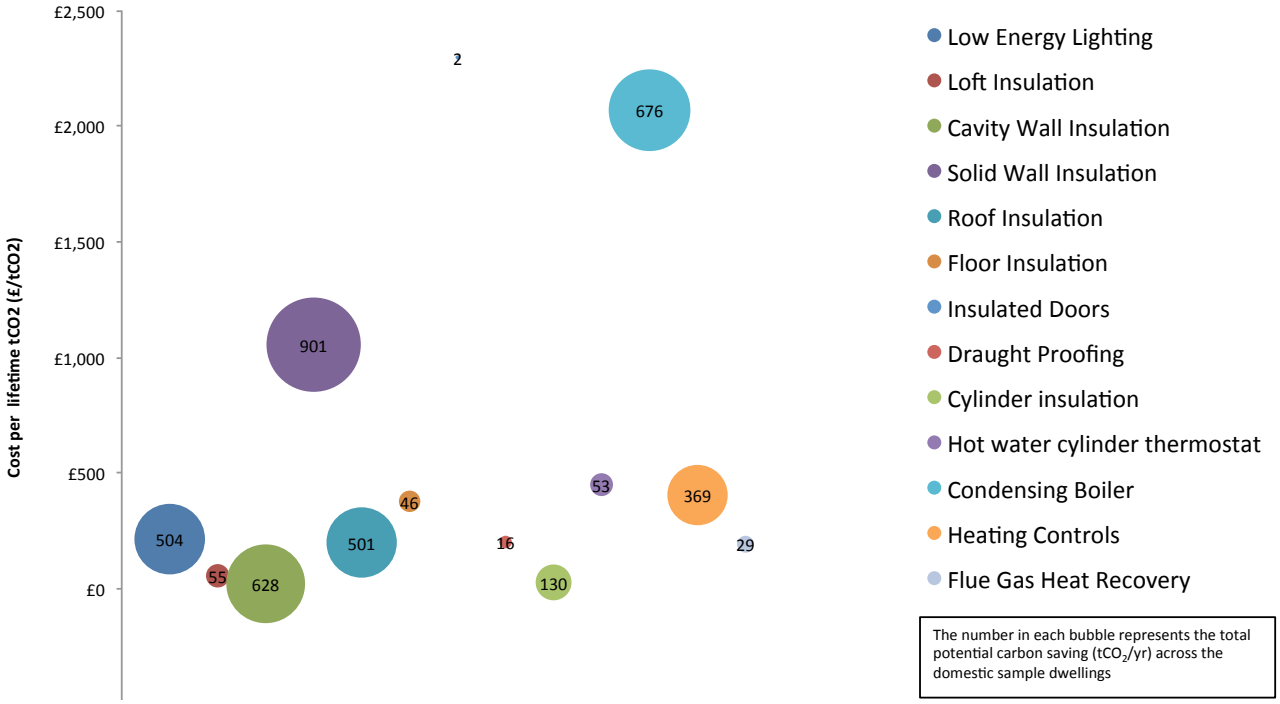


Figure 36: Cost efficiency and potential total CO_2 savings per measure

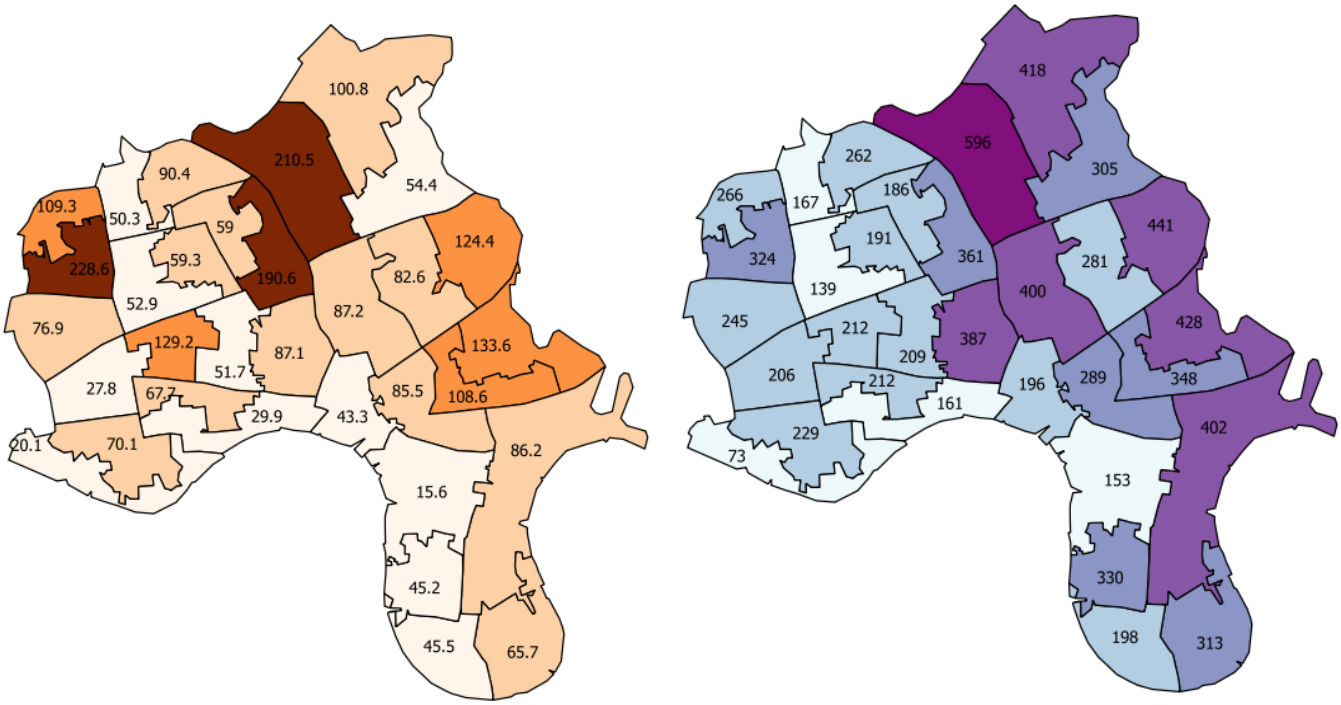


Figure 37: CO_2 saving potential (left) and sample of properties per area (right)

9.5 Non-Domestic Buildings

This section covers the data gathered for the non-domestic building stock in Tower Hamlets. The structure is similar to that in the domestic building section (9.4). Firstly, the different raw data sets are introduced, split between data that was used, data that was gathered but discarded and data that was not gathered. The Non-Domestic LLPG Matched database is summarised, along with the energy benchmarking process which led to the **Non-Domestic Carbon Solutions database**.

The non-domestic building stock in Tower Hamlets is very mixed in form and function. Table 16 below outlines the floorspace in the borough, split by bulk class and age. This shows that the majority of commercial floorspace is office space built post 1980, for example in the Canary Wharf area. Aside from this newer office space, most of the floorspace across the classes is pre-1940, and likely to have a good potential for retrofits.

Bulk Class	Unknown Age	Pre 1940	1940-70	1971-80	1981-90	1991-2000	2001-03	All ages
Retail	*	258	52	11	40	56	*	453
Office	*	214	59	93	584	736	*	2,152
Factory	*	268	128	20	50	43	*	532
Warehouse	*	272	189	48	92	107	*	738
Total	112	1,013	428	172	765	942	444	3,876

Table 16: Non domestic floorspace (000s m^2) in Tower Hamlets (bulk classes) (Source: CLG)

9.5.1 Raw Data: Gathered

Compared with the domestic building stock detailed in the previous section, non-domestic buildings present a different issue in terms of data collection. While there is greater availability of disaggregated (building-level) actual energy consumption data, especially for public buildings through schemes such as the Display Energy Certificates, there is also far greater variation in building type, form, internal systems and energy use.

Furthermore, as the non-domestic stakeholders are more diverse (private individuals, companies, etc.), specific data available across the different building types can vary significantly. Consequently, data collected for non-domestic buildings can come from a far greater number of sources, and many of the pieces of information cover only specific building types. For these reasons, the information gathered for the non-domestic buildings in Tower Hamlets is far more reduced compared with the domestic sector.

The table below outlines the key data sources that have been gathered for the Tower Hamlets non-domestic building stock.

Data	Source	Date	Resolution	Quality	Key Information
Display Energy Certificates	DECC (but sold by Landmark)	Updated annually*	Building-scale	★★★	*[Public buildings only]* Annual fossil-fuel use; annual electricity use; building size; HVAC type; heating fuel; improvement recommendations; LZC information
CRC Report	LBTH	Updated annually	Building-scale	★★★	*[Public buildings only]* Address; annual gas consumption; annual electricity consumption

Hospital Estates and Facilities Statistics	Department of Health	Updated annually	At the NHS site scale	★★	*[NHS trust buildings only]* Annual energy use breakdown; floor area & volume; building age; simple costs for improvements; LZC information
London Heat Map Study	Ramboll	Gathered in 2010/2011	Building-scale	up to ★★	Address; construction year; floor area
Inspection Reports	Ofsted	Regularly updated	Building-scale	★★★	*[Schools only]* Address; no. pupils; school type
Spogo & Active Places**	Spogo	Updated regularly	Building-scale	★★★	*[Sports facilities only]* Address; building type; facilities information; opening hours
National Heritage List	English Heritage	Updated regularly	Building-scale	★★★	*[Listed buildings only]* Address; building type; listing category

Table 17: Summary of databases used for non-domestic properties
** The accompanying 'Advisory Reports', which present additional information including simple building improvement suggestions based on the DEC tool and the surveyors' knowledge do not need to be updated annually but every seven years.*
*** The level of information held here varies with the type of facility. For example, for swimming pools, information on the dimensions of the pool itself is available*

Display Energy Certificates (DEC)

Display Energy Certificates have been mandatory in England & Wales for public buildings with a total useful floor area of 1,000 m^2 or more since 2008. The floor area threshold was reduced to 500m^2 in 2012.

DECs are a very important data source in understanding the energy performance of non-domestic buildings, as they contain actual metered energy use in buildings. This contrasts with Energy Performance Certificates (discussed previously for domestic properties) which estimate energy performance through modelling. Furthermore, the associated Advisory Reports (ARs) highlight recommended improvement suggestions for the building.

Data included in the DECs includes the annual electricity and fossil fuel energy use figures as well as information on a number of physical characteristics and systems, including total floor area, ventilation system, building services, Low or Zero Carbon technologies. Data from the ARs includes the building type (based on the categories defined in CIBSE TM46) and the improvement recommendations, including surveyor-selected likely carbon impacts and costs.

For a short period (from 2009 to 2011) it was possible to obtain the full database for free from DECC through a Freedom of Information request. However, this has now changed: individual DECs can be downloaded individually for free from DECC through an online registry run by Landmark but the data from the full set must be purchased. The data used for this study was extracted from a dataset made from information from four sources:

- A number of DECs provided by Tower Hamlets;
- DEC data published by the Centre for Sustainable Energy ;
- A Freedom of Information request from 2011;
- A small number of individual DECs downloaded from the Landmark website.

When necessary, data processing was required to identify the buildings in Tower Hamlets, which was carried out using the building postcodes. Data was then processed to remove issues such as default energy data and unlikely entries (e.g. zero energy use).

Following data processing and matching, a DEC data set has been created for Tower Hamlets. For some buildings, multiple years' energy data has been found, and where this is the case, each year's data has been included separately in the data files, so longitudinal studies can be carried out. Within Tower Hamlets **86 public non-domestic building LLPG entries** have been matched to DEC data with a quality rating of ★★ or ★★★. This includes between 1 and 4 years' energy data. In terms of total building numbers, the schools and higher/further education buildings make up the largest proportion of the data.

Note 1: For a small number of buildings with entries for multiple years, large variations in floor area can be observed across the DECs. This may be due to human error or may actually reflect refurbishment/extension of the building over time. As this cannot be checked within the framework of this project, for any buildings with conflicting floor area data of this nature only the most recent years' data has been included.

Note 2: For the initial years and in order to simplify sub-metering requirements, large properties (e.g. universities or hospitals) were allowed to create a single DEC to cover the entire site. Following this, individual buildings had to have separate certificates. Matching between some (early) site-wide DECs against (later) single-building DECs has been difficult. Where this is possibly an issue, the 'quality of data' rating has been set to ★★, and a note has been added to the data.

Note 3: It is important to note that, while we included a large number of DECs, this does not include every one available for Tower Hamlets. Furthermore, while DECs should be produced annually for public buildings over 500 m^2 (and 1,000 m^2 before), this has not necessarily been the case.

LBTH Carbon Reduction Commitment (CRC) Report

The London Borough of Tower Hamlets collects energy consumption figures for the buildings in the borough as a means of reporting the annual greenhouse gas emissions. This data has been received from Tower Hamlets for the years 2011-2012 and 2012-2013.

Annual gas and electricity consumption figures are presented alongside corresponding CO_2 emissions. These figures are disaggregated for the borough's non-domestic public buildings including schools, public offices, and libraries. The data is collected regularly and includes full address information. However, it should be noted that a few key variables are not included in the data, most significantly the building type and the floor area.

Identifying building type has been carried out by comparing the data to other data sources, using name matching (i.e. searching for key words such as 'nursery', or 'library'), and checking online. However, floor area could not be added. Following the data processing and matching, approximately 300 CRC entries were matched to **141 buildings**.

Hospitals Estates and Facilities Statistics

Each year the Department of Health publishes data on the energy performance of its estate. At the time of writing, the most recent data release is for 2013. The data set includes annual energy consumption information split by fuel type, including some information on renewable consumption. Additionally, it includes data on the physical structure of the built environment: floor area, heated volume, age profile, as well as estimated costs for improving the buildings (given as 'cost to eradicate risk backlog'). These elements of data are useful for estimating energy consumption, or the potential impact of improvement measures.

The energy data is based on meter readings from the individual trusts, and appears to be of high quality. However, this information is presented at a site level, which may include multiple buildings. Consequently, identifying the improvement potential for individual buildings -or parts of individual buildings- may be difficult.

The data is provided for the entire NHS trust, so significant processing is required to extract just those sites which relate to Tower Hamlets. This is not straightforward as the postcode data is excluded, so individual sites need to be identified from their primary care trust and checked individually. Following the data processing, **3 NHS properties** have been identified for Tower Hamlets: the Royal London Hospital, the London Chest Hospital, and the Tower Hamlets Centre for Mental Health. Due to the difficulty in assigning the larger hospital sites to specific buildings in the LLPG, this has not been carried out at this stage.

London Heat Map

The data collected for the London Heat Map study has been explained previously (please refer to section 9.4 on domestic buildings data). The non-domestic data set includes similar information. For a number of non-domestic buildings in the Heat Map database, non-benchmark energy figures are presented. In these instances, the data has originally been taken from a historic Tower Hamlets NI 185 release. Collection of energy use for buildings in the borough is now reported through the CRC reporting (see above) so the energy information from the London Heat Map has not been used for this study. However, it includes some key information missing from the CRC reporting such as building type and floor area, so these physical variables have been extracted.

Therefore, unlike the other data sources, matches were only included where the Heat Map data was necessary and useful (e.g. for buildings where energy data was already available, but floor area was missing). Following the data processing, **23 non-domestic properties** have been matched between the LLPG and Heat Map databases.

Inspection Reports

Although energy use data for schools is available through the DECs and the Tower Hamlets CRC reports, two key pieces of information that correlate to school energy consumption are not available; these are the number of pupils, and the school type (e.g. nursery, primary or secondary school). The number of pupils impacts on energy consumption in the same way as occupancy density in an office. Data for both of these variables are collected on the Ofsted database, as part of the Inspection Reports. This information has been gathered for the schools in the London Borough of Tower Hamlets and connected to the DEC and CRC energy data using the school name, and address information.

Spogo & Active Places

The Spogo and Active Places databases provide information on sports facilities in England. The data does not include any energy consumption figures. However, it does include building-scale information on key characteristics such as opening hours and physical structure. The specific information available varies with the type of facility. For example, for swimming pools, information is provided on the size of each of the pools in the building, as well as the age of construction of the changing rooms (including any major refurbishments). This information has been downloaded and processed with some difficulty and the Tower Hamlets sports facilities have been extracted using postcode data.

Listed buildings

If a building has a listed status, this will affect the potential retrofit options, either by restricting the measures that can be applied or the installation costs. For instance, a listed building may not be able to have original, single-glazed windows replaced with double-glazed or triple-glazed windows. The National Heritage List for England is searchable from the English Heritage website but it must be examined on a building-by-building basis and it was therefore not feasible to search for all of the non-domestic properties in the LLPG database. However, all those with sufficient energy data for inclusion in the final Non-Domestic Carbon Solutions Database were checked.

It should be noted that the National Heritage List for England is downloadable as a whole in GIS format from the English Heritage website, so LBTH may wish to add this to the central GIS structural database.

9.5.2 Raw Data: Gathered But Not Used

Other data sets were gathered for the non-domestic stock, but were excluded from the final non-domestic building database. These are described below.

Benchmarking Reports

Numerous reports providing benchmark energy data for UK non-domestic buildings have been published. Although data will vary from report to report, these often present 'typical' (i.e. mean or median) as well as 'good practice' (usually first quartile) energy use levels and breakdowns extracted from surveys of a sample of buildings.

These reports can be split up into the following categories:

- **Energy Consumption Guides:** These reports have been published over a number of years. Each typically focuses on a single building type. The guides that may be of particular interest for this study include Econ 19 (offices), Econ 54 (higher education buildings), Econ 83 (court buildings), and Econ 78 (sports buildings). These reports may also be useful in identifying the different sub-categories of building types that will correlate with variations in energy use (e.g. Econ 19 presents 4 typical office types, which have different physical characteristics, as well as energy profiles) and to estimate improvement options/potential.
- **Energy Use in Local Authority Buildings:** This report by the Carbon Trust was published in 2004 and presents typical energy benchmarks for a number of building types including town halls, libraries and care homes.
- **CIBSE TM46:** This Technical Memorandum introduced the original energy benchmarks for the Display Energy Certificates based on survey work and documents including CIBSE Guide F on Energy Efficiency in Buildings. This, alongside the analysis reports (such as CIBSE's review of the benchmarks from 2011) is a very useful source of benchmarks.
- **Wider Public Sector Emissions Reduction Potential:** This report by Camco from 2011 includes benchmark data for energy performance for a number of typical public building types.

In addition to the documents listed above, numerous academic studies are available, which examine energy performance in buildings and the factors which can influence carbon reductions.

The benchmarking work used to assess the potential for improvements in the Tower Hamlets non-domestic building stock has been made using the data produced for the Non-Domestic Green Deal, carried out by DECC in 2011 (outlined in Section 8) and CIBSE TM46.

Sub National Consumption Statistics

As with the domestic sub national consumption statistics discussed in the previous section, DECC publishes annual energy use data for non-domestic buildings in England and Wales. The broad details are the same as for the domestic data but there are two key differences:

- **Resolution:** Non-domestic data is presented at the Middle Super Output Area (MSOA) level, which represents a greater level of aggregation than the domestic data. For Tower Hamlets, on average, an MSOA will cover 430 non-domestic electric meters.
- **Meters:** Unlike domestic data, non-domestic electricity consumption data is not split between 'economy 7' and 'standard' electricity meters.

Family Services Directory and NHS Choices

One of the difficulties of the data processing and analysis was to estimate how much of the total building stock had been covered. Two sources of information have been found which are helpful in understanding this:

- **NHS Choices:** this website, run by the NHS, provides information on healthcare facilities in England. Information on the type of healthcare provided at each site, along with addresses are included. This data has been downloaded for Tower Hamlets.
- **Family Services:** this website, run by LBTH, includes a directory of useful facilities for residents in the borough. As with the NHS Choices data, this includes address and 'type' information only. This data has been collected for key building types within the borough, including schools and colleges, leisure centres and cultural venues.

It should be noted that, as neither of these sources includes any information that would enable energy modelling to take place, this information is only likely to be useful in identifying 'gaps' in the database.

9.5.3 Raw Data: Not Gathered

A number of data sources have been identified, which could not be gathered due to cost or time considerations. These are summarised in the table below and discussed in the following sub-sections. Those that overlap significantly with the domestic equivalent data are only briefly summarised.

Data	Source	Time	Resolution	Cost	Key Information
Geo-Information Group Data	GIG	Regularly updated, frequency tbc	Building scale	£10,000 + VAT annual license	Building footprint; height; type; building age; structure information
Online Maps	Google Maps/ Streetview and Bing Maps	Variable	Building scale	Free but time consuming	No. storeys; glazing proportions
EPCs	DCLG (but sold by Landmark)	New buildings regularly added	Building scale	1-10p per bldg depending on data	Address; energy use comparison with similar buildings; floor area; HVAC type
Ratings List*	VOA	Regularly updated	Building scale	£410 + VAT annual license	Address; floor area; some internal floor area breakdown information

Table 18: Summary of unused databases (non-domestic properties)
** The VOA data uses 'hereditaments' rather than 'buildings' as the scale. Essentially, 'hereditaments' are separate taxable properties. Therefore, in some instances, several individual buildings owned by a single entity can be considered as a single hereditament and vice versa.*

Geo-Information Group

The Geo-Information Group sells GIS data for the non-domestic building stock in the UK, as well as the domestic stock. The data is currently still being gathered and includes (alongside the footprint and height information) building type, age of construction and some information on wall and roof types. This information uses a similar coding approach to the residential 'building type' outlined in the previous domestic section.

Google Maps / Streetview / Bing Maps

Please refer to section 9.4 on domestic buildings information.

EPCs

Non-domestic EPCs are similar to domestic EPCs - most significantly in the fact that, while they present building-level information, metered energy consumption is not included and only modelled energy consumption is provided. However, there are a number of differences in the specific type of data that is available. Broadly, non-domestic EPCs include less detailed data. The key building information available from non-domestic EPCs is as follows:

- Building address;
- Energy efficiency rating;
- Total floor area;
- HVAC type;
- Heating fuel;
- Presence of any LZC technologies.

Ratings List

The Valuation Office Agency's Ratings List is used for business taxation. It includes information on all of the non-domestic properties in the UK, with some exceptions (e.g. churches and agriculture buildings). The information available varies considerably with building type. However this can include - for offices - address data, and a breakdown of internal floor area, by storey and space usage.

Although there are some complications in using this data (most significantly the difference between 'hereditaments' and 'buildings' explained previously) the dataset covers floor area and location information for around 80% of the national non-domestic stock, and is the basis for much analysis of the UK non-domestic building stock. Furthermore, it covers both public and private buildings.

9.5.4 Non-Domestic LLPG Matched Data

The final non-domestic LLPG Matched Data file consists of the LLPG properties with information from the matched sources listed above. Although information from each of the sources was included, the DECs and CRC data were considered key as these include the monitored energy use figures required for this study. In order to keep the matched data file to a manageable size the non-domestic LLPG Matched Data file does not include all of the raw data from every source. Instead, all of the key information has been included, and additionally, the reference numbers for each of the matched sources are included for each property so the original sources can be examined if necessary.

While the LLPG Matched Data file includes the matching data for all properties where possible, not all of these could be included in the subsequent energy benchmarking work. The approach taken for selecting the buildings to be benchmarked is outlined below:

1) *Does the property include an energy breakdown (kWh for both fossil fuel and electricity) and floor area for at least one year?* This could come either directly from a DEC (which includes both), or from the CRC information in conjunction with floor area data from another source (typically the Heat Map dataset).
2) *Is it actual energy data?* Where energy was estimated rather than metered (e.g. for a few CRC entries), these were excluded.
3) *Is the property building type known?* This was available through a number of the datasets, as described previously.
4) Where the building type was unavailable, an online search was carried out.

In total, the non-domestic database includes **126 non-domestic properties** from the LLPG matched database.

Representativity

The dataset is not representative of the borough's entire non-domestic building stock. Most notably, there are only a few private buildings. However the objective of the database was not to be a general stock model but to focus on public buildings.

Buildings which have not had a DEC and are not included in the CRC scheme

Any non-domestic building excluded from the DEC and CRC schemes (e.g. small buildings) has not been included in the Non-Domestic Building Carbon Offset Solutions database.

9.5.5 Non-Domestic Energy Benchmarking

The non-domestic benchmarking work has been carried out in two stages:

1. The energy use for each property was examined, using the other buildings in the borough, as well as available benchmarking data for comparison purposes.
2. Non-domestic Green Deal's rules of thumb were used to assess the likely impact of different improvement options for each of the buildings. These are explained in detail in the next two sub-sections.

In order to make the work transparent and easily adjustable (e.g. if the cost of a given retrofit measure should be revised or an incorrect energy benchmark figure amended), a macro has been created:

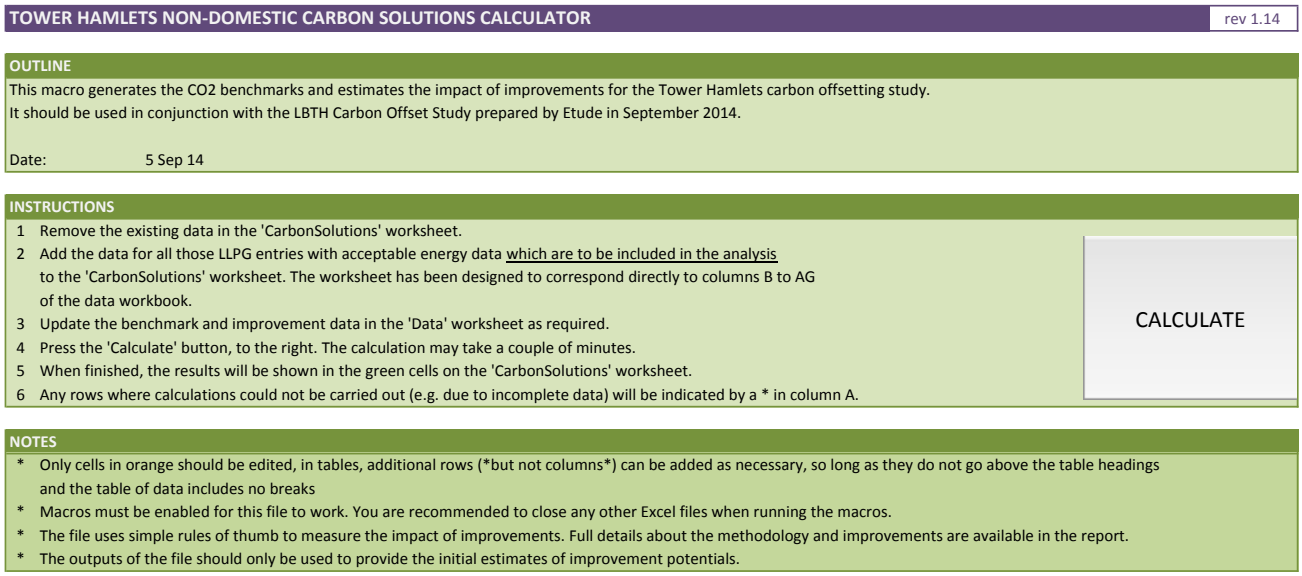


Figure 38: User interface developed for the 'Update' macro in the database

This is a very simple VBA-based spreadsheet which generates the benchmark figures and improvement impacts for the Tower Hamlets stock, based on the LLPG Matched data file. All of the figures used are editable.

Actual energy data was available for the non-domestic stock, energy modelling was not required to determine the performance of the buildings. Instead, the estimated performance of each building was examined using the approach outlined below:

1) Firstly, the carbon emissions associated with each building's energy consumption were calculated for the most recent year for which actual energy data was available.

2) Secondly, the carbon emissions per m^2 for each building were compared to the benchmark figures for that building type from CIBSE TM46, assuming electricity and natural gas as the fuels. For buildings with multiple specific uses the most likely indicative use was adopted (e.g. an office with a small restaurant would be compared to the office benchmark, instead of the restaurant benchmark).

Note on multiple year energy data: The most recent year for which energy data was available was used. It was decided not to average data available for multiple years as there may have been changes in use, internal area breakdown, refurbishment, etc. over time, which would make past years' data no longer representative.

Note on weather correction: Although this would be feasible using degree days, it would require to dissociate space heating from water heating and gas cooking. Although CIBSE TM46 could be used it was considered that the additional accuracy achieved through weather correction would be compensated by the inaccuracy associated with the methodology used.

Note on variables: Internal breakdown of uses, occupancy densities, hours of use and other variables all have an impact on the energy performance of a building. For instance, an office open 24/7 should not have the same target energy benchmarks compared as an office open 10 hours per day. Unfortunately there is no publically available information on these variables and these should be determined during the specific site survey carried out after the project identification phase.

The DEC methodology does consider the points discussed above. However, it would have limited this consideration only to those buildings with a matched DEC, i.e. buildings for which energy data has come from any other source (e.g. the CRC database or, in the future, self-reported energy data potentially) would have to be excluded.

9.5.6 Assessing improvements for non-domestic buildings

Unlike for the domestic buildings, there is not enough information available for the non-domestic buildings to carry out acceptably accurate building-scale energy modelling. A simpler approach had to be adopted.

The energy impact and costs of different improvement measures has recently been explored for different typical buildings by DECC for the Non-Domestic Green Deal. The study used energy modelling to estimate the change in electricity and fossil energy use for a number of refurbishment measures, along with the associated costs. The data has been introduced in Section 8. The appropriate measures, typical installation and capital costs (converted into £ per m^2 to account for variations in building size) and typical impacts (converted into % change in electricity or fossil-fuel use) were extracted from the table, and assigned to the LLPG matched database of non-domestic buildings in Tower Hamlets.

The table below is adapted from Section 8.0 and summarises the improvement assumptions used for each building type. The table includes the assumed typical installation and capital costs (£/m^2), along with the impact on annual electricity use (Elec) and fossil-fuel use (FTh) in terms of percentage.

A number of assumptions have been made in adjusting the results of the DECC Non-Domestic Green Deal modelling to this carbon offsetting study. For instance it has been assumed that the external insulation measures are not appropriate for 'listed' buildings. However, as with the non-domestic benchmarking discussed previously, the work has been built into a fully editable macro, so that users can adjust cost, applicability, energy variables and re-run the numbers.

Building Type	Number of Buildings	Heating Upgrade	Heating Controls	Chiller Upgrade	BMS	Lighting Upgrade	Lighting Upgrade + Controls	Wall Insulation	Roof Insulation	Double Glazing
Small office (not listed)	2	£9/m^2; Elec 0%, FTh 21%	£3/m^2; Elec 0%, FTh 14%	-	-	£2/m^2; Elec 17%, FTh 0%	£17/m^2; Elec 28%, FTh 0%	-	£7/m^2; Elec 0%, FTh 10%	£30/m^2; Elec 0%, FTh 21%
Medium office (not listed)	5	£7/m^2; Elec 0%, FTh 21%	-	-	£9/m^2; Elec 5%, FTh 10%	£5/m^2; Elec 13%, FTh 0%	£56/m^2; Elec 22%, FTh 0%	-	£6/m^2; Elec 0%, FTh 4%	-
Medium office (listed)	1	£7/m^2; Elec 0%, FTh 21%	-	-	£9/m^2; Elec 5%, FTh 10%	£5/m^2; Elec 13%, FTh 0%	£56/m^2; Elec 22%, FTh 0%	-	-	-
Large office (air con, not listed)	5	-	-	£8/m^2; Elec 2%, FTh 0%	-	-	£63/m^2; Elec 13%, FTh 0%	-	-	-
Large office (no AC, not listed)	2	-	-	-	-	-	£63/m^2; Elec 13%, FTh 0%	-	-	-
Large office (no AC, listed)	1	-	-	-	-	-	£63/m^2; Elec 13%, FTh 0%	-	-	-
Schools (not listed)	56	£3/m^2; Elec 0%, FTh 15%	-	-	£2/m^2; Elec 5%, FTh 9%	£1/m^2; Elec 13%, FTh 0%	£7/m^2; Elec 22%, FTh 0%	-	£7/m^2; Elec 0%, FTh 14%	-
Schools (listed)	5	£3/m^2; Elec 0%, FTh 15%	-	-	£2/m^2; Elec 5%, FTh 9%	£1/m^2; Elec 13%, FTh 0%	£7/m^2; Elec 22%, FTh 0%	-	-	-
Clinic (not listed)	6	£8/m^2; Elec 0%, FTh 21%	£4/m^2; Elec 0%, FTh 24%	-	£4/m^2; Elec 5%, FTh 10%	£2/m^2; Elec 17%, FTh 0%	£22/m^2; Elec 28%, FTh 0%	-	£8/m^2; Elec 0%, FTh 27%	-
Clinic (listed)	1	£8/m^2; Elec 0%, FTh 21%	£4/m^2; Elec 0%, FTh 24%	-	£4/m^2; Elec 5%, FTh 10%	£2/m^2; Elec 17%, FTh 0%	£22/m^2; Elec 28%, FTh 0%	-	-	-
Hospitals (no AC, listed)	1	-	-	-	-	£1/m^2; Elec 10%, FTh 0%	£5/m^2; Elec 18%, FTh 0%	-	-	-
Hospitals (no AC, not listed)	2	-	-	-	-	£1/m^2; Elec 10%, FTh 0%	£5/m^2; Elec 18%, FTh 0%	-	£7/m^2; Elec 0%, FTh 3%	-
Sports Centres	6	£7/m^2; Elec 0%, FTh 21%	-	-	£10/m^2; Elec 10%, FTh 10%	-	-	-	-	-
Workshops (not listed)	4	-	-	-	£5/m^2; Elec 10%, FTh 10%	-	£2/m^2; Elec 19%, FTh 0%	£91/m^2; Elec 0%, FTh 35%	£30/m^2; Elec 0%, FTh 33%	-
Universities/FE Colleges (not listed)	5	£3/m^2; Elec 0%, FTh 15%	-	-	£2/m^2; Elec 5%, FTh 9%	£1/m^2; Elec 13%, FTh 0%	£7/m^2; Elec 22%, FTh 0%	-	£7/m^2; Elec 0%, FTh 14%	-
Universities/FE Colleges (listed)	1	£3/m^2; Elec 0%, FTh 15%	-	-	£2.3/m^2; Elec 5%, FTh 9%	£1/m^2; Elec 13%, FTh 0%	£7/m^2; Elec 22%, FTh 0%	-	-	-
Shops & Services (not listed)	3	£4/m^2; Elec 0%, FTh 21%	£8/m^2; Elec 0%, FTh 10%	-	-	£4/m^2; Elec 9%, FTh 0%	£39/m^2; Elec 15%, FTh 0%	-	£3/m^2; Elec 0%, FTh 3%	£24/m^2; Elec 0%, FTh 44%
Emergency Buildings (not listed)	9	-	-	-	£5/m^2; Elec 10%, FTh 10%	-	£1/m^2; Elec 19%, FTh 0%	£91/m^2; Elec 0%, FTh 35%	£30/m^2; Elec 0%, FTh 33%	-

Emergency Buildings (listed)	2	-	-	-	£5/m^2; Elec 10%, FTh 10%	-	£1/m^2; Elec 19%, FTh 0%	-	-	-
Cultural Activities (not listed)	4	£3/m^2; Elec 0%, FTh 15%	-	-	£2/m^2; Elec 5%, FTh 9%	£1/m^2; Elec 13%, FTh 0%	£7/m^2; Elec 22%, FTh 0%	-	£7/m^2; Elec 0%, FTh 14%	-
Cultural Activities (listed)	4	£3/m^2; Elec 0%, FTh 15%	-	-	£2/m^2; Elec 5%, FTh 9%	£1/m^2; Elec 13%, FTh 0%	£7/m^2; Elec 22%, FTh 0%	-	-	-
Entertainment Halls (not listed)	1	£3/m^2; Elec 0%, FTh 15%	-	-	£2/m^2; Elec 5%, FTh 9%	£1/m^2; Elec 13%, FTh 0%	£7/m^2; Elec 22%, FTh 0%	-	£7/m^2; Elec 0%, FTh 14%	-

Table 19: Modelled improvements in the database

For the improvement assessment, each LLPG entry was assigned to a building type. The costs and energy impacts of each improvement measure were assigned using the table above, and the 'new' carbon emissions were calculated to determine the change using the average improvement lifetimes from the DECC Green Deal project.

Note on Advisory Report recommendations

There are technical complexities associated with the option of using the DEC's Advisory Reports to inform the options available and estimate their impact. Therefore this was not undertaken. However, the Advisory Reports will be useful once the buildings have been identified, as part of the surveying work, to help with any refurbishment strategy. Therefore, in order for them to be easily used, the matched Advisory Report reference numbers are included in the Matched Data file, and the files are included in the 'raw data' folder.

9.5.7 Non-Domestic Carbon Solutions Database

The Non-Domestic Carbon Solutions Database presents the LLPG entries matched against selected building level data from the DEC and CRC databases and the outputs of the benchmarking calculations undertaken, including the carbon offset potential and the associated range of costs.

The database includes **125 non-domestic public buildings**.

The building level data provides a summary of the building's actual energy consumption data and outlines the impact of different improvements. The key outputs include the following:

- Current actual energy consumption (kWh/year);
- Current actual CO_2 emissions (tCO_2/year);
- Estimated cost of each measure (£/year);
- Estimated lifetime[6] CO_2 emission reduction per measure;
- Total potential CO_2 saving (tCO_2/year);
- % CO_2 saving.

The main benefit of this database is to provide the information above on a building by building basis. However, it can also be used to analyse trends and averages.

Preliminary analysis

[6] *using the average improvement lifetimes from the DECC Green Deal project.*

Below is a selection of data visualisation figures which have been derived from the database:

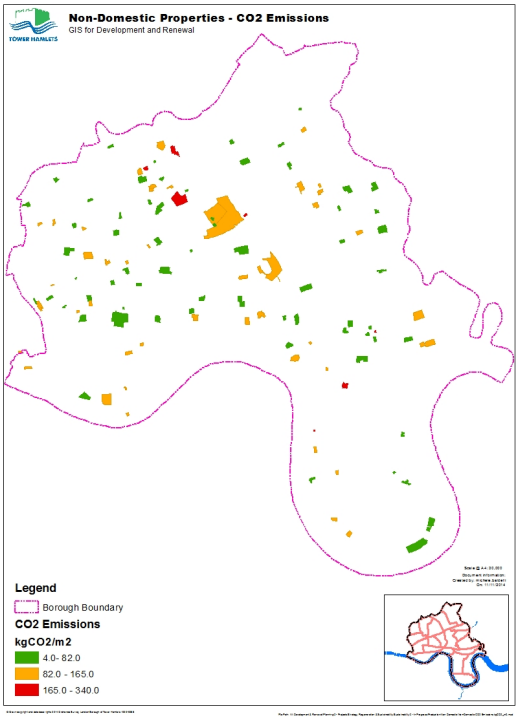


Figure 39: Non-domestic public buildings – Current CO_2 emissions ($kgCO_2/m^2/yr$)

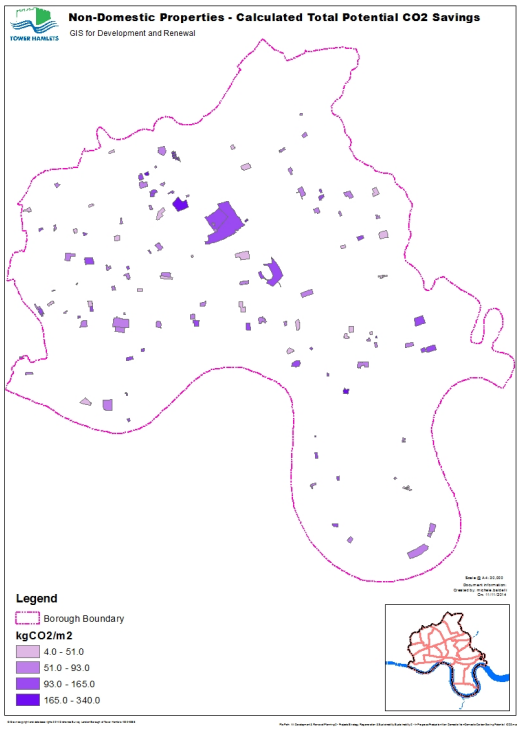


Figure 40: Non-domestic public buildings – Potential CO_2 savings ($kgCO_2/m^2/yr$)

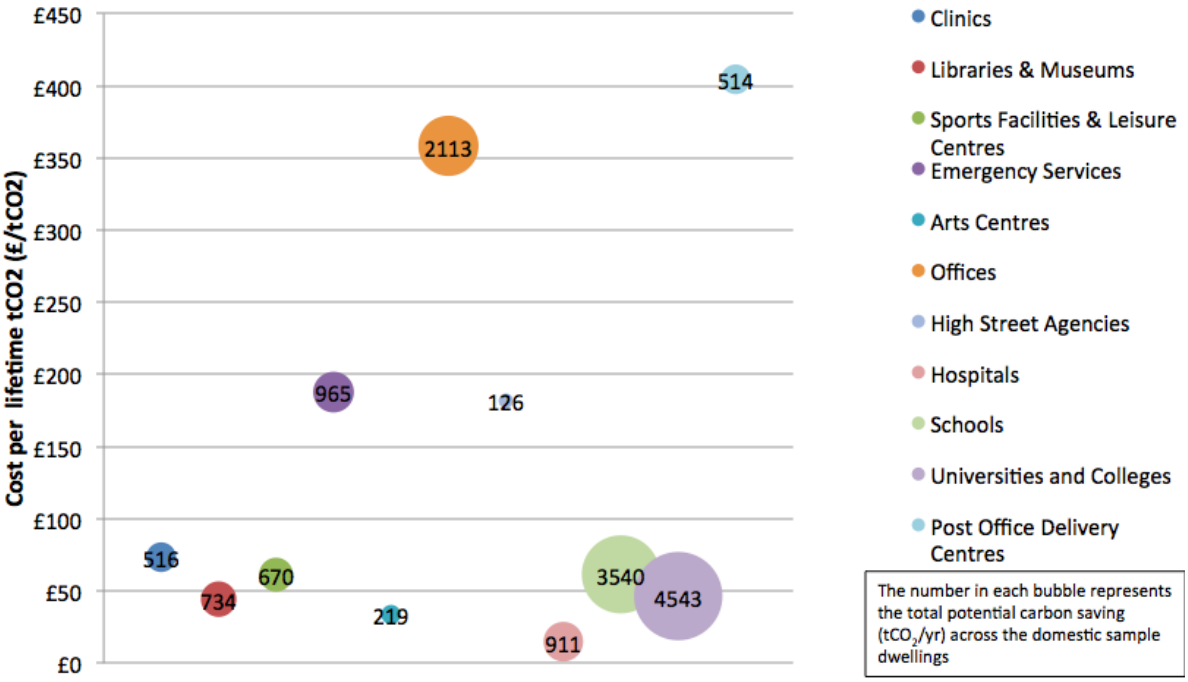


Figure 41: Cost efficiency and potential total CO_2 savings per building type

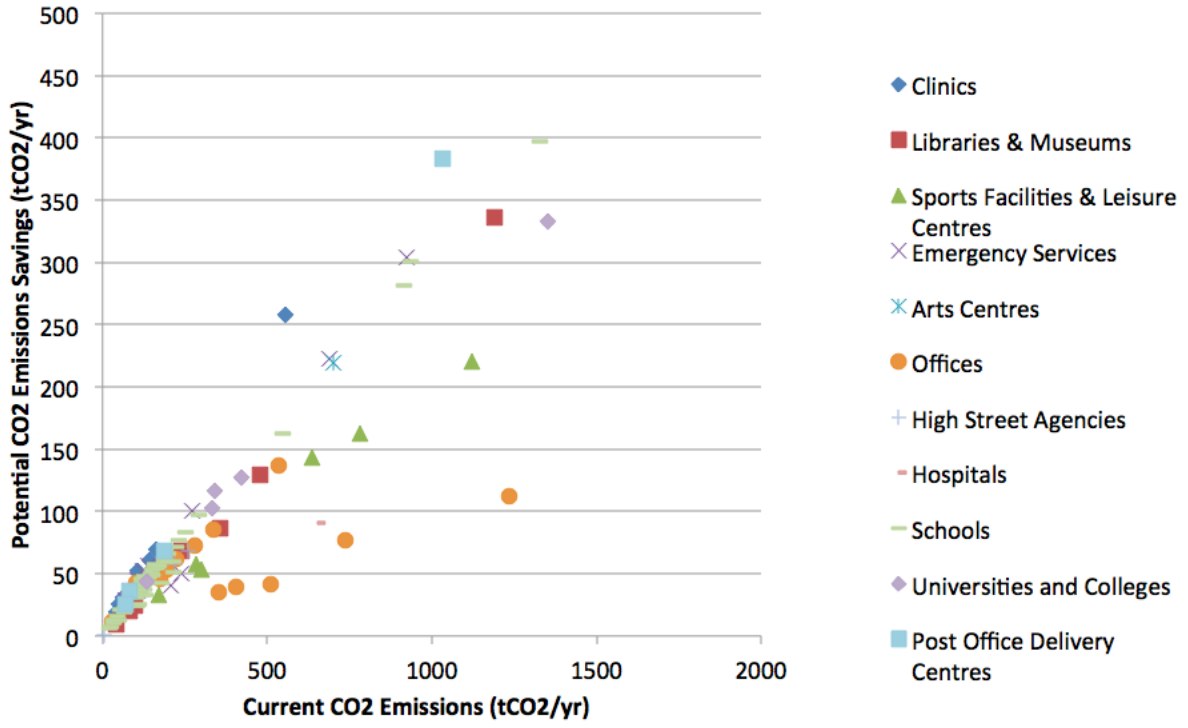


Figure 42: Current CO_2 emissions vs Potential CO_2 reduction for the public buildings

The key building types are discussed separately in turn below. However, the data file includes all of the building sub-types.

Schools

There are **61 schools** included in the Tower Hamlets Non-Domestic Carbon Solutions database. The average floor area is approximately 2,750m^2, although they vary between under 500m^2 to over 10,000m^2. The average carbon emissions for the stock is 70.5 kgCO_2/m^2, with a wide variation, the minimum being under half the mean, and the maximum over three times the mean. 62% of the schools have emissions higher than the benchmark figure by, on average, 40%.

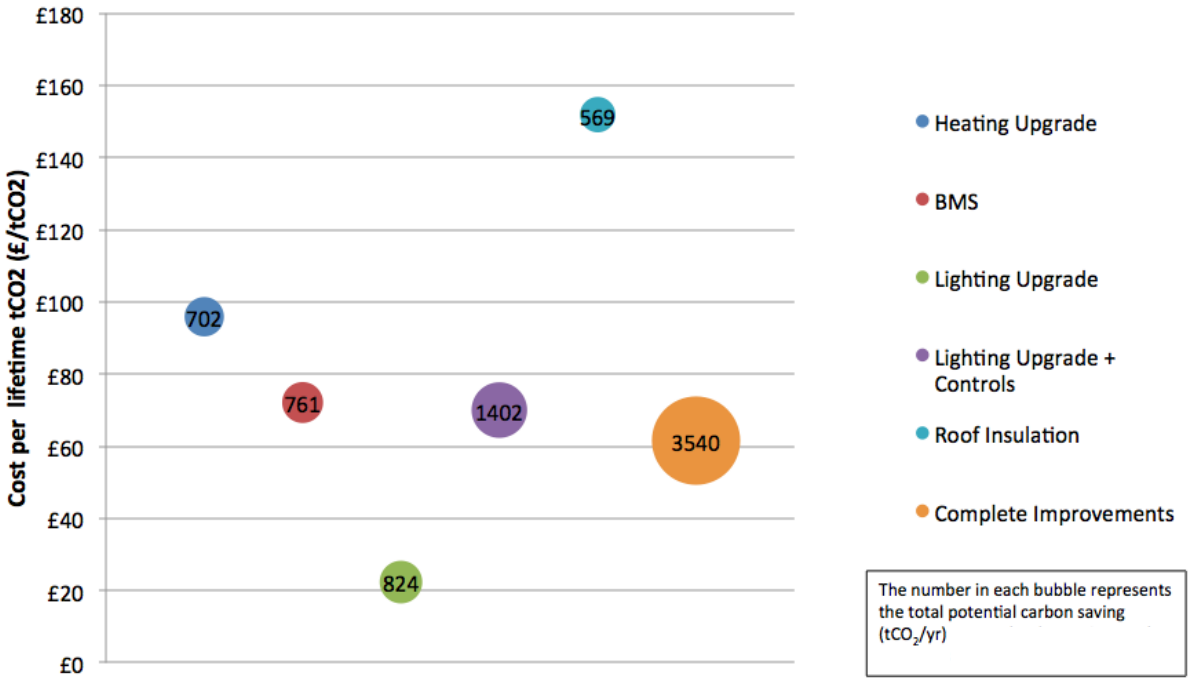


Figure 43: Cost efficiency and potential total CO_2 savings per measure for Schools

Sports Centres

There are **6 sports centres** included in the Tower Hamlets Non-Domestic Carbon Solutions database. Two-thirds of these buildings were found to have emissions higher than their benchmark.

Cultural Buildings

There are **8 cultural buildings** included in the Tower Hamlets Non-Domestic Carbon Solutions database: 6 libraries/Idea Centres and 2 museums. Of these, half have emissions greater than the benchmark figure, one of which was 2.5 times higher. The average emissions for this building type was approximately 97 kgCO_2/m^2.

Offices

There are **15 offices** included in the Tower Hamlets Non-Domestic Carbon Solutions database. Most of them are between 500m^2 and 15,000m^2, although there is one office which is over 30,000m^2. The average carbon emissions for the stock is approximately 108 kgCO_2/m^2, and for three-quarters of the buildings the actual emissions are higher than the benchmark figure by, on average, 60%.

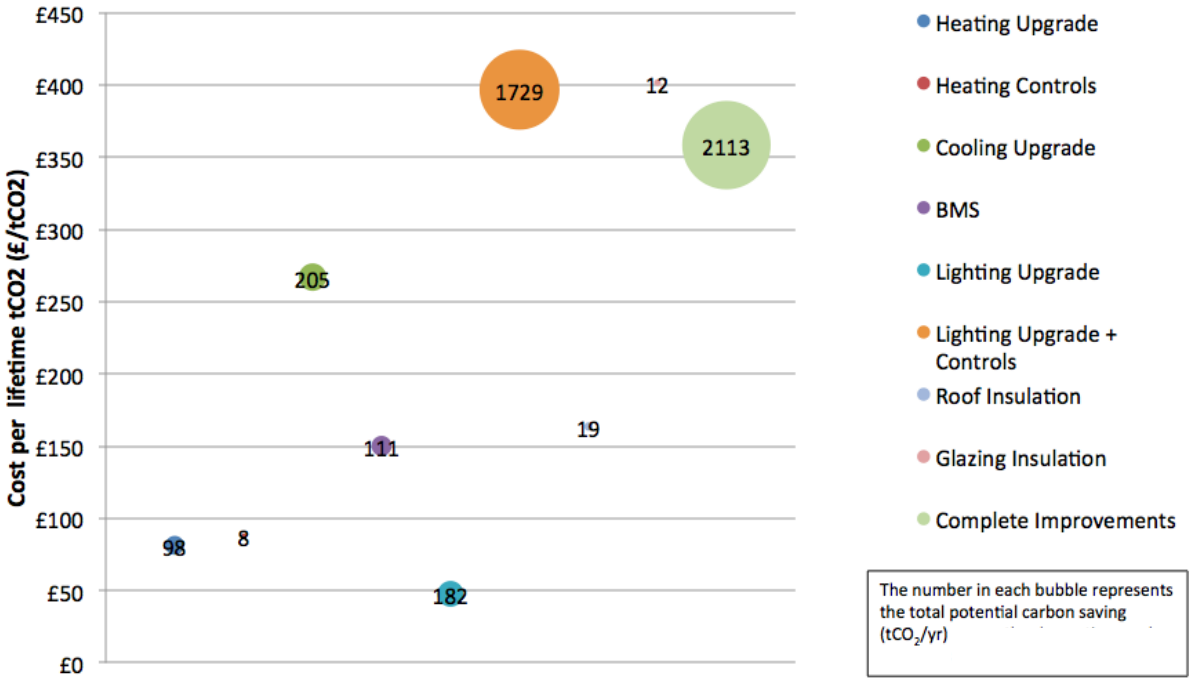


Figure 44: Cost efficiency and potential total CO_2 savings per measure for Offices

Emergency Services

There are **11 emergency services buildings** included in the Tower Hamlets Non-Domestic Carbon Solutions database, consisting of 6 fire stations and 5 police stations. Unlike schools and offices, relatively few of these buildings are below the benchmarks, with only 3 of the buildings (2 fire stations and 1 police station) having carbon emissions higher than the benchmark figures.

9.6 Conclusion

This section summarised all datasets considered and the process adopted to gather, analyse, match and process the data as well as the modelling / benchmarking work done on that basis. It is fundamental to understand these processes to understand the key conclusions which can be drawn from a review of the Domestic Buildings and Non-Domestic Buildings Carbon Offset Solutions Databases and the associated GIS tools. These three key deliverables are presented in the following section.

10.0

THE CARBON OFFSET FUND DATABASE AND THE GIS MAPPING TOOL

10.0 THE CARBON OFFSET SOLUTIONS DATABASES AND THE GIS MAPPING TOOL

As detailed in sections 8.0 and 9.0, the range and diversity of domestic and non-domestic energy efficient retrofits is much wider and complex than other carbon saving measures (e.g. renewable energy projects). This partially explains why investment in energy efficient retrofits tends to proceed on a *measure-by-measure* approach (e.g. cavity wall insulation, energy efficient lighting, etc.) or on an *ad hoc* basis (i.e. when a project comes forward).

As energy efficient retrofits could be the key beneficiaries from the LBTH Carbon Offset Fund, it could be very beneficial for LBTH to develop a strategic approach to energy efficient retrofits with a particular focus, at least during the first years, on social housing and non-domestic public buildings (e.g. schools, libraries, etc.).

Three tools have therefore been developed to inform this borough-wide strategy:

- a **GIS mapping tool** which can now display key energy and carbon data;
- the **Domestic Carbon Solutions Database**;
- the **Non-Domestic Carbon Solutions Database**.

The proposed project identification sequence would be as follows:

1. the GIS mapping tool is used to identify a selection of potentially suitable projects based on their type, carbon saving potential, associated indicative budget and proximity to a new development (option);
2. the Carbon Solutions Databases can then be used to support this initial analysis, refine it and provide additional information;
3. a shortlist of projects and a brief can be prepared to tender the provision of energy efficient retrofit services, including an initial survey to verify the validity of the information gathered during steps 1 and 2 and confirm the scope of works/proposals. The selection process would lead to a preferred contractor which would be contractually responsible for delivering the works and the anticipated carbon savings.

This section summarises the key features of the GIS mapping tool and the two databases.

10.1 The Carbon Reduction Opportunity Map

As mentioned previously, one of the key aims of the study is to enhance the GIS mapping tool so that it can help visualising energy performance of buildings in the borough and carbon saving opportunities through retrofits.

10.1.1 Existing Building Types

It is proposed that the GIS tool will geographically display and contain key data for the following building types:

- Social housing;
- Schools and colleges;
- Council owned buildings;
- Libraries;
- Public museums;
- Public sport centres;

- Fire stations;
- Police stations;

Only buildings for which energy/carbon data is available will have this information on the GIS mapping tool.

10.1.2 *Key Information to be provided within the GIS Carbon Reduction Opportunity Tool*

It is proposed that the information the GIS tool will be able to display for each property listed on the Domestic and Non-domestic Carbon Offset Solutions database will include:

- Geographical location;
- Property type (e.g. social housing, education) and sub-type (e.g. flat, library, etc.);
- Property size (sqm);
- Energy consumption;
- CO_2 emissions;
- Potential absolute CO_2 savings (tonne/year) and potential relative CO_2 savings (%);
- Estimated capital costs (£) and estimated cost of carbon (£/tonne CO_2).

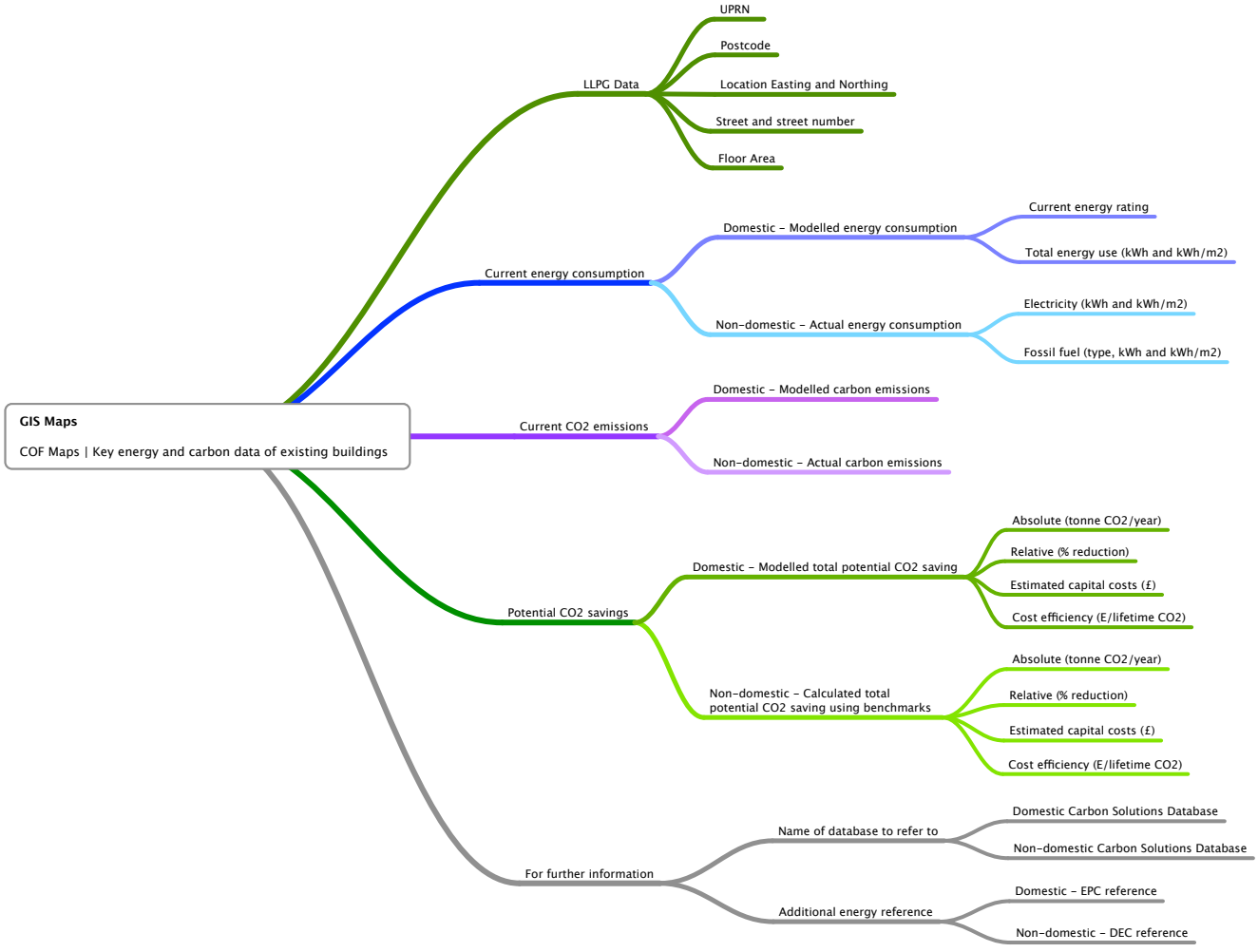


Figure 45: Key data now available on the GIS mapping tool for 8,000+ social housing properties and 120+ public buildings

It is also proposed that the GIS Tool is used to record the Carbon Offset payments associated with new planning applications.

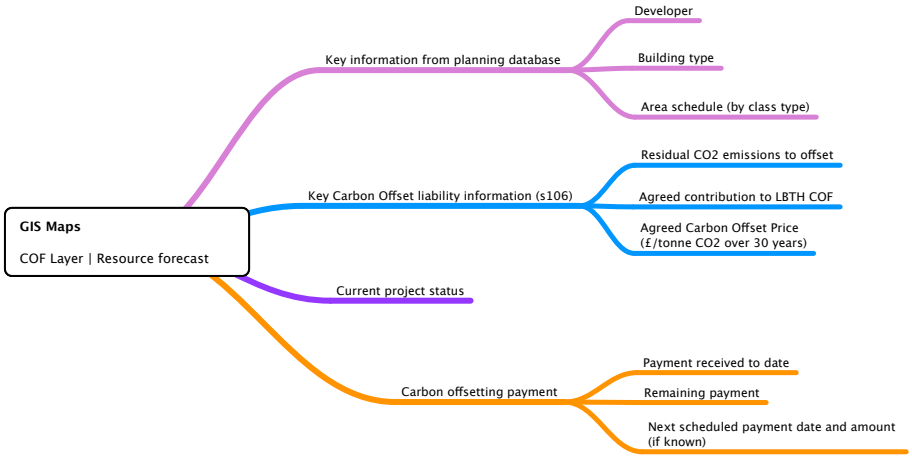


Figure 46: Information on new developments to be gathered by the GIS tool

10.2 The Domestic Carbon Solutions Database

The Domestic Carbon Solutions Database presents the LLPG entries matched against selected building level data from the NROSH and EPC databases, and the outputs of the CHM modelling, including the carbon offset potential and the associated range of costs.

It is used to provide additional information which is not simple enough to be included in the GIS tool but specific about the property and relevant for the consideration of energy improvements (e.g. impact of various measures on CO_2 emissions).

The database includes:

- 131,913 LLPG entries, broadly representing the domestic dwellings in LBTH;
- 44,290 NROSH entries, representing social housing properties in LBTH;
- 12,964 EPC entries matched against the LLPG and NROSH entries;
- 8,313 entries where all three datasets had a good match, and there was sufficient data for energy modelling.

The building level data provides an overview of the building fabric and services in each dwelling, which are used as the basis for the energy modelling work, and outlines the different improvements that were recommended for each dwelling as potentially viable. The modelling outputs include the following:

- Current modelled energy consumption (kWh/year);
- Current modelled CO_2 emissions (tCO_2/year);
- Modelled energy bill reduction per year (£/year);
- Total potential CO_2 saving (tCO_2/year), including the 'in-use' factor;
- % CO_2 saving;
- Cost per tCO_2 over the average lifetime of **each improvement** (£/tCO_2) (low, high and midpoint costs are given) as well as a combination of them.

10.3 The Non-Domestic Carbon Solutions Database

The Non-Domestic Carbon Solutions Database presents the LLPG entries matched against selected building level data from the DEC and CRC databases, and the outputs of the benchmarking calculations undertaken, including the carbon offset potential and the associated range of costs.

Similarly to the Domestic Database, it provides additional and specific energy and carbon information on each building.

The database includes 121 non-domestic public buildings.

The building level data provides a summary of the building's actual energy consumption data and outlines the impact of different improvements. The key outputs include the following:

- Current actual energy consumption (kWh/year);
- Current actual CO_2 emissions (tCO_2/year);
- Estimated cost of each measure (£/year);
- Estimated lifetime[7] CO_2 emission reduction **per measure**;
- Total potential CO_2 saving (tCO_2/year);
- % CO_2 saving.

[7] lifetime was approximated as 10 years for all measures

11.0

RECOMMENDATIONS FOR THE CARBON OFFSET FUND MANAGEMENT

11.0 RECOMMENDATIONS FOR THE CARBON OFFSET FUND MANAGEMENT

This section focuses mainly on our recommendations in terms of set-up and management in order to create a sustainable, successful and growing local Carbon Offset Fund. The key principles of the Carbon Offset Fund structure, governance and management should be considered by the London Borough of Tower Hamlets.

11.1 Introduction

The Carbon Offset Fund developed by Milton Keynes Council is the most 'mature' and successful to date in the UK. It has been in operation for ten years. A review of the fund carried out in 2011 highlighted three principles for how a Carbon Offset Fund should work:

- The whole process should be simple to understand and operate;
- Any details, text and requirement should be clear and unambiguous;
- Take up of the scheme needs good marketing.

These three principles have been supported by the Carbon Offset Fund benchmarking review and therefore form the structure of this section.

The LBTH Carbon Offset Fund should also be designed to operate simply and on a small scale at first, but also be easily expandable as the Fund matures. To that end, this section is formatted such that immediate decisions can help guide the simple and fundamental design of the initial fund and other decisions can be considered to guide the evolution of the fund into new directions in the future.

11.2 Key recommendations

11.2.1 Differentiating strategic control and operational management

Our recommendation is to follow the approach recommended by the Milton Keynes Carbon Offset Fund review: a two-tiered governance structure. LBTH could create a Strategic Board/Panel, an Advisory Board and set up an the Operational Team:

- The Strategic Board/Panel could be composed exclusively of representatives from Tower Hamlets Council (e.g. Mayor of Tower Hamlets, Councillors, Sustainable Development team representative, Housing team representative, Operational Team director, etc.). It could meet quarterly, start as a Panel and evolve as a Board as the Fund develops.
- The Advisory Board could be composed of key stakeholders (e.g. developers, environmental groups, residents, contractors, technical experts, representatives of other Carbon Offset Funds). It could be consulted annually by the Strategic Board to seek their views on the development of the fund.
- The Operational Team should be composed exclusively of representatives from Tower Hamlets Council during the first stage but its duties could potentially be carried out by a third party organisation in the medium to long term.

Recommendation for LBTH:

Decide on the overall operational logic for the fund, and whether the proposed governance structure above is appropriate.

11.2.2 *Creating a Strategic Board/Panel to oversee the Carbon Offset Fund*

The purpose and duties of the Strategic Board/Panel would include the following:

- Regularly review the reports submitted by the Carbon Offset Fund Operational Team;
- Decide on the priorities for the allocation of funds;
- Regularly review the Carbon Offset Price and Carbon Offset Ratio;
- Review the fund management costs;
- Review marketing and outreach priorities.

Recommendation for LBTH:

- Review above list of requirements for Strategic Board/Panel and begin inviting suitable members/stakeholders for an initial stakeholder engagement event.

In the future:

- Consider awarding funds as prizes and giveaways to local residents and small businesses in ways that are very visible and provide a marketing benefit to the fund.

11.2.3 *The role of the Operational Team*

LBTH should seek to ensure that the Operational Team, either in-house to the Council or as an appointed external third party, undertakes the following duties:

- administers the funds;
- manages application process;
- summarises recommendations for funding to the Strategic Board/Panel;
- instructs consultants to carry out detailed energy surveys to inform the contractor's brief;
- instructs contractors to undertake works;
- tracks referrals, progress and installations;
- provides customer service and resolves customer complaints;
- monitors selected projects once completed;
- reports to the Strategic Board/Panel.

Recommendation for LBTH:

Assume a low level of revenues initially but set up the operational management so that all key principles are in place from the outset and can easily evolve as the scale of the fund increases.

11.2.4 *Creating a Special Purpose Vehicle*

A Special Purpose Vehicle (SPV) would be a separate legal entity and could contract in its own name.

One of the other key advantages of a Special Purpose Vehicle is that it can potentially receive direct payments secured through s106. It would enable the Carbon Offset Fund to have direct access to its own funds and to be able to have a more robust and predictable budget. This principle was proposed to Local Authorities in Cambridgeshire in 2010 at a

workshop on a potential Community Energy Fund[8] and participants could not see any legal objections to the concept that funds would be collected through s106 and paid into a separate legal entity but this would need to be confirmed by LBTH legal department.

Company Limited by Guarantee (CLG)

A Company Limited by Guarantee (CLG) appears to be the most suitable vehicle for the LBTH Carbon Offset Fund in the medium to long term as it is a corporate vehicle which is familiar to Local Authorities and is suitable for a not-for-profit organisation with a community investment mandate. It also offers limited liability status and requires only a nominal guarantee which becomes due in the event of the company being wound up.

The CLG would hold the funds paid to it after they have been collected from developers through s106 planning agreements and would be managed by a Board of Directors, i.e. the Strategic Board.

The constitution of the CLG would be its Articles of Association which would set out the objects and powers of the company, how the Board of Directors would be appointed and what their powers are and a restriction on its right to distribute any profit. The CLG could be formed by the London Borough of Tower Hamlets only. Other stakeholders (e.g. environmental charities, residents, developers) could be given a formal role or a more consultative one, for example through the creation of a consultative committee or advisory board.

An example of a Company Limited by Guarantee operating in a similar field in the National Energy Foundation (NEF), previously the United Sustainable Energy Agency (USEA), which manages the Milton Keynes Carbon Offset Fund.

Community Interest Company (CIC)

A relevant alternative to a CLG is a Community Interest Company (CIC) which can be established as a CLG but has additional regulatory features, most importantly the requirement for its activities to fulfill a 'community purpose' and the obligation to file a community interest report each year.

The most significant benefit of a CIC is the use of the 'Community Interest Company' brand, which can be very appealing in the case of the LBTH Carbon Offset Fund.

Other options

Although the Special Purpose Vehicle (SPV) could take other forms, including a limited company or an Industrial and Provident Society (IPS), the CLG or the CIC structures appear to be the two most relevant legal structures for the LBTH Carbon Offset Fund in the medium to long term.

Recommendation for LBTH:
Investigate the feasibility of setting up a Company Limited by Guarantee (CLG) or a Community Interest Company (CIC) dedicated to Carbon Offset Solutions in Tower Hamlets with LBTH Legal Department.

11.2.5 Fund management : in-house or outsourced?

The decision to manage the Carbon Offset Fund internally or to appoint a third party management firm requires consideration and is a different issue to the legal entity. A CLG or a CIC could be set up and managed exclusively by LBTH officers or its management could be 'outsourced' to a third party.

[8] *Element Energy and Manches, Cambridgeshire Community Energy Fund – Stage 2 report 2012*

Most Local Authorities have handled it internally as discussed in the benchmarking review while a few have outsourced it to existing organisations or charities. The following table summarises some of the approaches taken:

Local Authority	Management	Managers
London Legacy Development Corporation	Internal	London Legacy Development Corporation
Southampton	3rd Party	The Environment Centre
Milton Keynes	3rd Party	National Energy Foundation (NEF)
Ashford	Internal	Ashford Borough Council
Islington	Internal	London Borough of Islington
Brighton and Hove	Internal	Brighton & Hove City Council
Westminster	Internal	Westminster City Council

Table 20: Fund managers

Recommendation for LBTH:

- Given the context of uncertainty and the anticipated scale of the Carbon Offset Fund for the first two years, we would recommend to keep the operational fund management duties in-house within the Council at least during the initial stage.
- Collaborations with members of the GLA's RE:NEW and RE:FIT frameworks who already have a system in place for collecting building and project data, should be explored. This would allow LBTH to share some of the responsibilities with established organisations.

In the future:

- A third party fund manager could be considered when the scale of the fund and the projects to be delivered become significant;
- LBTH could seek to collaborate with other boroughs as the data sharing and knowledge exchange could be beneficial. The appointment of the same operational fund manager could also potentially produce economies of scale and allow funds to be operated more efficiently, although the specific local approach would need to be retained.

11.2.6 Fund management costs

Recommendation for LBTH:

- It is strongly recommended that the administrative costs (if included in the carbon price) is structured flexibly so as to allow for frequent reviews and adjustment along with the carbon price itself.
- It should be acceptable for the initial management and marketing costs to be a higher percentage of the overall fund as the scheme works to gain traction.

11.2.7 Data requirements

This is an extremely important part of the fund management strategy. In order to ensure that the fund design is future-proofed and can easily be expanded, special care should be taken to adopt an appropriate data management strategy and that suitable resources are assigned to data management. The data manager should have sufficient experience to provide support and respond to customer queries/complaints for individual households as well as larger projects. The data management duties include:

- Collecting building data for potential projects from the GIS tool and Carbon Offset Solutions Database developed by Etude;
- Shortlist investment opportunities;
- Collect projected carbon savings for potential projects through targeted building surveys (to be carried out by others);
- Track project applications and referrals;
- Track installations and project progress;
- Take in monitoring data to track fund progress;
- Track complaints and develop resolution procedures.

Recommendation for LBTH:

- Identify data management as a clear and crucial duty;
- Approach Re-NEW contractors, who already collect much of the required information.

In the future:

- Appoint an internal 'Carbon Offset Fund' data manager.

11.2.8 Payment into the funds

LBTH should proceed on the assumption that Carbon Offset payments should be made through s106.

Recommendation for LBTH

The option of setting up a CLG or a CIC in the future to enable payment into it from the s106 fund should be evaluated by LBTH legal department;

11.2.9 Verification

The Fund Manager will be responsible for project monitoring and verification as well as reporting on results to the Project Board. However, it is critical that a balance be struck in devising a strategy that simultaneously ensures the Carbon Offset Fund is used effectively, while not imposing such rigid measurement and verification protocols that the process itself becomes a barrier. The London Legacy Corporation decided that it was inefficient to insist on *ex post* verification from fund recipients. Since the Offset Fund's contribution was often necessary for a project to be viable, they felt that making the funding dependent on a later performance would create a perception of risk that could be seen as a barrier to investment in carbon savings.

They proposed instead to monitor project inputs as part of the verification process, and data for the outcomes is collected on a voluntary basis only. They also make it a condition of the funding that the project agrees to participate in any monitoring that may take place, allowing the flexibility to devise a bespoke monitoring strategy both for verification and research purposes.

Recommendation for LBTH:

- Require the 'Carbon Offset Fund Data Manager' to maintain rigorous records of all project inputs, *ex-ante* verifications and *ex-post* verifications.
- Suggest a voluntary reporting process for verifying actual project outcomes through monitoring (additional *ex-post* verification).
- Require that funding recipients consent to participation in long term building monitoring.

In the future:

- Identify key projects which should be part of long term monitoring studies.
- Build collaborations with research bodies such as the Technology Strategy Board (TSB) and academic institutions to participate in the *ex-post* verification process.

11.2.10 Applications for funding

The London Borough of Tower Hamlets is keen to enable organisations across the Borough to apply for funding from the LBTH Carbon Offset Fund in the future. Therefore, a specific **LBTH Carbon Offsetting Guidance** has been prepared to set out the pre-requisites and application procedure (see Appendix C). It also includes an initial version of the application form which will need to be filled in by all applicants. The same application form will be completed by Tower Hamlets Council for any of the projects requiring funding.

When applications to the LBTH Carbon Offset Fund will be open to external organisations, all application forms will be gathered by the LBTH Carbon Offset Fund Operational team which will:

- acknowledge receipt of the application;
- contact the applicant if any of the information provided is missing or unclear;
- gather and analyse all applications received and provide a summary to the Strategic Board/Panel.

The Strategic Board/Panel will decide which projects to allocate funding to. The 3 key criteria for allocation of funds will be:

1. CARBON: carbon savings and their associated cost efficiency;
2. ADDITIONALITY: it is essential that carbon savings are truly additional and would not happen without funding;
3. COMMUNITY BENEFITS: other benefits for the community beyond carbon (e.g. fuel poverty, job creation, improved community facilities, etc.) will be seen as a plus by the Council.

The assessment and selection process and the verification and quality control system are both crucial components of the carbon saving strategy as they will enable the LBTH Carbon Offset Fund to:

- assess investment opportunities and compare them in a fair way;
- perform due diligence on investments;
- monitor the quality and efficacy of various Carbon Offset Solutions so that underperformance can be addressed.

Important note on funding:

Funding will be in the form of reimbursement of receipts. Indicative reimbursement schedules may be agreed with Tower Hamlets Council but it is very important to note that the applicants will have to pay for the works to be undertaken and that it is only with the

associated receipts and satisfactory evidence that the works have been undertaken that these will be reimbursed.

In the future:

- Decide when to open the application process to external organisations;
- Consider making a portion of the funding available through a Pay As You Save revolving loan fund model. Funds are loaned out for cost effective refurbishments and repaid through the savings in the utility bills.

11.2.11 Reporting

It is recommended that the performance of the Carbon Offset Fund is detailed and reviewed annually in LBTH Annual Monitoring Report (AMR).

12.0

CONCLUSIONS AND NEXT STEPS

12.0 CONCLUSIONS AND NEXT STEPS

The work undertaken under the seven workstreams of this study led to a diverse set of findings and outcomes. This section aims at summarising the main conclusions and at outlining how they could be taken forward in order for a successful and efficient Carbon Offset Fund to be set up by the London Borough of Tower Hamlets.

12.1 Conclusion

12.1.1 Key concepts and principles

The literature research undertaken at the beginning of the study provided a wealth of information about Carbon Offsetting but also highlighted a lack of clarity and in some instances a degree of confusion about key concepts and principles. In particular:

- the **unit used for the Carbon Offset Price** and the **cost efficiency of carbon saving measures**: Carbon Offset Prices could either be based on the 30-year CO_2 emission shortfall (in that case the yearly rate would apply i.e. £60/tCO_2) or on a single year of CO_2 emission shortfall (in that case the 30-year rate would apply, i.e. £60/tCO_2 x 30 = £1,800/tCO_2) and the specific lifetime of the measures need to be taken into account in the cost efficiency calculations.
- the differing expectations for the **Carbon Offset Price** and the resulting tension between those focusing on the income side and wanting to avoid a price which would be too high for developers and those focusing on the expenditure side and requiring a price which would be high enough to focus a wide range of carbon saving measures.

We have sought to clarify this relative confusion by introducing the concept of **Carbon Offset Ratio**. While the Carbon Offset Price's main objective is to be fair to developers and to be in line with the GLA's recommended price (i.e. £1,800/tCO_2 applied to the annual CO_2 shortfall), the Carbon Offset Ratio aims at assessing the cost efficiency of the funded carbon saving measures. Although an overall target ratio of 1:1 is recommended for the Carbon Offset Fund as a whole, lower ratios should be possible on specific projects to enable a wider range of energy efficiency measures (e.g. deep energy efficiency retrofit of a school) and to deliver other LBTH's objectives (e.g. reduction of fuel poverty, local job creation, etc.).

We have also referred throughout the report to a Carbon Offset Price over 30 years (i.e. £1,800/t CO_2) and to cost efficiencies for carbon saving measures expressed in £ / lifetime CO_2.

12.1.2 Benchmarking review

The benchmarking review of various Carbon Offset Funds operating or in development in the UK has been extremely beneficial. The factual information and qualitative feedback kindly provided by Officers in nine Local Authorities has enabled us to provide a series of recommendations for the London Borough of Tower Hamlets. These include the following:

- The requirement to **offset residual CO_2 emissions** should focus on regulated emissions and cover all applications i.e. residential and commercial, minor and major;
- **s106 agreements** should be used as the mechanism to obtain contributions into the Carbon Offset Fund;
- **Payment** into the Carbon Offset Fund should be sought on commencement;

- **Carbon saving project delivery** should be a structured process including the identification of project with clear *ex ante* and *ex post* verifications.

12.1.3 Fund management

The fund management principles should include clarity, accountability and transparency.

A two-tiered governance structure with a clear distinction between strategic decisions and operational management is recommended.

The creation of a Special Purpose Vehicle would have a number of advantages in the medium to long term and is recommended as a future development after the initial phase. Although the legal form of a Company Limited by Guarantee (CLG) could be suitable and is a familiar structure for Local Authorities, the form of a Community Interest Company (CIC) is considered to be the most suitable option for the LBTH Carbon Offset Fund. Not only would the constraints enshrine the objective of acting for the community but it would also offer a clear message to contributors (e.g. developers) as well as beneficiaries (e.g. social housing tenants). A CIC would echo through its legal structure the benefits of a Carbon Offset Fund.

Finally, the operational management of the CIC could be outsourced to a third party fund manager although it is recommended that these duties are undertaken by LBTH officers at least during the initial phase (2015-2016).

12.1.4 Forecasting revenues

The exercise of forecasting revenues which would be able to fund carbon saving projects in Tower Hamlets for the next 20 years is very uncertain as it relies on many parameters which are difficult to predict, particularly the **quantum of development**: *How many planning applications will be submitted for new hotels in Tower Hamlets? How many residential units will be built over the years? How will key mixed-use areas of the borough grow over the next 20 years?* Responses to these questions will have a key influence on the scale of the Carbon Offset Fund.

Based on historic figures rather than predictions for the quantum of development, our forecasts indicate that:

- The financial resources which would be generated by development in Tower Hamlets and available to LBTH for Carbon Offset Solutions project over the period 2015-2034 would be in the region of **£16.2m** (undiscounted).
- The theoretical annual budget available to the London Borough of Tower Hamlets for Carbon Offset Solutions is likely to be **in the range of £0.5m-£2m**.

These numbers should be treated with care as they rely heavily on a number of assumptions. However, they provide an idea of the scale of the resources potentially available.

12.1.5 Carbon saving measures / projects

Whereas private Carbon Offset Funds Solutions providers may focus in the future on carbon reduction exclusively, the London Borough of Tower Hamlets has the advantage of appreciating the potential additional benefits of some carbon saving measures and being in a position to prioritise those measures which can be beneficial for the community living and working in the borough.

A number of carbon saving measures / projects were reviewed and our recommendation is for the LBTH Carbon Offset Fund to focus on:

- **Domestic energy efficient retrofits focusing on the social housing sector (Fuel Poverty projects)**;
- **Non-domestic energy efficient retrofits focusing on public buildings;**

- **Community energy projects (e.g. community owned renewable energy projects);**
- **Connections to existing District Heating Networks**

The project selection process should take into account LBTH priorities including tackling fuel poverty, reducing operational energy use and CO_2 emissions, air quality impacts and offering value for money. The convergence wider of Council objectives in the project selection process is important as the delivery of carbon offsetting projects can provide wider benefits for the community living and working in Tower Hamlets.

12.1.6 The Carbon Offset Solutions Databases

A significant work has been undertaken in order to gather, review, process, match, model and analyse data from a number of sources, most importantly residential Energy Performance Certificates (EPCs), non-domestic Display Energy Certificates (DECs), the National Register of Social Housing (NROSH), the English Housing Survey (EHS) and the LBTH Carbon Reduction Commitment (CRC) information.

These carbon and cost data informed the development of the **Domestic Carbon Solutions Database** and the **Non-Domestic Carbon Solutions Database** which contain data gathered on energy performance for **8,000+ domestic properties in the social housing sector** and **120+ non-domestic public buildings** respectively.

The databases are compatible with the format used by the London Borough of Tower Hamlets for their Geographic Information System (GIS), which can now display the following information for the properties contained in the databases:

a. Current energy consumption (kWh/year);

b. Current CO_2 emissions (tCO_2/year);

c. Estimated total potential CO_2 saving (tCO_2/year)

d. Estimated % CO_2 saving;

e. Estimated capital costs (£).

The interactive map of the borough could therefore be used to identify the worst performing schools in Tower Hamlets or visualise a cluster of properties with a significant carbon reduction potential, thereby enabling LBTH to make informed decisions about the strategic allocation of the funds.

The objective of these Carbon Solutions Databases is not to enable the selection of a single project and the accurate definition of the budget required for carbon reduction measures. Its aim is to identify a number of projects which seem to be the most appropriate. A more detailed analysis of the databases (which contain much more information than shown on the GIS tool) complemented by an on-site survey will enable a more accurate prediction of the likely capital costs and carbon savings involved.

12.1.7 Application

In the future, the London Borough of Tower Hamlets is also keen to enable organisations across the Borough to apply for funding from the LBTH Carbon Offset Fund. Therefore, a specific **LBTH Carbon Offsetting Guidance** has been prepared (see Appendix C).

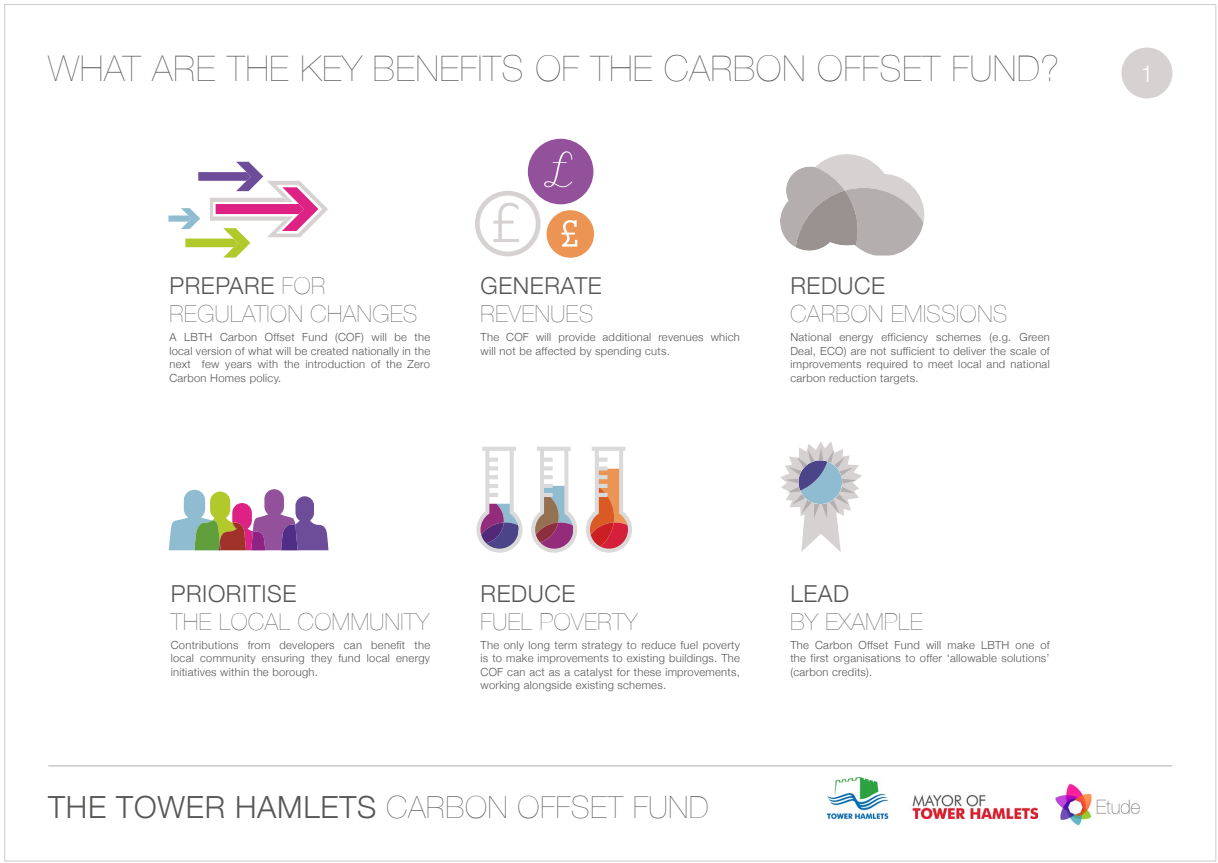
12.2 Consultation

12.2.1 Stakeholder engagement

An initial presentation of the Carbon Offset Solutions Study was given to registered providers operating in Tower Hamlets during the development of the study. Further consultation events were held at the Town Hall:

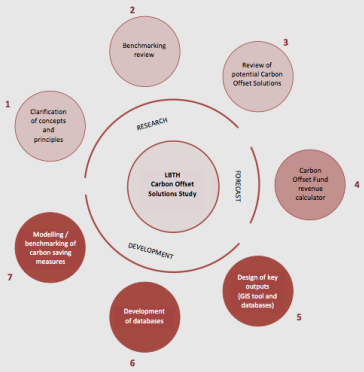
- **Workshop 1** (2nd December 2014) was dedicated to private developers and consultants;
- **Workshop 2** (10th December 2014) was dedicated to registered providers;
- **Workshop 3** (10th December 2014) was dedicated to LBTH planning officers;
- **Workshop 4** (12th December 2014) was dedicated to other Local Authorities operating a Carbon Offset Fund.

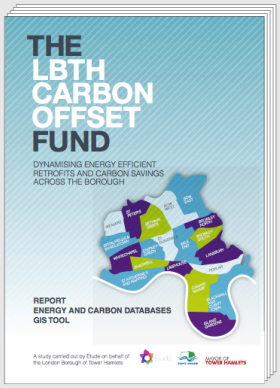
A series of A3 consultation boards have been prepared specifically for these events: they are reproduced here.



RESEARCH, DATA ANALYSIS AND ENERGY MODELLING

2





RESEARCH & DEVELOPMENT | DETAILED REPORT | CONSULTATION

THE TOWER HAMLETS CARBON OFFSET FUND

TOWER HAMLETS | MAYOR OF TOWER HAMLETS | Etude

HOW DOES THE CARBON OFFSET FUND WORK?

3

CONTRIBUTIONS TO THE FUND

All new planning applications (minor and major) which fail to achieve the carbon reduction targets required by LBTH Planning Policy have to offset the 'residual' CO_2 emissions by contributing into the LBTH Carbon Offset Fund.

Their contributions are **project specific** and depend on the difference between their estimated carbon performance and the planning target.

The figures below illustrate examples of contributions already secured:

- 12 residential units: £3,450
- 270-bedroom hotel: £115,575
- 67no student accommodation: £17,940
- Mixed-use development: £60,858

The current offset rate is £1,800/tCO_2 (i.e £60/tCO_2 year over a 30 year period), with 50% of the contribution on commencement and 50% before completion.

IDENTIFICATION OF PROJECTS

Tower Hamlets Council have undertaken an intensive review and analysis of energy performance and carbon saving potential for 8,000+ social housing properties and 120+ non-domestic public buildings. Energy/carbon databases have been created and linked to LBTH GIS mapping system.

Tower Hamlets Council is also keen to offer the possibility to organisations and individuals the ability to apply for funding. The **LBTH Carbon Offset Guidance** provides details about the process. The Council will follow the same process when putting forward one of the projects in the database for funding.

More information about the work undertaken by LBTH is provided on Boards 4, 7 and 9.

FUND MANAGEMENT

Tower Hamlets Council manages the Fund. It has already been created and contributions have already been secured. They are ring fenced for carbon saving projects.

The responsibilities of Tower Hamlets Council include:

- Selecting carbon saving projects in the Borough which should benefit from funding;
- Procuring the works in order to deliver carbon savings;
- Ensuring that carbon savings are delivered.

The anticipated annual carbon offset budget is £1m-£2m.

More information about this step is provided on Boards 6 and 10.

PROJECT DELIVERY

Several routes are available to Tower Hamlets Council to deliver the carbon saving measures depending on project types. The Council will be able to work with delivery partners including energy efficiency engineers, contractors and energy services companies and use frameworks and established delivery routes such as the GLA RE:NEW and RE:FIT programmes.

THE TOWER HAMLETS CARBON OFFSET FUND

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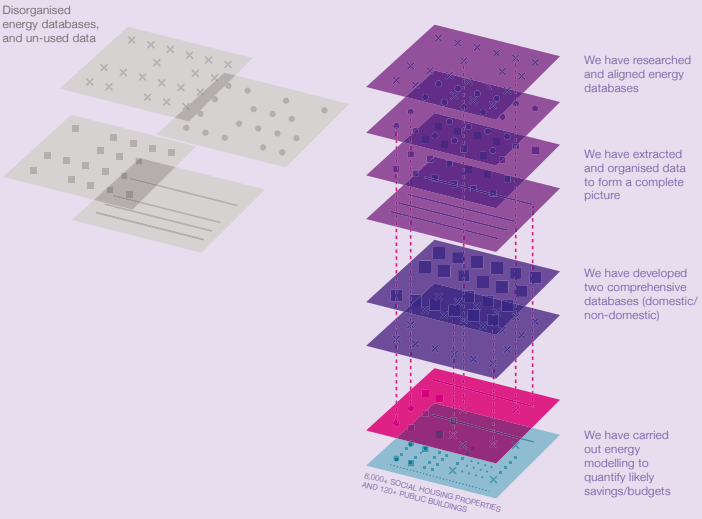
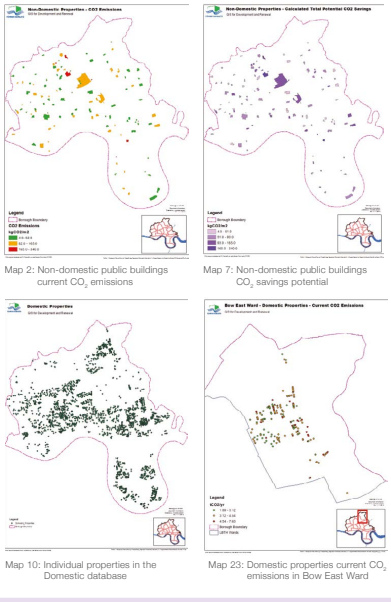
HOW HAVE PROJECTS BEEN IDENTIFIED?

4

ENERGY/CARBON DATABASE DEVELOPMENT PROCESS



EXAMPLES OF ENERGY MAPS PRODUCED



Map 2: Non-domestic public buildings current CO_2 emissions

Map 7: Non-domestic public buildings CO_2 savings potential

Map 10: Individual properties in the Domestic database

Map 23: Domestic properties current CO_2 emissions in Bow East Ward

THE TOWER HAMLETS CARBON OFFSET FUND

TOWER HAMLETS MAYOR OF TOWER HAMLETS Etude

HOW DO I APPLY?

The London Borough of Tower Hamlets has undertaken an extensive study to identify dwellings and public buildings most in need of energy improvements. Funding carbon saving measures (i.e. energy efficient retrofits, renewable energy system, connection to an existing low carbon district heating network) also helps to deliver other objectives of the Council, including reducing fuel poverty and energy bills, developing skills for the low carbon economy and creating local jobs.

Tower Hamlets is also keen to enable individuals and organisations across the Borough to apply for funding from the LBTH Carbon Offset Fund. Therefore, a specific 'LBTH Carbon Offsetting Guidance' has been prepared to set out the pre-requisites and application procedure. It also includes an application form which will need to be filled in by all applicants. The same application form will be completed by Tower Hamlets Council for any of the projects requiring funding.

All application forms will be gathered by the LBTH Carbon Offset Fund Operational team which will:

- acknowledge receipt of the application;
- contact the applicant if any of the information provided is missing or unclear;
- analyse all applications and provide a summary to the Strategic Board;

The Strategic Board will decide which projects to allocate funding to. The 3 key criteria for allocation of funds are:

1. **CARBON**: carbon savings and their associated cost efficiency;
2. **ADDITIONALITY**: it is essential that carbon savings are truly additional and would not happen without funding;
3. **COMMUNITY BENEFITS**: other benefits for the community beyond carbon (e.g. fuel poverty, job creation, improved community facilities, etc.) will be seen as a plus by the Council.

The assessment and selection process and the verification and quality control system are both crucial components of the carbon saving strategy as they will enable the LBTH Carbon Offset Fund to:

- assess investment opportunities and compare them in a fair way;
- perform due diligence on investments;
- monitor the quality and efficacy of various Carbon Offset Solutions so that under-performance can be addressed.

IMPORTANT NOTE ON FUNDING:

Funding will be in the form of reimbursement of receipts. Indicative reimbursement schedules may be agreed with Tower Hamlets Council but it is very important to note that the applicant will have to pay for the works to be undertaken and that it is only with the associated receipt and satisfactory evidence that the works have been undertaken that these will be reimbursed.

APPLICATION TO THE LBTH CARBON OFFSET FUND

5

GENERAL INFORMATION

Name of the applicant:

Contact details: email: Telephone:

Type of applicant: Individual Charity Private Company/Partnership Tenant Landlord or Building Manager

If funding is awarded will you be able to instruct/proceed with the works within 3 months?
YES/NO

If NO who in your organisation will be able to instruct/proceed with the works within 3 months?

Has this person co-signed the form?
YES/NO/NA

Can you confirm that all works will be completed within 2 years from the allocation of funds?
YES/NO

CARBON SAVING PROJECT REQUIRING FUNDING

Name of the project to be funded:

Project description:

Building address:

Building description:

Can you confirm that the project is in Tower Hamlets:
YES/NO

If a single measure - estimated lifetime:

If multiple measures - estimated lifetime:

Source of information for lifetime of measure(s):

Green Deal Other (please specify)

ESTIMATED CARBON SAVINGS

Current building/dwelling energy consumption: kWh/year kWh/m²/year;

Current building/dwelling CO_2 emissions: tCO_2/year kg CO_2/m²/year;

Estimated annual carbon savings: tCO_2/year kg CO_2/m²/year;

Does this figure include 'in-use factors':
YES/NO

Estimated annual carbon savings over the lifetime: tCO_2/lifetime

Methodology used to estimate the savings:

TM22 iPMVP RdSAP SAP SBEM DSM

Other (please specify and justify)

Name and qualifications of the individual who has carried out the survey/assessment/calculations:

Any additional information deemed relevant:

FUNDING REQUIREMENTS

Contribution sought from the LBTH Carbon Offset Fund: £

Cost efficiency: £/annual CO_2

£/lifetime CO_2

Targeted energy bill savings: £ /year

Proportion of administration costs: %

Do you understand that the funding which will be allocated to your project will be fixed and represents the maximum sum payable to you?
YES/NO

Should you be awarded funding, do you commit to seeking complementary funding to ensure that the Carbon Offset Fund will not be used for measures which could have been funded by another programme?
YES/NO If not why?

Which alternative funding will you seek:
Green Deal ECO FIT RHI Other

VERIFICATION AND CONTROL

Can you commit to provide LBTH with sufficient written and photographic evidence to demonstrate that the carbon saving measures have been implemented have taken place?
YES/NO

Will you allow representatives of the LBTH Carbon Offset Fund to attend site at any time subject to three days' prior notice?
YES/NO

Will you install energy metering and monitoring equipment to enable a detailed energy assessment of the building after the works?
YES/NO

Will you provide a detailed analysis of the energy performance 1 year after completion of the works?
YES/NO

Will you authorise LBTH to undertake a Post-Occupancy Verification study, monitor data for up to 3 years and publish the findings?
YES/NO

OTHER COMMUNITY BENEFITS

Fuel poverty Local skills development Education opportunity
Health benefits Creation of local jobs Reduced public expenditure on energy
Better community facilities Other

COMMITMENTS

I, the undersigned, confirm that none of the works covered by this application for funding by the LBTH Carbon Offset Fund, were part of any Capital Works Programme / Budget and that these works will not be undertaken within the next two years if no funding from the LBTH Carbon Offset Fund is allocated to the project. I, the undersigned, confirm that all works and activities the works covered by this application are legally entitled to receive funding from LBTH, and do not breach any rules (e.g. State Aid).

Signed: Date:

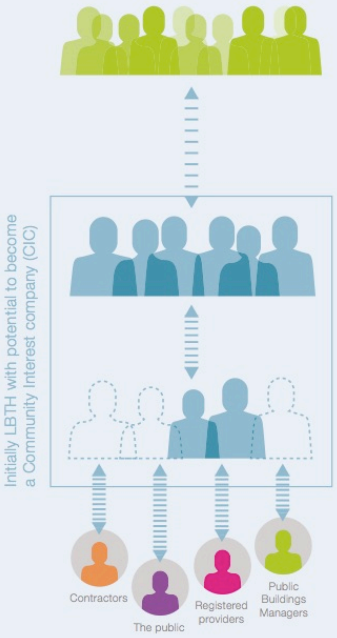
Caution: Failure to respond accurately to the questions above can lead to funds being withdrawn at any point during the project.

THE TOWER HAMLETS CARBON OFFSET FUND

TOWER HAMLETS MAYOR OF TOWER HAMLETS Etude

HOW WILL THE FUND BE MANAGED?

6



ADVISORY BOARD

- Composed of **key local stakeholders** (e.g. developers, environmental groups, residents, contractors, technical experts, representatives of other Carbon Offset Funds).
- It will be consulted annually by the Strategic Board to seek their views on the development and management of the Fund.

STRATEGIC BOARD

- Made up of **representatives of different departments from Tower Hamlets Council.**
- Meets quarterly to select projects to be funded, review the performance of the Operational Team and set the key objectives for each year.

OPERATIONAL TEAM

- Composed **exclusively of representatives from Tower Hamlets Council during the first stage.**

Administers the funds • manages application process • summarises recommendations for funding to the Strategic board • instructs consultants to carry out detailed energy surveys to inform the contractor's brief • instructs contractors to undertake retrofit works • tracks referrals and installations • track project progress • provides customer service and resolve customer complaints • monitors contractors and consultants • monitors selected projects once completed • reports to the Strategic Board.

KEY PRINCIPLES OF THE FUND

FINANCIAL AUTONOMY

The COF will rely on s106 contributions collected for Carbon Offsetting purposes in order to employ consultants/engineers/contractors directly.

DATA MANAGEMENT

The Operational Team will need to collect, gather, analyse data in order to be able to report on the progress and success of the carbon saving measures.

VERIFICATION AND CONTROL

Several types of verifications will be required: the operational team will have to ensure that:

- ☑ The tools recommended for the assessment of carbon savings have been used
- ☑ The methodology used is correct
- ☑ The carbon saving measures are implemented to a satisfactory level of quality (e.g. photographic evidence)
- ☑ Any change is recorded and validated
- ☑ Requirements in terms of handover and user information are met
- ☑ Client satisfaction and actual energy impact are measured

THE TOWER HAMLETS CARBON OFFSET FUND

TOWER HAMLETS MAYOR OF TOWER HAMLETS Etude

WHICH MEASURES CAN BE FUNDED?

7

The following measures are eligible for funding from the Carbon Offset Fund. However a whole building approach is recommended and therefore this board should be read in conjunction with Board 8.

Large potential carbon savings
Average potential carbon savings
Low potential carbon savings

£ Very cost efficient
££ Cost efficient
£££ Not very cost efficient

DOMESTIC RETROFITS

BUILDING ENVELOPE

Solid wall insulation	£££
Cavity wall insulation	£
Loft or rafter insulation	£
Flat roof insulation	££
Floor insulation	££
New windows	£££
High performance external door	£££
Draught proofing	££
Ventilation improvements	££

Figures based on the sample of 8,000+ social housing properties in the LBTH Carbon Offset Domestic Database

BUILDING SERVICES

Lighting systems and fittings	££
New condensing gas boiler	£££
Flue gas heat recovery	££
Hot water cylinder insulation	£
Hot water cylinder thermostat	££
Heating controls	££

NON-DOMESTIC RETROFITS

Heating upgrade	££
Improved controls and BMS	££
Lighting	£
Roof insulation	££
Wall insulation	££
Floor insulation	££
Draught proofing	£
Ventilation improvements	££

Figures based on the sample of 83 schools in the LBTH Carbon Offset Non-domestic Database

DOMESTIC & NON-DOMESTIC

RENEWABLE ENERGY

Solar PVs	££
Solar water heating	££

CONNECTION TO A LOW CARBON DISTRICT HEATING NETWORK

Connection	£££

THE TOWER HAMLETS CARBON OFFSET FUND

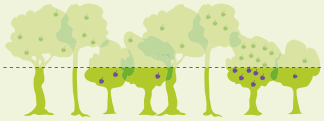
TOWER HAMLETS MAYOR OF TOWER HAMLETS Etude

BEYOND MEASURE BY MEASURE APPROACH: TOWARDS A BETTER MODEL FOR RETROFITS

8

MEASURE BY MEASURE

By selecting measures with the highest carbon reduction effectiveness, short term results are good but the approach is not sustainable as later returns will be lower, and increasingly difficult to deliver.



Like collecting low hanging fruits from all the trees to a certain level, and returning at a later date to collect from higher levels.

DRAWBACKS:

- Short term strategy
- Likely to cost more in the end
- Multiple interventions instead of a single occurrence
- Could lead to incompatible measures
- Greater risk of rebound effect
- Unforeseen negative effects (e.g. draught proofing without new ventilation system can lead to mould issues)

HOLISTIC

By viewing buildings as a whole, one can implement a package of measures which best addresses an entire building before moving on to the next. This approach is sustainable as a long term approach.

Like choosing the tree with the most fruits and picking all of them at once, before moving to the next tree with the most fruit.

BENEFITS:

- Better understanding of interactions between measures
- Better risk management
- Improvement to comfort and health
- More sustainable strategy

WHY IS A HOLISTIC APPROACH BETTER?

IT CAN BE MORE COST EFFECTIVE: **RE-NEW**

RE-NEW was launched in April 2009 and was run in successive phases: through the technical trials, demonstration phase and Phase 1 nearly 60,000 homes across London were treated and more than 12,000 annual tonnes CO_2 saved. Phase 2 of the programme has recently been completed and Phase 3 is due to start soon.

After a home has been visited and provided that the occupant has agreed to the programme of 'easy' energy efficiency measures, a further referral is required for 'harder' energy efficiency measures (e.g. insulation, heating improvements).

A comprehensive review of Phase 1 has been undertaken. It highlighted a number of interesting conclusions including:

- **The 'harder' energy efficiency measures were on average more cost effective at saving carbon than the 'easy' measures;**
- The need for a further referral led to low penetration rates for 'harder' measures
- The additional complexity of 'harder' measures and the lack of coordination between stakeholders also prevented their installation in some cases.

A 'whole-building' approach to energy measures and a greater coordination between stakeholders should enable to achieve greater carbon savings more cost effectively.

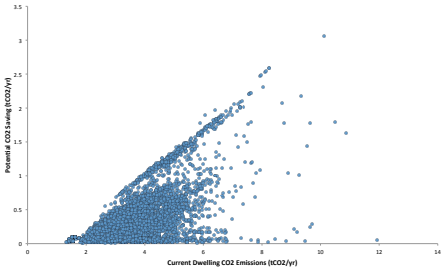
IT IS THE RIGHT STRATEGY TO MITIGATE CLIMATE CHANGE: **IPCC**

The Intergovernmental Panel on Climate Change (IPCC) highlighted that:

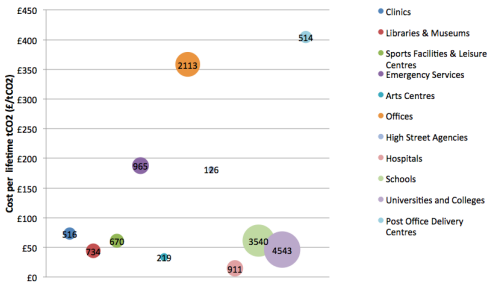
- Studies have repeatedly indicated the important distinction between conventional 'shallow' retrofits, often reducing energy use by only 10–30%, and 'deep' retrofits reducing energy used by 50% or more relative to baseline conditions;
- **There is a potential risk for shallow retrofits to result in lower levels of energy efficiency and higher medium-term mitigation costs** when compared to performance based policies promoting deep retrofits;
- **There is sufficient evidence that deep retrofits can be cost effective**. While the cost range expands with very large savings, there are many examples that indicate that deep retrofits do not necessarily need to cost more in specific cost terms than the shallow retrofits, i.e., their cost-effectiveness can remain at equally attractive levels for best practice.

ENERGY/CARBON DATABASE ANALYSIS

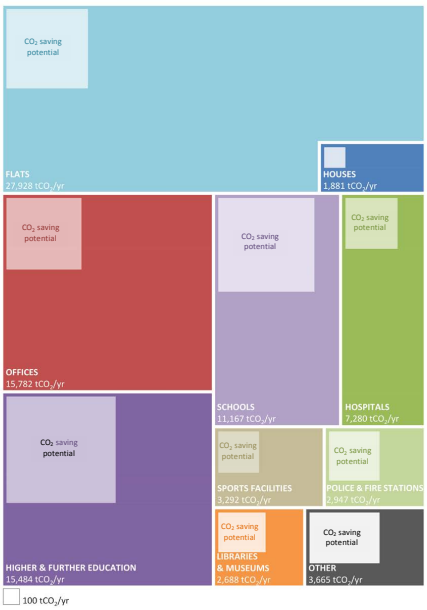
9



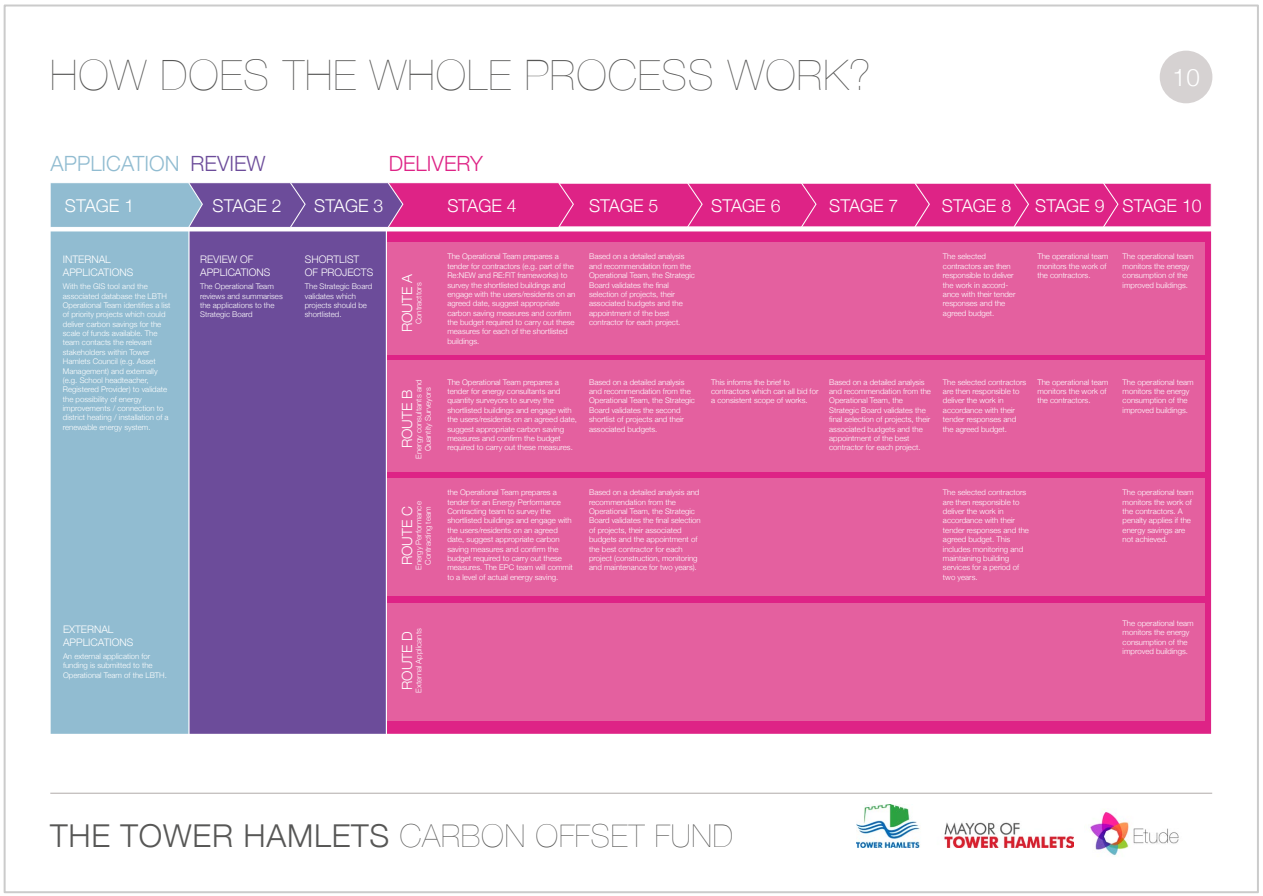
Dwelling CO_2 emissions VS CO_2 saving potential



Non-domestic public buildings - cost and potential CO_2 savings (based on sample of 120+ public buildings)
The number in each bubble represents the total potential carbon saving (tCO_2/year)



Visualisation of CO_2 emissions and CO_2 savings potential based on the LBTH Carbon Solutions databases developed as part of this study for 8,000+ social housing properties and 120+ public buildings



The above consultation events were very useful and feedback from various stakeholders informed the development of the final report.

12.2.2 *Wider consultation*

The final report will be made public to enable feedback from all parties.

12.3 Potential next steps

12.3.1 *Further stakeholder engagement*

Additional workshops could be organised:

Workshop 5 could involve public organisations or public/private organisations, e.g.

- The Zero Carbon Hub;
- The Department for Energy and Climate Change;
- The Department for Communities and Local Government;
- The Institute for Sustainability.

Workshop 6 could involve potential delivery partners, , e.g.

- Contractors part of the RE:NEW/RE:FIT frameworks;
- Other parties involved in retrofits in Tower Hamlets (e.g. Rockwool).

12.3.2 *Developing the databases*

Although they have been created with the objective of being easy to use, the databases are large Excel spreadsheets and it could be beneficial to import them into another format (e.g. SQL) to enable a better user interface.

12.3.3 *Investigating delivery further*

The main objective of this study was to develop a robust strategic approach to Carbon Offset Solutions by creating two energy and carbon databases linked to the GIS tool. Therefore, the delivery of these Carbon Offset Solutions was not investigated in detail and it was recommended to seek to use existing framework (e.g. RE:NEW, RE:FIT). We would recommend investigating the potential delivery mechanisms and partners further.

12.3.4 *Verification of carbon savings*

In the interest of consistency with other funding schemes (e.g. ECO) the mandatory verification methodology recommended in this study for *ex ante* and *ex post* verifications is the use of accredited Part L softwares (e.g. SAP, SBEM, TAS, IES) combined with 'in use' factors.

It is also recommended that beneficiaries of funds would need to accept the principle of a post occupancy energy monitoring study to be carried out by LBTH.

Additional work could be undertaken on the verification methodology and in particular on the feasibility of following the International Performance Measurement and Verification Protocol (IPMVP).

13.0

BIBLIOGRAPHY

13.0 BIBLIOGRAPHY

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14.0

GLOSSARY

14.0 GLOSSARY

BCIS Index	Formerly known as BERR Construction Price and Cost Indices, the BIS Construction Price and Cost Indices are basic tools of the trade for anyone involved in estimating, cost checking and fee negotiation on public sector construction works.
Carbon Compliance	The Carbon Compliance limit is the on-site carbon target proposed by the Zero Carbon Hub.
Regulated emissions:	CO_2 emissions covered by Part L of the Building Regulations, i.e. heating, hot water, lighting, fans and pumps.
Unregulated emissions:	Those which are not covered by the Building Regulations, that is to say carbon emissions from appliances and cooking.
Zero Carbon	Level of regulated CO_2 emissions achieved through on-site measures (e.g. fabric performance, energy efficiency, on-site renewables), connected measures (e.g. district heating) and Allowable Solutions (latest definition).

Appendix A:

Carbon Offset Fund comparison matrix

Project number 20140055

Project name LBTH Carbon Offset Solutions Study

Document Carbon Offset Fund Benchmarking Matrix

Tab Simplified Matrix

Revision E

	Brighton & Hove	Croydon	Hackney	Hounslow	Islington	Milton Keynes	Southwark	Westminster	LLDC *(acting as Developer)*	LLDC *(acting as Local Planning Authority)*
Status of Fund	Awaiting adoption in 2015.	In operation	Awaiting adoption	Awaiting adoption.	In operation	In operation since 2008.	Awaiting approval	In operation	In operation	Awaiting adoption
Cost / tonne CO2 (over 30 years)	£1,000	£1,380	£1,800	£1,800 (expected - not set yet)	£920	£200	£1,380	£7,560	£1,380	£1,800 (expected - not set yet)
What is the cost based on?	Costs of retrofitting from BRE study.	GLA recommendation.	GLA recommendation	GLA recommendation	The cost of installing solid wall insulation.	Schemes and measures available.	GLA	Arup study. Accounts for measures applicable to Westminster.	Original price for Allowable Solutions from CLG.	GLA recommendation.
How often will this be reviewed?	3 yearly due to limited resources.	Likely in line with GLA	In line with the Zero Carbon Hub recommendations.	In line with the Zero Carbon Hub recommendations.	No set time-frame.	It has not been reviewed since the policy was implemeneted in 2008.	Likely in line with GLA.	Every 2 years.	It is anticipated that the Carbon Offset Price will remain at £1,380/tonne.	
Has this been challenged?	The policy has not been implemented. Not challenged at consultation stage.	No.	No.	No.	No. The terms have been informally challenged.	No.	Policy not in force.	Negotiations always happen.		
Happy with this cost?	Probably too low to deliver.	Yes - it keeps things straightforward. Croydon's priority is existing stock and getting money in to improve it.	Feel it should be higher - but not time or resource to conduct a study.	Feel it is robust.	Yes.	Aware it should be refreshed.	Yes (though accepted it's probably too low for a tonne for tonne offset).	Yes.		
Relevant Policies / Commitments	City Plan Core Policy 8 (CP8) - Sustainable Buildings, pg 161. City Plan Core Policy 7 (CP7), pg 164 and 165 SPD 08 Sustainable Building Design	London Plan	DMLP s.106 SPD	Local Plan (in consultation) SPD on Planning Obligations (to be refreshed) Planning Guidance Note (to be created)	Core Strategy Environmental Design SPD	Sustainable Construction Policy D4	Core strategy - adopted Draft SPD - expected adoption late 2014	London Plan Westminster's City Plan - Policy S40	Planning application for the Legacy Communities Scheme and associated planning obligations.	London Plan Westminster's City Plan - Policy S40
Residential / Commercial	Residential and commercial	Residential and commercial	Residential and commercial	Residential and commercial	Residential and commercial.	Residential and commercial	Residential and commercial	Residential and commercial	Residential and commercial	Residential and commercial
Carbon reductions required	Related to CfSH and BREEAM: Minor - CSH Level 4 / Very Good Major - CSH Level 5 / Excellent	London Plan	London Plan	London Plan Resi - CSH Level 4 on-site Non-resi commercial and new build - BREEAM Excellent	100%	100%	London Plan	40% (LP) 20% on-site renewables.	Full' Fabric Energy Efficiency Standard and Carbon Compliance Level as set by the Zero Carbon Hub	
Applicable to Major / Minor applications	Major and minor.	Major.	Major. Minor from 2016	Major.	Major and minor (only new build residential for minor developments).	Major.	Major	Major	Legacy Communities Scheme only.	
Regulated / Unregulated	Regulated and unregulated.	Regulated	Regulated	Regulated	Regulated and unregulated.	Regulated and unregulated.	Regulated	Regulated	Regulated	Regulated
S.106	s.106 used.	S.106 is use. No problems.	s.106 will be used.	s.106 used	s.106 used.	s.106 used	s.106 used.	s.106 used.	s.106 used.	s.106 used.
CIL	CIL is not adopted. Ex	CIL is adopted and has not been affected. District heating removed from Reg 123	CIL not adopted.	CIL not affected.	CIL not adopted.	Not implemented.	CIL not affected.	CIL not adopted.	No	
Payment terms (e.g. 50% on commencement - 50% on completion)	On completion.	On completion.	On completion. For larger regeneration projects stage payments negotiated.	On completion.	At commencement.	On completion.	Not specified.	Negotiable.		
Managed by who?	Not decided. May use a Green Deal Partnership that has already been set up to streamline costs	Internally. Two boards - s.106 board and Energy and Carbon management board.	Internally managed. Overseen by Environment Sustainability Board.	Not decided. Likely to be internal.	Internally. By s.106 team and the Energy Services team.	Externally. National Energy Foundation.	Internally. Sustainable Services Team.	Internally.	Internally.	Internally.
Accountability	Not decided. Partial funding likely due to costs.	Internal public sector audit and governance.	A report will be issued yearly setting out contributions to schemes and the associated % offset.	Pre-established reporting procedures.	Tonne for tonne approach is not required.	Carbon Offset Fund Board (Milton Keynes, NEF, HEA). They meet to discuss how the fund is spent. Independent annual audit.	Quarterly on-line report Annual report detailing where s.106 and CIL money has been spent.	RE:FIT model used.	RE:FIT and RE:NEW frameworks and models likely to be used.	RE:FIT and RE:NEW frameworks and models likely to be used.
Administration cost (e.g. x% management fee)	Expected to be 10%.	Lean. Piggy back on other projects.	Expected to be 5%.	Not adding administration fee.	15%.	10% taken from monies collected.	Approximately 3% but not set currently.	5% management fee included.		
Who delivers the projects?	Housing associations Developer Landlord through contribution to renewable energy grants Private householders directly, through subsidy.	Contract manager within council, if delivered by third party.	Delivery of projects to be managed internally by the council.	Through existing pipelines on existing projects.	No projects have been delivered at this point in time.	NEF.	Council	Either developer or the Council.	LLDC through RE:NEW and RE:FIT	LLDC through RE:NEW and RE:FIT
Types of projects identified	Not specified.	Residential projects only for receipt of funding.	Community level schemes Not targetting refurbishments.	Existing projects within the council - e.g. fuel poor, the elderly.	Existing stock.	Mainly residential energy efficiency improvements	Likely council owned buildings.			
How are projects identified?	Application to the fund SESP (a Green Deal Partnership) May create a portfolio of identified projects. Likely to prioritise the fuel poor.	No systematic approach - opportunisitic. Largely dependent on whether additional funding can be drawn.	Prospective projects will be given the opportunity to present their funding opportunity to the councils Environmental Sustainability Board.	Existing projects.	Working on this.	1) Incoming applications 2) Targetting projects / marketing	Not confirmed.			
What measures are funded?	District heating (until CIL comes in) Retrofit - domestic and commercial Renewables	Loft insulation Cavity wall insulation Fit and forget measures	Community energy schemes - PV External wall insulation LEDs Tree Planting Behaviour change	Refurbishments (residential and commercial) Renewables (building scale).	Energy efficiency improvements.	Energy efficiency measures mainly. In theory, anything that delivers CO2 savings.			- Focus on projects close to the LLDC boundaries (e.g. Bromley-by-Bow) - Focus on education projects - Behaviour projects included - Water efficiency improvements included	- Focus on projects close to the LLDC boundaries (e.g. Bromley-by-Bow) - Focus on education projects - Behaviour projects included - Water efficiency improvements included
How is CO_2 accounted for?	Existing studies and methodologies will be used (e.g. EST, BRE, ZCH, government documents).		Using nationally recognised benchmarks.	Approach still being decided.	Unknown.	Standard published figures from DECC.				

Appendix B:

Questionnaire to Local Authorities.

LBTH Carbon Offset Solution Study

Questionnaire for Existing Carbon Offset Funds

AIM OF THIS QUESTIONNAIRE

This questionnaire has been developed in order to inform our benchmarking review of existing carbon offset funds in operation by local authorities across the United Kingdom.

CONTEXT

The London Borough of Tower Hamlets is undertaking a carbon offsetting study to identify projects to be funded through offsetting, create a tool to assist investment decisions and also set out the principles for management of the fund.

We are sustainability consultants and are working for the London Borough of Tower Hamlets. An important part of our work is to undertake research into other Boroughs approaches to carbon offsetting.

We would be grateful of your input and any insights you have for delivering successful offsetting funds/projects and have developed the enclosed questionnaire to structure our discussion and ensure that we will make the best use of your time.

If you have any questions about this study, please do not hesitate to contact us.

LBTH	Jonathan Taylor	020 7364 5812	Jonathan.Taylor@towerhamlets.gov.uk
Etude	Anna MacKenzie	020 3176 4464	anna.mackenzie@etude.co.uk

Item	Question
0	**Implementation and Policy**
0.1	At what stage is the Carbon Offset Fund?
	□ Preparation and planning □ Awaiting approval / adoption □ In operation
0.2	Which policy relates to the Carbon Offset Fund and when was it adopted?
1.	**Cost, £/tonne CO_2**
1.1	What is the cost per tonne of carbon used by the borough?
1.2	What is this cost based on?
1.3	How frequently are reviews of the cost of carbon carried out?
1.4	Are you happy with the cost per tonne of CO_2 used?
1.5	Has the cost of CO_2 per tonne been challenged by developers?
2	**Magnitude of the Fund**
2.1	How has the magnitude of the fund been forecast?
2.2	Is reality in line with forecasts?

2.3	What is the methodology for establishing developer contributions
2.4	Are both major and minor developments included?
2.5	Has it been worthwhile to include minor funds? What proportion of monies collected is expected to come from minor funds?
2.6	Would you consider a flat rate charging mechanism?
3	**Mechanism and Timing of Payments**
3.1	Has Planning Obligations Section 106 worked well as a mechanism for collecting payments?
3.2	Have Community Infrastructure Payments been affected?
3.3	When is payment from the developer required by?
3.4	Is there a timeframe in which collected funds must be spent by?
4	**Management of the Fund**
4.1	How is the fund managed and by whom? Internal or externally managed?
4.2	Would you consider creating your own third party charity exclusively to manage the fund?
4.3	How is accountability for delivering carbon savings handled?

4.4	What have been the administration costs as a % of monies collected? Or, what are the average person-hours required to manage the fund per month?
4.5	How challenging were the data requirements? Are all the various data sets managed by the same database/tool? (e.g. potential projects, income forecasts, applications, approved applications etc)
5	**Carbon Reduction Measures**
5.1	How are CO_2 savings identified?
5.2	What measures are funded?
5.3	Complete or partial funding?
5.4	How is funding awarded?
5.5	Against which measures can you claim CO_2 reductions?
	□ Domestic refurbishments □ Non-domestic refurbishments □ Renewables □ Community Renewables □ Street Lighting □ Tree Planting □ Behavioral change projects

5.6	How are CO_2 savings calculated for the above measures?
5.7	Where has the cost data for measures come from?
5.8	Who delivers the CO_2 savings, who is in charge of the works?
6	**General**
6.1	What are the main challenges you have come across?
6.2	Is there a particular piece of advice you would like to give to London Borough of Tower Hamlets?

Appendix C:

LBTH Carbon Offsetting Guidance

22 December 2014

LBTH Carbon Offset Solution Study

LBTH Carbon Offsetting Guidance

AIM OF THIS NOTE

This document focuses on the LBTH Carbon Offsetting Guidance.

It summarises the requirements applying to any applicant for funding from the LBTH Carbon Offset Fund and the application procedure. The draft application proforma is also provided in Section 4.0.

CONTENTS

1.0 INTRODUCTION

The London Borough of Tower Hamlets has undertaken an extensive study to identify dwellings and public buildings most in need of energy improvements. Energy and carbon databases have been developed and linked to the Council's Geographic Information System (GIS) tool in order to enable the visualisation of current energy / carbon performance of more than 120 public buildings and 8,000 social housing properties. The GIS tool and databases also provide information on the carbon saving potential and budget.

The main objective of these tools is to inform investment decisions so that resources from the Carbon Offset Fund can deliver carbon savings to offset emissions from new developments. Funding carbon saving measures (i.e. energy efficient retrofits, renewable energy system, connection to an existing low carbon district heating network) also helps to deliver other objectives of the Council, including reducing fuel poverty and energy bills, developing skills for the low carbon economy and creating local jobs.

Tower Hamlets Council is also keen to enable organisations across the Borough to apply for funding from the LBTH Carbon Offset Fund in the future for any carbon saving project. This specific *'LBTH Carbon Offsetting Guidance'* sets out the **requirements** for all applications. It also includes an **application form** which will need to be filled in by all applicants. The same application form will be completed by Tower Hamlets Council for any of the projects requiring funding.

The aim of the Council has been to set up a simple application process in order to make it easy for organisations to apply. It is therefore essential that organisations comply with the requirements below, complete the application form accurately and accept to provide additional information to the London Borough of Tower Hamlets if necessary.

2.0 REQUIREMENTS

The primary objective of the LBTH Carbon Offset Fund is to save carbon. As one of the potential hurdles to carbon saving is the need to convince the future 'beneficiary' of the benefits of the carbon saving works, enabling a voluntary application process can help to attract funding applications from organisations which are already convinced of these advantages. However, an open application process also introduces significant risks which should be managed carefully. Therefore a set of requirements has been established and are summarised in this section. Failure to comply with these requirements or to respond accurately to the questions in the application form can lead to funds not being awarded or being withdrawn at any point during the project.

2.1 Location

All projects applying for funding from the LBTH Carbon Offset Fund must be located in Tower Hamlets.

2.2 Additionality

It is fundamental that the LBTH Carbon Offset Fund helps to deliver projects which would not have happened without it within a reasonable timeframe (i.e. 3 years).

Two examples of projects which should not be funded by the LBTH Carbon Offset Fund include:

- An organisation using the funds to finance replacement/maintenance/improvement works which have already been or should reasonably have been budgeted for by the organisation. This could include the replacement of a heating system which is reaching the end of its life or a lighting improvement scheme for LEDs.

- A private landlord using the funds to finance the installation of a renewable energy system and then benefitting from the ongoing benefits (e.g. Feed in Tariff, Renewable Heat Incentive). These incentives should be sufficient to enable the private landlord to make the investment.

The London Borough of Tower Hamlets therefore requires, as a pre-requisite, that any applicant for funding acknowledges that the works requiring funding are truly additional and, if the application is successful, commits to seeking other forms of funding in order to ensure additionality (e.g. ECO funding).

Any successful applicant should expect the London Borough of Tower Hamlets to question additionality and request appropriate evidence.

2.3 Eligibility for funding

The LBTH Carbon Offset Fund is a source of public funding. Therefore, the London Borough of Tower Hamlets has to comply with strict rules in terms of how these financial resources can be spent and the same rules apply to beneficiaries of this fund as of any other public fund. It is therefore crucial that any applicant ensures that the organisation is eligible for funding from the LBTH Carbon Offset Fund and that the scale of funding applied for does not reach any aid restriction thresholds (e.g. State Aid Rules).

2.4 Accuracy

Estimating carbon savings can be difficult and subject to interpretation and a number of methodologies are available to quantify potential carbon savings, e.g:

- Carbon savings can be calculated on a measure by measure basis using manufacturer's information (e.g. lighting replacement);
- An energy survey of an existing building can be undertaken following an accepted methodology (e.g. TM22) and form the basis of energy saving calculations undertaken to estimate carbon savings;
- A site visit could be undertaken to gather a number of assumptions which will inform the development of an energy model which can then be used to estimate carbon savings.

Although the London Borough of Tower Hamlets does not wish to be prescriptive in terms of carbon saving assessment method at least initially, it is essential that applicants declare the methodology they have used to assess potential carbon savings and that, if required, this assessment is communicated to the London Borough of Tower Hamlets.

2.5 Cost efficiency

The main purpose of the LBTH Carbon Offset Fund is to deliver carbon savings. The scale and cost efficiency of carbon savings must be clearly set out in all applications. Although the London Borough of Tower Hamlets does not require a minimum cost efficiency in terms of £/tCO_2, projects delivering large carbon savings cost efficiently should be rewarded.

2.6 Benefits to the community

Carbon saving projects already identified by the London Borough of Tower Hamlets 'converge' with other Council's responsibilities and objectives. Carbon saving projects applying for funding from the LBTH Carbon Offset Fund may not deliver benefits to the community. Examples include:

- A private landlord applying for funding to improve the energy efficiency of a private block of apartments. Beyond CO_2 savings, the benefits would be exclusively for the landlord and the private residents;

- A local business applying for funding to connect to a local district heating scheme. Beyond CO_2 savings, the benefits would be for the local business itself and the company operating the district heating system.

The London Borough of Tower Hamlets will therefore require all applicants to declare the potential benefits to the community associated with the project in order to be able to reward those with the most significant impact. These can include reduction of fuel poverty, job creation, skills development.

2.7 Delivery

Once a project has been awarded funding from the LBTH Carbon Offset Fund, it must be started within 6 months and completed within a reasonable timeframe, up to a maximum of 3 years.

Funding will be in the form of reimbursement of receipts. Indicative reimbursement schedules may be agreed with Tower Hamlets Council but it is very important to note that the applicant will have to pay for the works to be undertaken and that it is only with the associated receipts and satisfactory evidence that the works have been undertaken that these will be reimbursed.

It must also be noted that funding will be awarded in the form of a capped sum of money. If the works funded are more expensive than initially estimated by the applicant, the London Borough of Tower Hamlets will not provide any additional funding.

2.8 Verification of carbon savings

When a carbon saving project is supported financially by the Carbon Offset Fund, the applicant should expect the London Borough of Tower Hamlets to check that the funds are used as intended, that the works are being undertaken to a satisfactory level of quality and that the funded measures do indeed deliver the carbon savings anticipated.

It is a condition of funding that the applicant:

- submits written and photographic evidence to the LBTH Carbon Offset Fund to demonstrate that the carbon saving measures are implemented;
- allows representatives of the LBTH Carbon Offset Fund to attend site at any time subject to two days' prior notice;
- installs energy metering and monitoring equipment which will enable a detailed energy assessment of the building after the works;
- provides a detailed analysis of the energy performance for the first three years after completion of the works.

Any applicant should also accept in principle the monitoring of the carbon saving project for a period of at least 3 years by the Council.

3.0 APPLICATION PROCEDURE

All application forms will be gathered by the LBTH Carbon Offset Fund Operational team which will:

- acknowledge receipt of the application;
- contact the applicant if any of the information provided is missing or unclear;
- gather and analyse all applications received and provide a summary to the LBTH Carbon Offset Fund Panel.

The Panel will meet every three months and decide which projects to allocate funding to based on an analysis of their respective merits.

All applicants will be contacted within a maximum of 6 months of the date of their application and advised whether it has been successful or not.

4.0 APPLICATION PROFORMA

See next pages.

GENERAL INFORMATION

Name of the applicant:

Contact details: email: Telephone:

Type of applicant: Individual ☐ Charity ☐ Private Company/Partnership ☐ Tenant ☐ Landlord ☐ or Building Manager ☐

If funding is awarded will you be able to instruct/proceed with the works within 3 months?

YES/NO

If NO who in your organisation will be able to instruct/proceed with the works within 3 months?

Has this person co-signed the form?

YES/NO/NA

Can you confirm that all works will be completed within 2 years from the allocation of funds?

YES/NO

CARBON SAVING PROJECT REQUIRING FUNDING

Name of the project to be funded:

Project description:

Building address:

Building description:

Can you confirm that the project is in Tower Hamlets:

YES/NO

If a single measure - estimated lifetime:

If multiple measures - estimated lifetime:

Source of information for lifetime of measure(s):

Green Deal ☐ Other (please specify) ☐

ESTIMATED CARBON SAVINGS

Current building/dwelling energy consumption: kWh/year kWh/m^2/year;

Current building/dwelling CO_2 emissions: tCO_2/year kg CO_2/m^2/year;

Estimated annual carbon savings: tCO_2/year kg CO_2/m^2/year;

Does this figure include 'in-use factors':

YES/NO

Estimated annual carbon savings over the lifetime: tCO_2/lifetime

Methodology used to estimate the savings:

TM22 ☐ IPMVP ☐ RdSAP ☐ SAP ☐ SBEM ☐ DSM ☐

Other (please specify and justify) ☐

Name and qualifications of the individual who has carried out the survey/assessment/calculations:

Any additional information deemed relevant:

FUNDING REQUIREMENTS

Contribution sought from the LBTH Carbon Offset Fund: £

Cost efficiency: £/annual CO_2

£/lifetime CO_2

Targeted energy bill savings: £ / year

Proportion of administration costs: %

Do you understand that the funding which will be allocated to your project will be fixed and represents the maximum sum payable to you?

YES/NO

Should you be awarded funding, do you commit to seeking complementary funding to ensure that the Carbon Offset Fund will not be used for measures which could have been funded by another programme?

YES/NO If not why?

Which alternative funding will you seek:

Green Deal ☐ ECO ☐ FiT ☐ RHI ☐ Other

VERIFICATION AND CONTROL

Can you commit to provide LBTH with sufficient written and photographic evidence to demonstrate that the carbon saving measures have been implemented have taken place?

YES/NO

Will you allow representatives of the LBTH Carbon Offset Fund to attend site at any time subject to three days' prior notice?

YES/NO

Will you install energy metering and monitoring equipment to enable a detailed energy assessment of the building after the works?

YES/NO

Will you provide a detailed analysis of the energy performance 1 year after completion of the works?

YES/NO

Will you authorise LBTH to undertake a Post-Occupancy Verification study, monitor data for up to 3 years and publish the findings?

YES/NO

OTHER COMMUNITY BENEFITS

Fuel poverty ☐ Local skills development ☐ Education opportunity ☐

Health benefits ☐ Creation of local jobs ☐ Reduced public expenditure on energy ☐

Better community facilities ☐ Other

COMMITMENTS

I, the undersigned, confirm that none of the works covered by this application for funding by the LBTH Carbon Offset Fund, were part of any Capital Works Programme / Budget and that these works will not be undertaken within the next two years if no funding from the LBTH Carbon Offset Fund is allocated to the project. I, the undersigned, confirm that all works and activities the works covered by this application are legally entitled to receive funding from LBTH, and do not breach any rules (e.g. State Aid).

Signed: Date:

Appendix D:

Delivery strategy - Consultation with LBTH

CO_2 REDUCTION MEASURES

The tables below provide a summary of key measures that would typically be employed to reduce CO_2 emissions in buildings, as outlined in chapter 8 of the LBTH Carbon Offset Fund Report. These measures have been split into two main groups to indicate which may be more appropriate for LBTH to manage internally, and which may be more easily implemented by external contractors. Each of these groups is split into two further sub-groups based on the nature of the measures employed.

BEHAVIOURAL CHANGE

- Introduce/improve energy management structures
- Energy management training (facilities/energy managers)
- Energy benchmark competitions (e.g. schools, leisure centres)

PLUG & PLAY TECHNOLOGY

- Solar photovoltaics
- Incandescent light bulb retrofits

These measures may have greater potential for internal LBTH management

ELECTRICAL EFFICIENCY

- IT power management
- Lighting benchmarking, automation & efficiency
- DHW thermostats & insulation
- Building management systems
- CIBSE TM44 air conditioning inspections & implementation

THERMAL EFFICIENCY

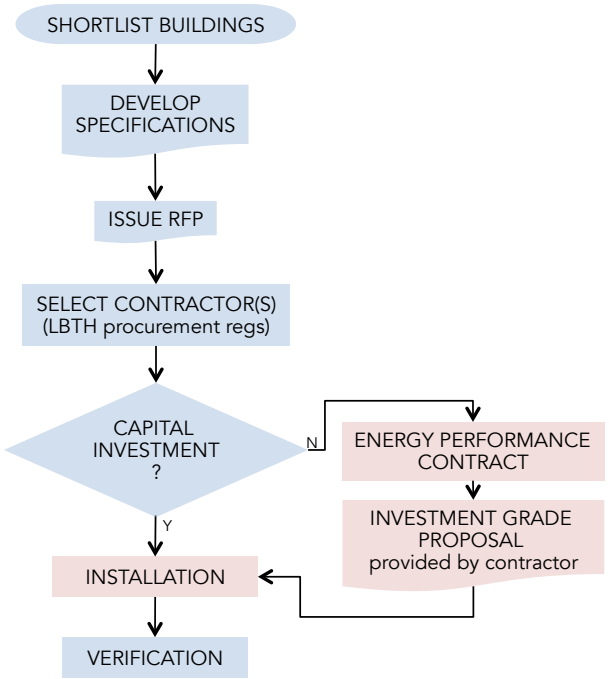
- Heating system upgrades
- Heating control upgrades
- Flue gas heat recovery
- Thermal envelope improvements:
  - Roof insulation
  - Cavity wall insulation
  - Solid wall insulation
  - Floor insulation
  - Airtightness
  - Glazing upgrades

Technical complexity of these measures may necessitate outsourcing

LBTH CARBON OFFSET FUND | DELIVERY STRATEGY

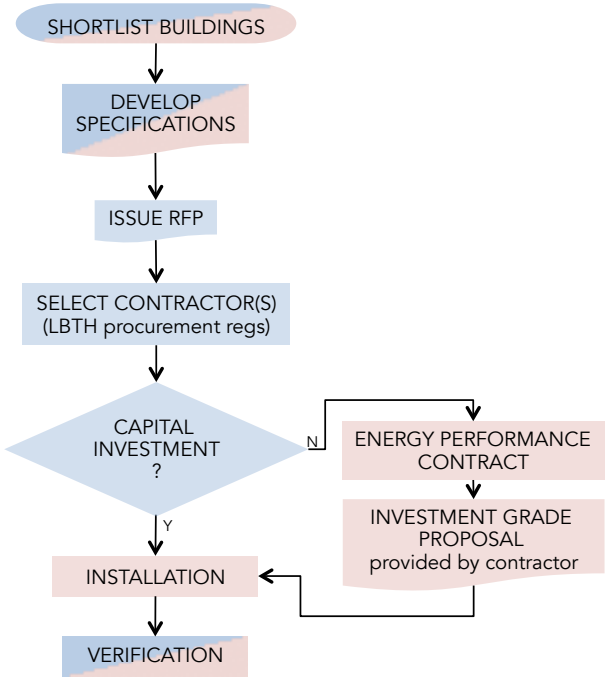
OPTION 1 – LBTH INTERNAL

- Popular approach with other offset schemes
- LBTH appoints programme manager internally
- Carbon offset fund study data/report informs decisions
- DEC data & reports, together with TM44 A/C reports also useful
- Programme manager handles all aspects of programme
- May be useful to divert more funding toward energy management training for existing facilities/energy managers to build expertise within LBTH and its facilities
- Pilot project recommended as a priority – third party assistance may be necessary to achieve excellence



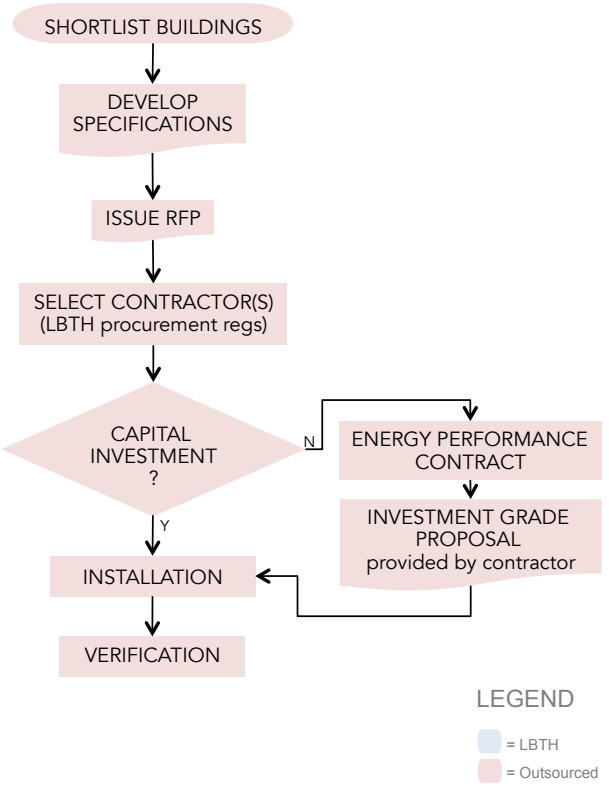
OPTION 2 – HYBRID

- Overall management remains with LBTH
- Third parties provide objective assistance on an ad-hoc basis for more technical parts of the implementation process such as short-listing buildings, advising on best-practice specifications, RFP submissions etc.
- LBTH can internally implement general procurement programmes for straightforward technologies such as photovoltaic installations and LED street lighting retrofits as per the standard financial instructions. One time assistance may help to establish strategic recommendations for programme delivery
- LBTH selects contractors based on RFP responses and over time may build relationships with preferred contractors that simplifies delivery
- Pilot project recommended as a priority



OPTION 3 – OUTSOURCED

- Milton Keynes successfully employed this approach with NEF
- LBTH appoints an organisation to manage, implement & monitor progress
- GLA Refit/Renew programmes have experience with projects using S106 funding and could take on significant parts of the process
- Recommended that independent third party review should be commissioned after first few projects are complete to ensure contractor is delivering



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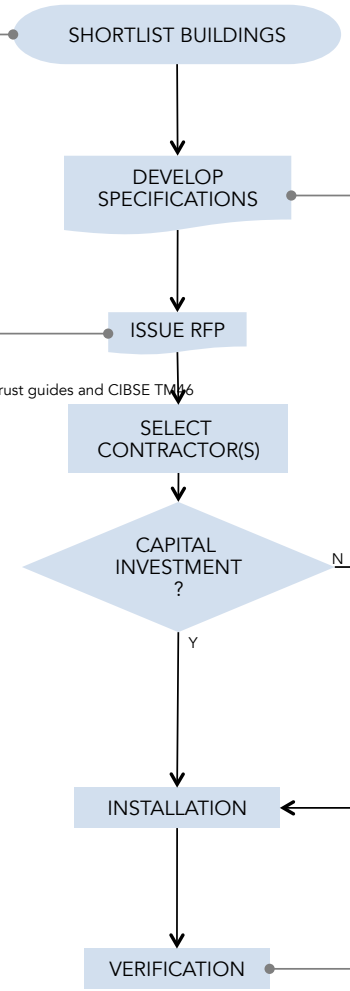
LBTH CARBON OFFSET FUND | DELIVERY STRATEGY

NAVIGATING IMPLEMENTATION

The flow chart below outlines the typical process that a building owner/manager would undergo to select an Energy Performance Contractor. Key considerations have been identified for each step of the process.



POTENTIAL DATA FOR CROSSREFERENCING

- Eligibility for s106 funding
- Display Energy Certificate data & advisory reports (available online)
- TM 44 Air conditioning reports (available online)
- Compare performance to benchmarks for similar buildings
- Fuel poverty reductions
- Job creation
- Planned maintenance/renovation
- Criteria for elimination, e.g. building lifespan
- Building occupancy
- Other low carbon & energy efficiency programmes
- Benchmarks for similar buildings such as those in DEFRA's 'Energy Consumption Guides',Carbon Trust guides and CIBSE TM46

CRITICAL STEP IN ACHIEVING SIGNIFICANT CO_2 EMISSIONS REDUCTIONS

- Companies offering EPC's generally seek 'low hanging fruit'
- LBTH has longer term interest in overall CO_2 reduction
- LBTH should carefully develop specifications to achieve best potential
- For example, specifying higher efficiency photovoltaic modules with module level power electronics (MLPE) could double annual electricity generation for the same roof area
- Symbolic value of completing a smaller number of buildings to a higher level of environmental performance
- Consider context of overall UK emission reduction requirements for 2050
- Specifications developed for pilot projects could serve as templates for later projects
- Aim to exceed good practice benchmarks for similar buildings where possible

REQUEST FOR PROPOSALS

- Assume LBTH financial instructions would govern this process
- May wish to consider contractors participating in GLA RE:NEW & RE:FIT programmes

ENERGY PERFORMANCE CONTRACTS

- 'Pay as you save' not strictly necessary as capital is available through the offset fund
- Contractual guarantee of energy savings may provide reassurance, particularly if LBTH decides to manage implementation internally
- Could use money from the carbon offset fund as leverage to achieve greater overall savings, providing LBTH or energy bill payers are comfortable with contract terms

RE:NEW Suppliers:

Axis Breyer Group Plc
British Gas Climate Energy Services Ltd
Carillion Energy Services
Enterprise
Groundwork London
Lakehouse Contracts Ltd
Osborne Energy
United House Ltd
Warm Zones CIC
Willmott Dixon Partnerships

RE:FIT Suppliers:

Bouygues Energies & Services FM (UK) Ltd
British Gas Trading Ltd
COFELY Ltd
EDF Energy Customers Plc
E.ON Energy Solutions Ltd
Honeywell Control Systems Ltd
Imtech Technical Services Ltd
MCW MITIE TFM Ltd
Norland Managed Services Ltd
Skanska Construction UK Ltd
Willmott Dixon Energy Services Ltd

OPTIONS

- Display Energy Certificates
- National benchmarks
- IPMVP
- Periodic detailed reviews of completed projects

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Appendix E

Project identification – Consultation with LBTH

LBTH CARBON OFFSET FUND | PROJECT IDENTIFICATION

DOMESTIC BUILDINGS OVERVIEW

LBTH contains approximately 131,913 properties, however cross referenced data is available for only 6% of these properties, consisting of:

- 23 bungalows
- 6556 flats
- 426 houses
- 1301 maisonettes

These properties may serve as markers to locate inefficient buildings or developments that contain other properties for which data could not be cross referenced.

In general, space heating should be a priority due to positive second order effects such as reduction in fuel poverty and associated weather related health issues. Consideration should also be given to the need to modernise properties at the same time as reducing their carbon emissions, to achieve buy in from residents.

A broad approach to domestic carbon reduction could be based on a three pronged strategy:

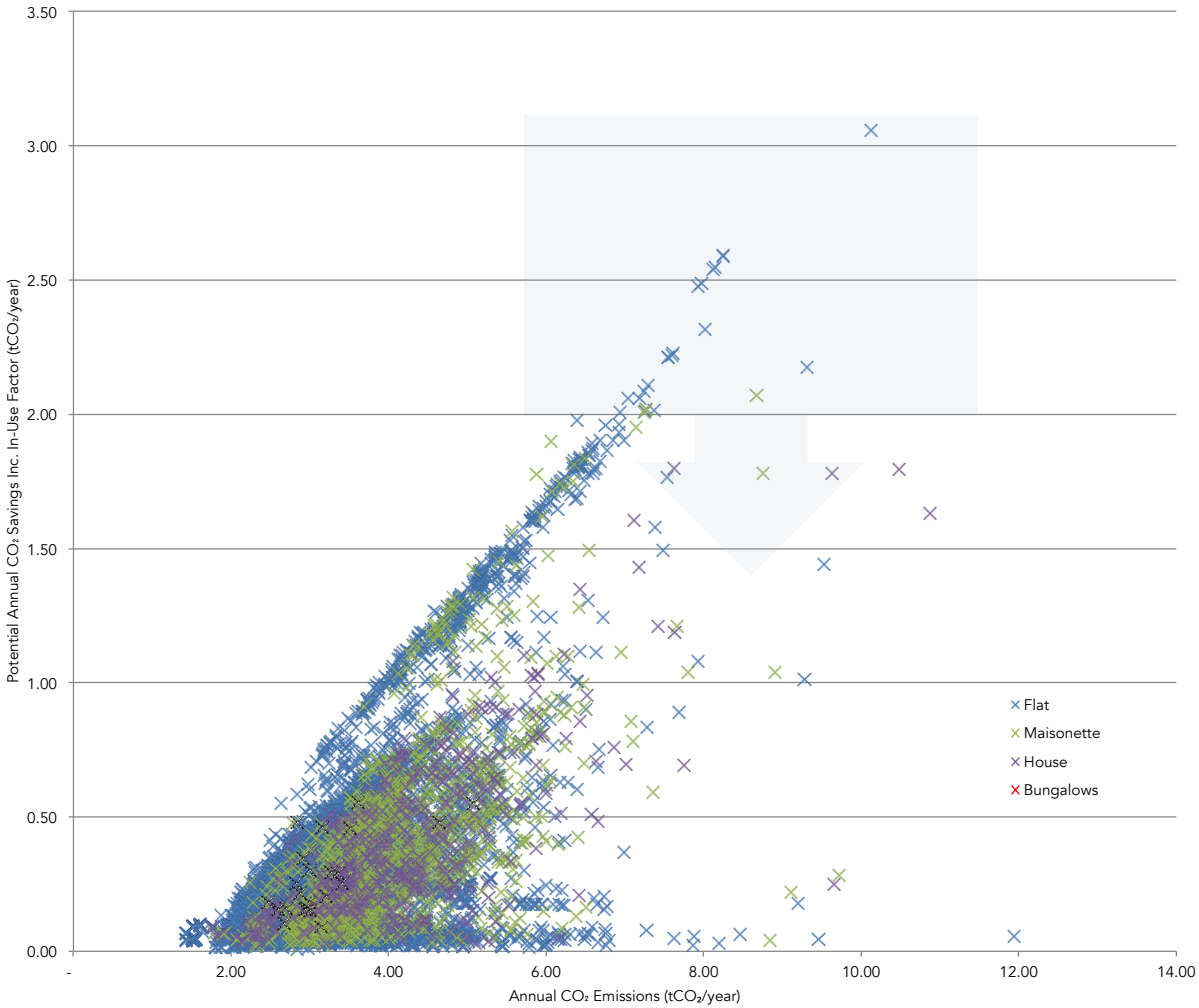
1. Plug and play solutions such as replacement light bulbs directly to a large number of properties.

2. Audit and install solutions such as photovoltaics, draught proofing, loft insulation, daylight/occupancy lighting controls, hot water tank insulation, boiler upgrades to targeted groups of properties where a whole building retrofit is not suitable.

3. Provide 'analyse, audit and deep retrofit' solutions such as wall insulation, floor insulation, secondary glazing and heating controls to larger clusters of high emission property in the same area. The economy of scale and large resultant reduction in carbon emission provided by this approach will justify the additional time required to carefully research, plan and implement the necessary retrofit works.

As with the non-domestic buildings, it is suggested that priority is given to completing a small number of pilot projects, one of which should be a deep retrofit that demonstrates the potential carbon reduction that can be achieved.

POTENTIAL CO_2 SAVINGS



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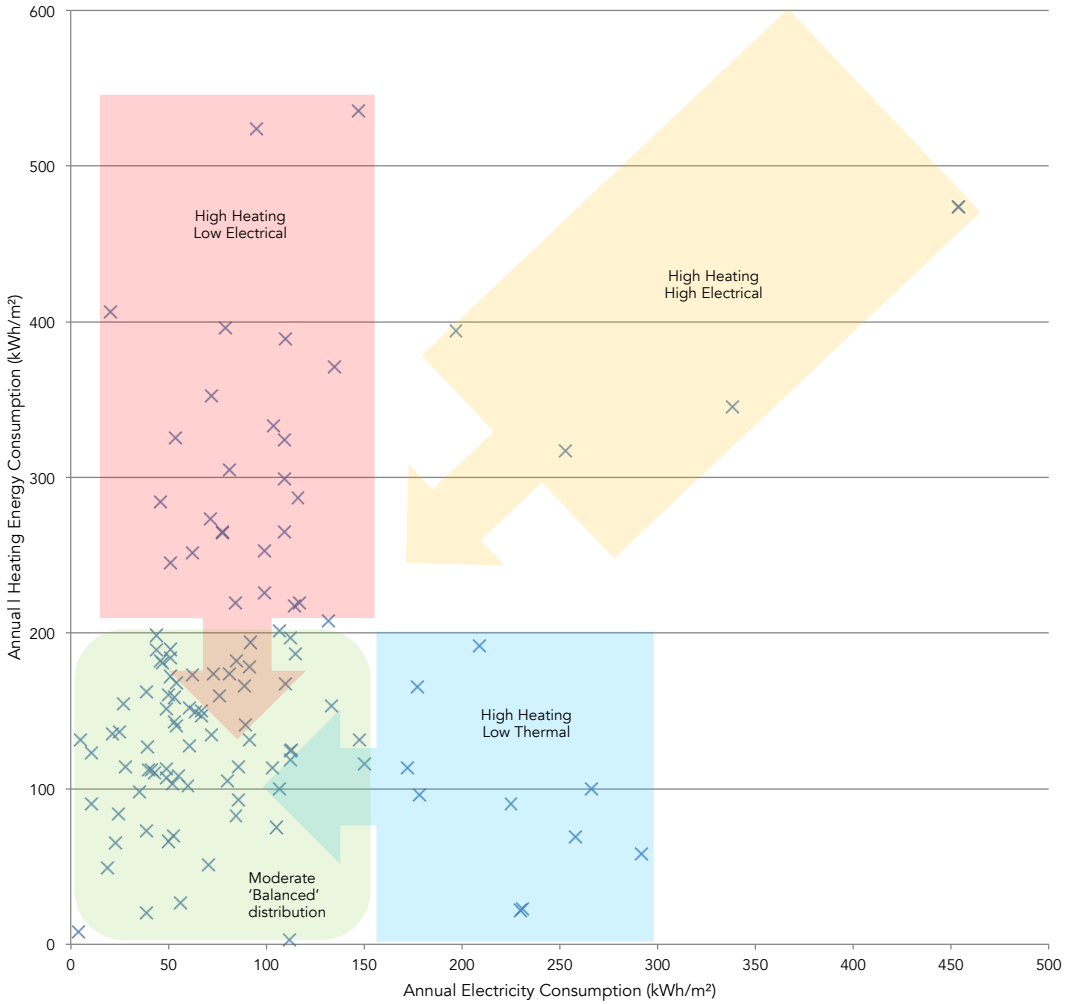
LBTH CARBON OFFSET FUND | PROJECT IDENTIFICATION

NON DOMESTIC BUILDINGS OVERVIEW

- 63 primary schools
- 14 secondary schools
- 6 special schools
- 10 Council office buildings
- 12 community centres
- 4 Idea stores
- 5 libraries
- 7 leisure centres

CHARACTERISING THERMAL VS ELECTRICAL ENERGY DEMAND



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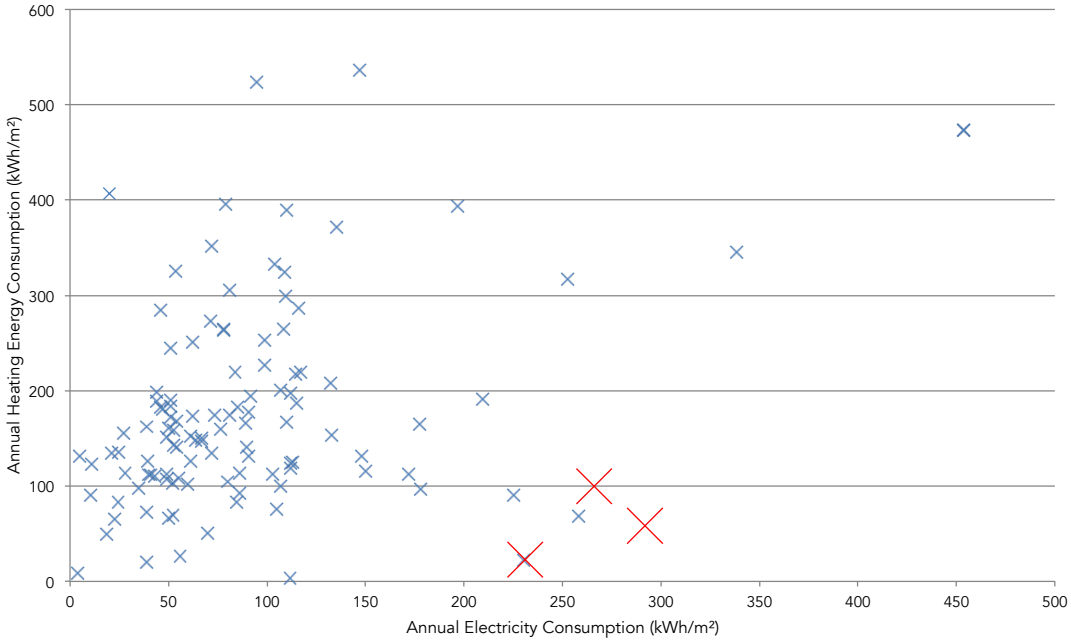
LBTH CARBON OFFSET FUND | PROJECT IDENTIFICATION

OVERVIEW | HIGH ELECTRICAL, LOW THERMAL

Buildings with high electricity consumption and low heating demand may provide straightforward opportunities for CO2 reduction as retrofit measures to reduce electricity consumption are often less intrusive than measures required to achieve similar savings by reducing thermal energy demand, with the exception of optimising heating control systems. Reductions in electricity consumption are also immediately quantifiable, enabling tracking of associated reductions in CO_2 attributable to electricity generation.

Energy and carbon reduction strategies to reduce high electrical energy consumption include:

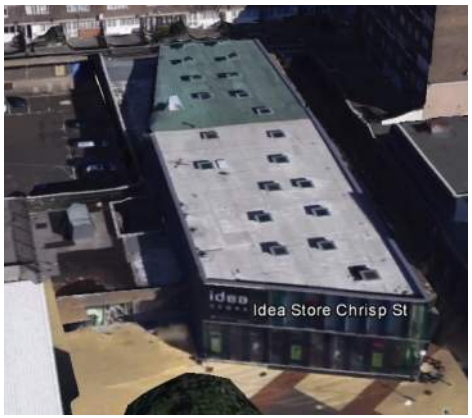
- Automated power management software for IT equipment
- Outsourcing servers to low carbon providers
- Automated occupancy and daylight controls on lighting systems
- Adjusting lighting levels to meet best practice benchmarks
- Higher lumen/watt lamps or luminaires
- Installation of PV electricity generation systems to provide low emission electricity on-site
- Consolidation of IT equipment



CHRISP ST. IDEA STORE

Electricity: 292kWh/m²/annum

Heating: 58kWh/m²/annum



DUNBRIDGE ST. PRIMARY CARE TRUST CENTRE

Electricity: 231kWh/m²/annum

Heating: 23kWh/m²/annum

CYRIL JACKSON PRIMARY SCHOOL

Electricity: 266kWh/m²/annum

Heating: 100kWh/m²/annum

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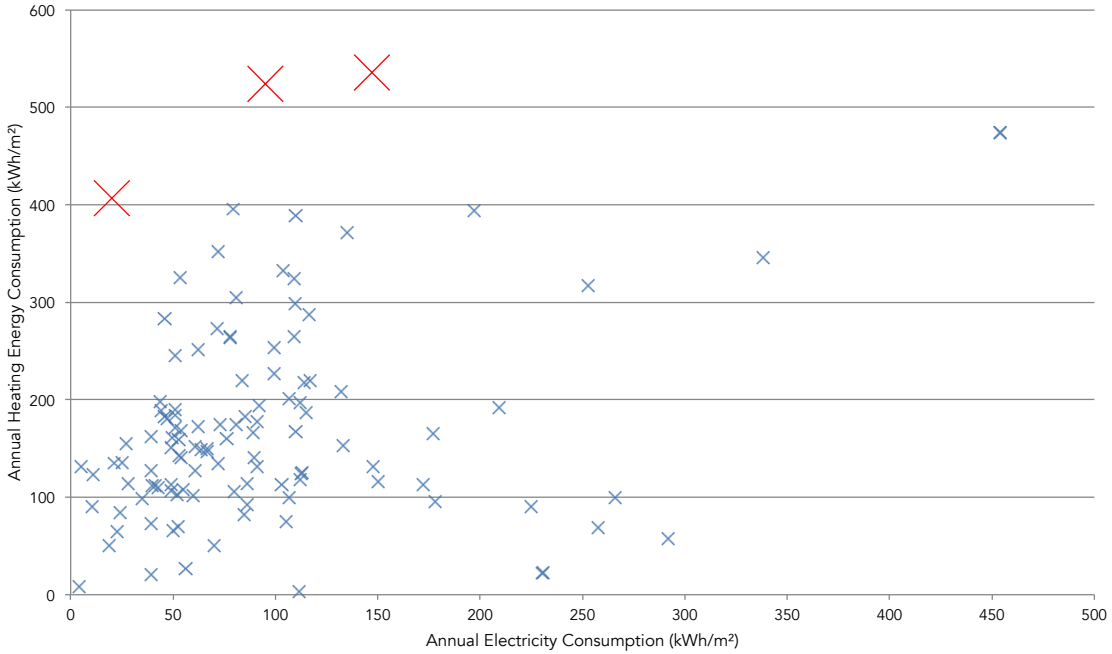
OVERVIEW | HIGH THERMAL, LOW ELECTRICAL

May indicate a building with low occupancy/utilisation and poor thermal performance due to heating control strategy, heating system efficiency or deficiencies in the thermal envelope. This pattern of energy consumption suggests that a site visit/audit may be warranted to better determine the cause of high thermal energy demand.

In some cases, this may reveal

Examples include:

- Automated power management software for IT equipment
- Automated occupancy and daylight controls on lighting systems
- Adjusting lighting levels to meet best practice benchmarks
- Higher lumen/watt lamps or luminaires
- Installation of PV electricity generation systems to provide low emission electricity on-site



PHOENIX SCHOOL

Electricity: 20kWh/m²/annum

Heating: 407kWh/m²/annum

GUARDIAN ANGELS SCHOOL

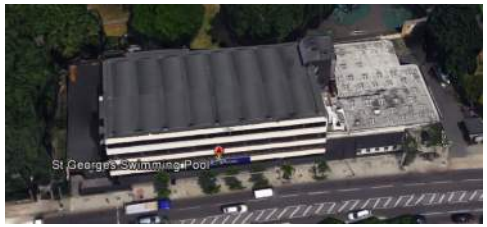
Electricity: 147kWh/m²/annum

Heating: 536kWh/m²/annum

ST GEORGES LEISURE CENTRE

Electricity: 95kWh/m²/annum

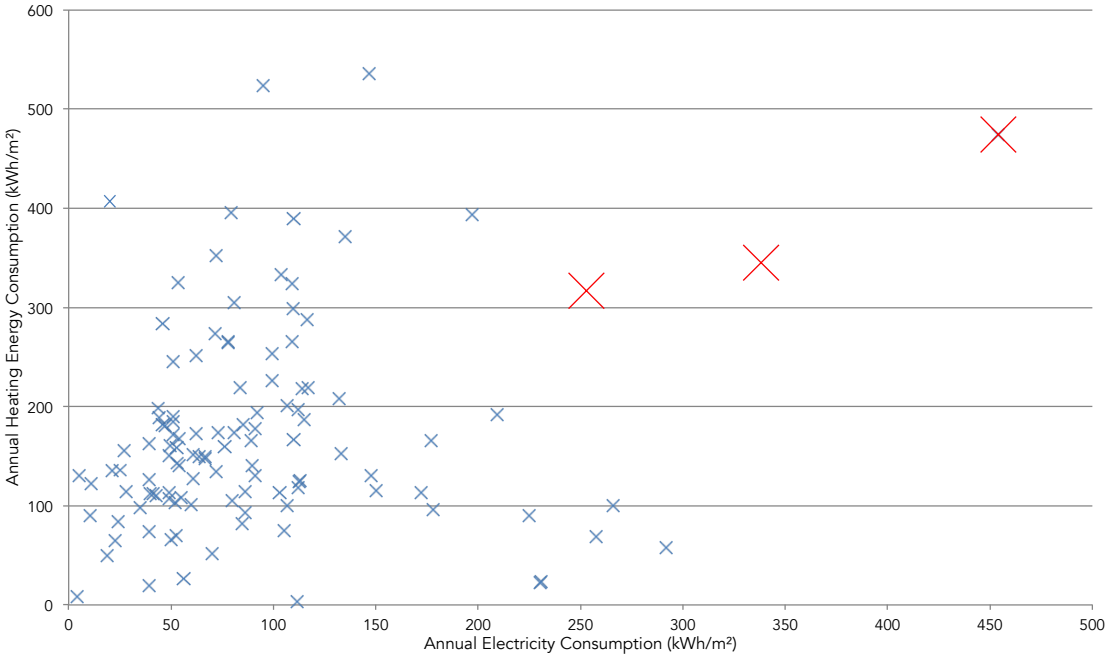
Heating: 524kWh/m²/annum



LBTH CARBON OFFSET FUND | PROJECT IDENTIFICATION

OVERVIEW | HIGH THERMAL, HIGH ELECTRICAL

May indicate a building with inherently high energy consumption, such as the London Chest Hospital. Otherwise may suggest a building with a culture of indifference toward energy consumption, poor energy management practices and generally poor levels of energy efficiency. Could also indicate there is a specific issue with one or more energy consuming system that needs to be resolved. This pattern of energy consumption suggests that a site visit/audit may be warranted to better determine the cause of high overall energy demands.



LONDON CHEST HOSPITAL

Electricity: 454kWh/m²/annum

Heating: 474kWh/m²/annum

MORPETH SECONDARY SCHOOL

Electricity: 338kWh/m²/annum

Heating: 345kWh/m²/annum

ST JOHNS C OF E PRIMARY SCHOOL

Electricity: 253kWh/m²/annum

Heating: 317kWh/m²/annum

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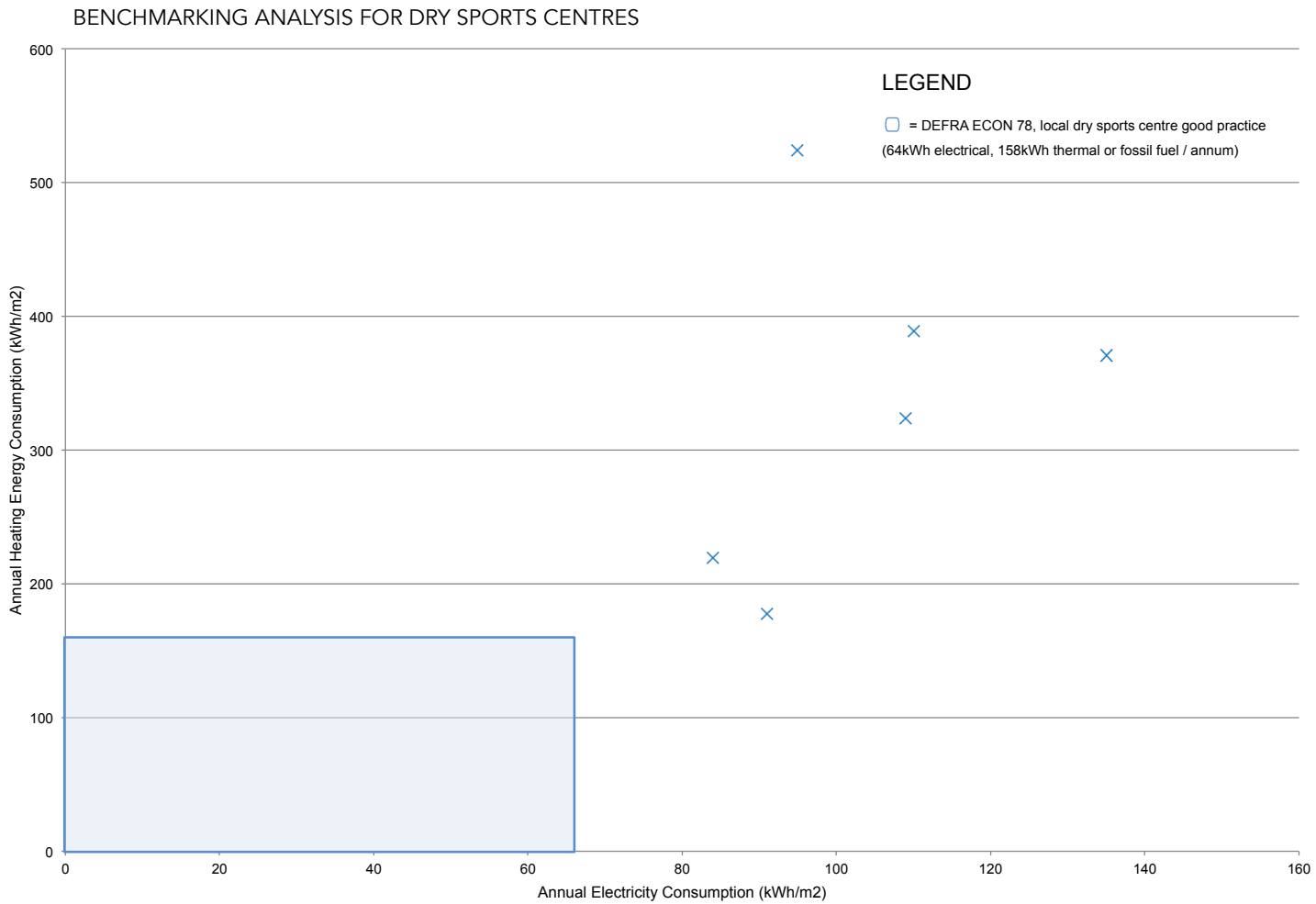
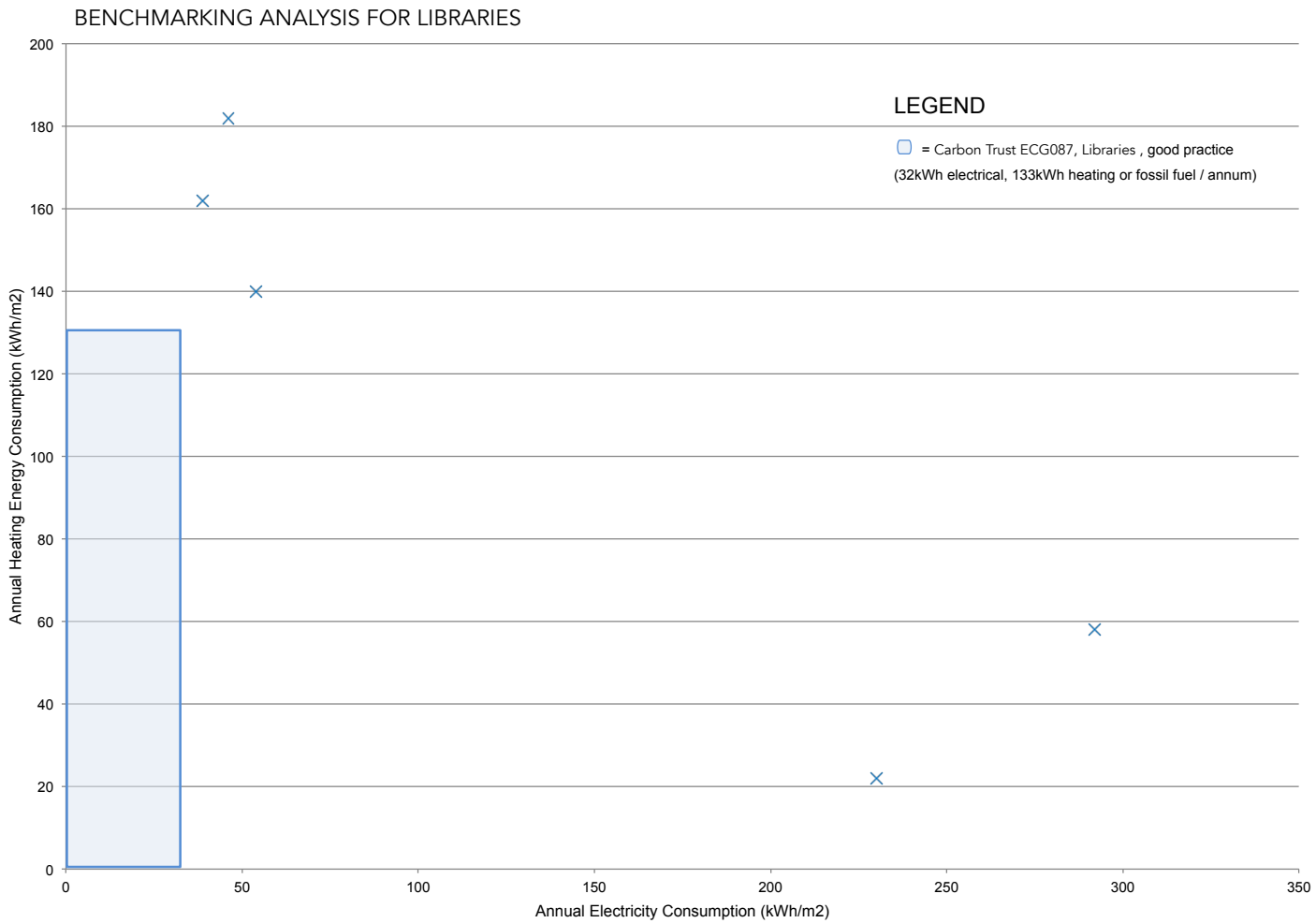
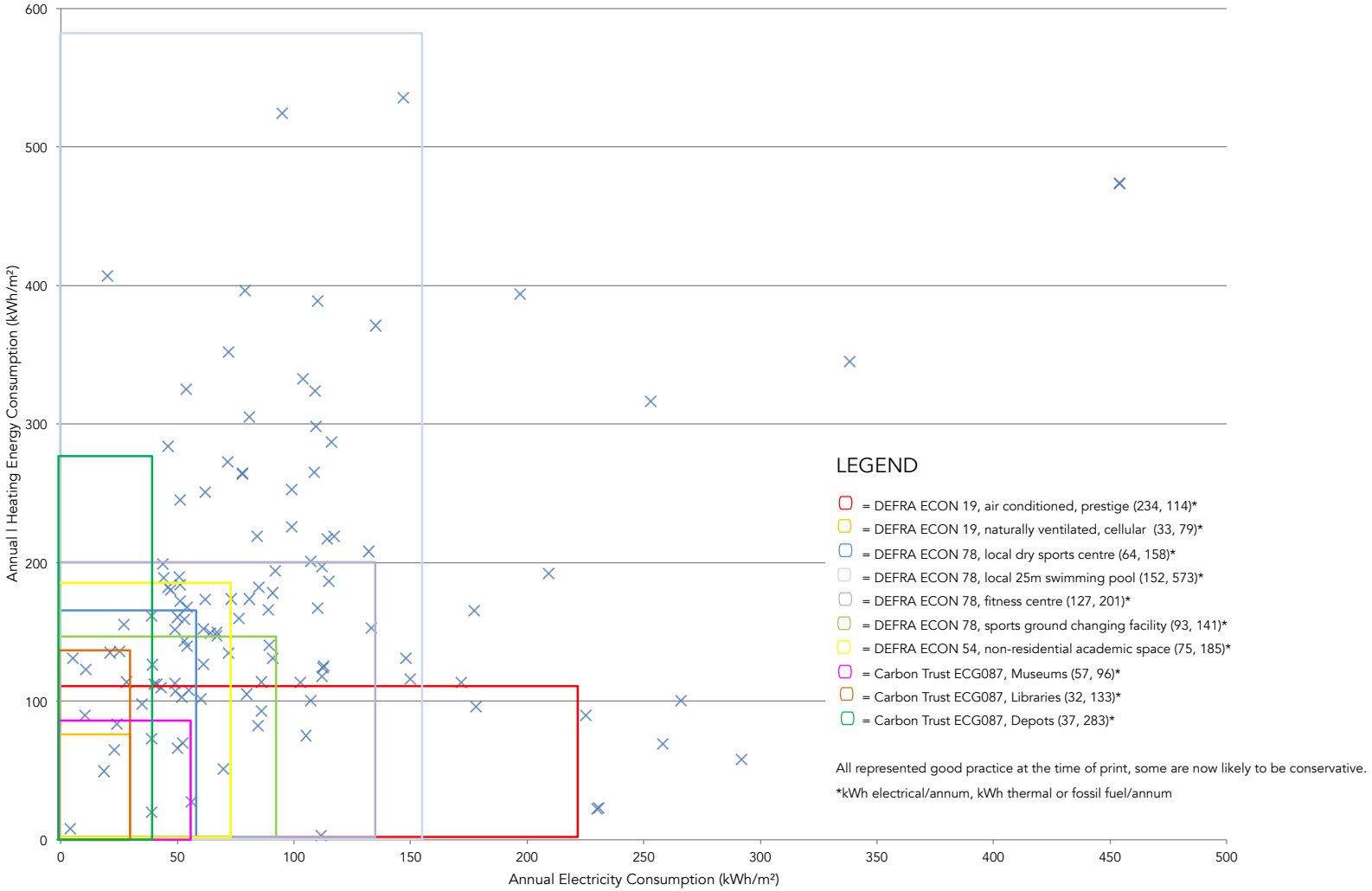

BENCHMARKING ANALYSIS FOR DRY SPORTS CENTRES
LEGEND
= DEFRA ECON 78, local dry sports centre good practice
(64kWh electrical, 158kWh thermal or fossil fuel / annum)
Annual Heating Energy Consumption (kWh/m2)
Annual Electricity Consumption (kWh/m2)
0
100
200
300
400
500
600
0
20
40
60
80
100
120
140
160


BENCHMARKING ANALYSIS FOR LIBRARIES
LEGEND
= Carbon Trust ECG087, Libraries , good practice
(32kWh electrical, 133kWh heating or fossil fuel / annum)
Annual Heating Energy Consumption (kWh/m2)
Annual Electricity Consumption (kWh/m2)
0
20
40
60
80
100
120
140
160
180
200
0
50
100
150
200
250
300
350

BENCHMARKING ANALYSIS OVERVIEW



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LBTH CARBON OFFSET FUND | PROJECT IDENTIFICATION

	DESIGN FLOOR AREA	ENERGY (kWh/m²/annum)	CO_2 (t/annum)	RETROFIT MEASURES*	INDICATIVE CAPITAL & INSTALLATION COSTS	CO_2 SAVING* (t/annum)	COST PER CO_2 SAVING* (£/t CO_2 lifetime)
CHRISP ST. IDEA STORE 	1,244 m²	Electricity: 292 Heating: 58	239	Heating upgrade BMS Lighting upgrade Lighting controls Roof insulation	£ 23,597* BMS: £6,220 Lighting retrofit auto T5: £ 9,952 Roof insulation 400mm: £24,880	172	£ 20
GUARDIAN ANGELS SCHOOL 	552 m²	Electricity: 147 Heating: 536	101	Heating upgrade BMS Lighting upgrade Lighting controls	£6,883* BMS: £2,760 Lighting retrofit auto T5: £ 4,416 Roof insulation 400mm: £11,040	77	£ 19
MORPETH SECONDARY SCHOOL 	5,279 m²	Electricity: 338 Heating: 345	1,328	Heating upgrade BMS Lighting upgrade Lighting controls Roof insulation	£100,135* BMS: £26, 395 Lighting retrofit auto T5: £ 42,232 Roof insulation 400mm: £105,580	931	£ 15

*Values based on Display Energy Certificate and associated advisory report.

THE LBTH CARBON OFFSET FUND

Delivering carbon savings, reducing fuel poverty and creating local jobs – particularly through energy efficient retrofits – are the main objectives of the London Borough of Tower Hamlets Carbon Offset Fund.

This Study reviewed current practice in the UK for carbon offsetting and led to the creation of two databases compiling data from a number of sources and integrating energy modelling. Both databases provide energy and carbon data, displaying the impact of various carbon saving measures and their associated costs. The domestic version includes data for over 8.000 properties in the social housing sector and the non-domestic version for over 120 public buildings.

These databases aim to bridge the gap between strategic decisions and individual projects: they have been linked to LBTH's Geographic Information System (GIS) which can now be used to visualise the buildings' energy performance and their carbon saving potential.

The London Borough of Tower Hamlets is the second most densely populated borough in London. At more than 260,000 residents, its population has increased by nearly 30% over the last ten years, the fastest growing population of any local authority in the country. LBTH is working towards becoming a zero carbon borough and seeks to address climate change. The LBTH Carbon Offset Fund will contribute to these aims.

Etude is a firm of Sustainability Engineers specialising in low energy new buildings and refurbishments, environmental design and assessments, research and innovation.