MAYOR OF LONDON

ENERGY PLANNING

Monitoring the implementation of London Plan energy policies in 2015

COPYRIGHT

Published by
Greater London Authority
City Hall
The Queen's Walk
More London
London SE1 2AA
www.london.gov.uk
enquiries 020 7983 4100
minicom 020 7983 4458
Copies of this report are available from www.london.gov.uk

Report Authors:
Robin Wiltshire (BRE)
Owain Jones (UCL)
Mark Roberts (GLA)

CONTENTS

Executive Summary **4**

Introduction **13**
- Strategic scale applications determined in 2015 15
- Energy policies in the London Plan 16

Application of the energy hierarchy **18**
- Meeting the targets through the energy hierarchy 19
- Step 1: Energy efficiency in new developments 20
- Step 2: New developments supporting the plans for district heating in London 21
- Step 3: Renewable energy in new developments 26

Reductions in regulated CO_2 emissions achieved in 2015 **29**
- Energy targets applied to developments in 2015 30
- Overall regulated CO_2 reductions 30
- Proportion of developments meeting the target through on-site measures 33
- The cumulative shortfall in CO_2 reductions 33
- Additional CO_2 reductions from refurbishment projects 34

Investment due to London Plan energy policies **35**

Conclusion **37**

Appendix 1: Bibliography **39**

Appendix 2: Glossary **41**

Appendix 3: Case study examples of developments **43**

EXECUTIVE SUMMARY

This document sets out the outcomes secured in 2015 as a result of implementing the Mayor's energy policies for new development, in particular Policy 5.2 for minimising carbon dioxide (CO_2) emissions.

London Plan targets have been set to ensure a progression towards zero carbon standards, and developers have continued to respond as these standards have been raised, with the majority of applicants still responding successfully to new more challenging targets; almost 95 percent have met or exceeded the appropriate Part L of the Building Regulations through energy efficiency measures alone.

Schemes submitted in 2015 continue to demonstrate a range of energy solutions based on energy efficiency and low and zero carbon technologies each of which contributes to the delivery of decentralised energy systems in London.

The information contained in this report may be of interest to developers and their consultants, planning case officers, policy officers and others with an interest in how London Plan policies are implemented.

Highlights:

Key outcomes secured in 2015 as a result of implementation of the London Plan energy policies include:

- Regulated CO_2 emission reductions of 35 percent more than required by Part L of the Building Regulations across applications considered by the Mayor.
- Cumulative regulated CO_2 emission reductions of over 49,000 tonnes per annum against the relevant Part L baseline.
- Normalised to Part L 2010 carbon emission reductions exceeded 57,000 tonnes per annum, an increase from 2014 of nearly 7 percent.
- Commitment to the provision of low carbon and renewable energy infrastructure including: Combined Heat and Power (CHP) plant able to produce over 26MW of electricity (broadly equivalent to the amount required to supply 62,000 homes) and a similar amount of heat, more than 74,000m^2 of solar photovoltaic (PV) panels (equivalent to the electricity demand requirements of around 15,000 homes) and a substantial number of heat pump installations.
- Significant investment (and with it associated employment opportunities) at each stage of the energy hierarchy including:
    - Be Lean - Investment in energy demand reduction measures resulting in an 8.4 percent reduction in CO_2 emissions compared with relevant Building Regulations in force through energy efficiency measures alone
    - Be Clean - £139 million in heat network infrastructure and associated CHP
    - Be Green - £15 million in PV panels and additional investment in other renewable energy technologies, most notably heat pumps.

Every planning application referable to the Mayor must be accompanied by an energy assessment, setting out how London Plan energy policies will be met within the development. Applicants are required to set out how the proposals apply the following energy hierarchy:

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy.

This hierarchy provides the mechanism through which the CO_2 emission reduction targets in Policy 5.2 of the London Plan are achieved. It also contributes to the implementation of strategic energy policies relating to decentralised energy systems and ensures opportunities for building occupants to receive efficient, secure and affordable energy are maximised.

A specialist team evaluates each energy assessment to ensure compliance with London Plan energy policies and, where necessary, negotiates improvements to applications.

In 2015, 147 applications which were granted provisional permission by the local planning authority were considered by the Mayor at Stage II and approved. One of these applications was for a refurbishment; consequently it was not assessed against Part L and the savings for this application are not included in the overall CO_2 emissions assessment. A further application was assessed against its own benchmark instead of Part L; however, an equivalent figure has been obtained for reduction in CO_2 emissions against Part L 2013 and consequently the estimated CO_2 savings for this application are included.

As in 2014, developments considered by the Mayor in 2015 were assessed against one of three energy targets (summarised in Table 5). Although the current target came into force during 2014 there were still some applications reaching Stage II that had been submitted at Stage I when earlier targets were still in force.

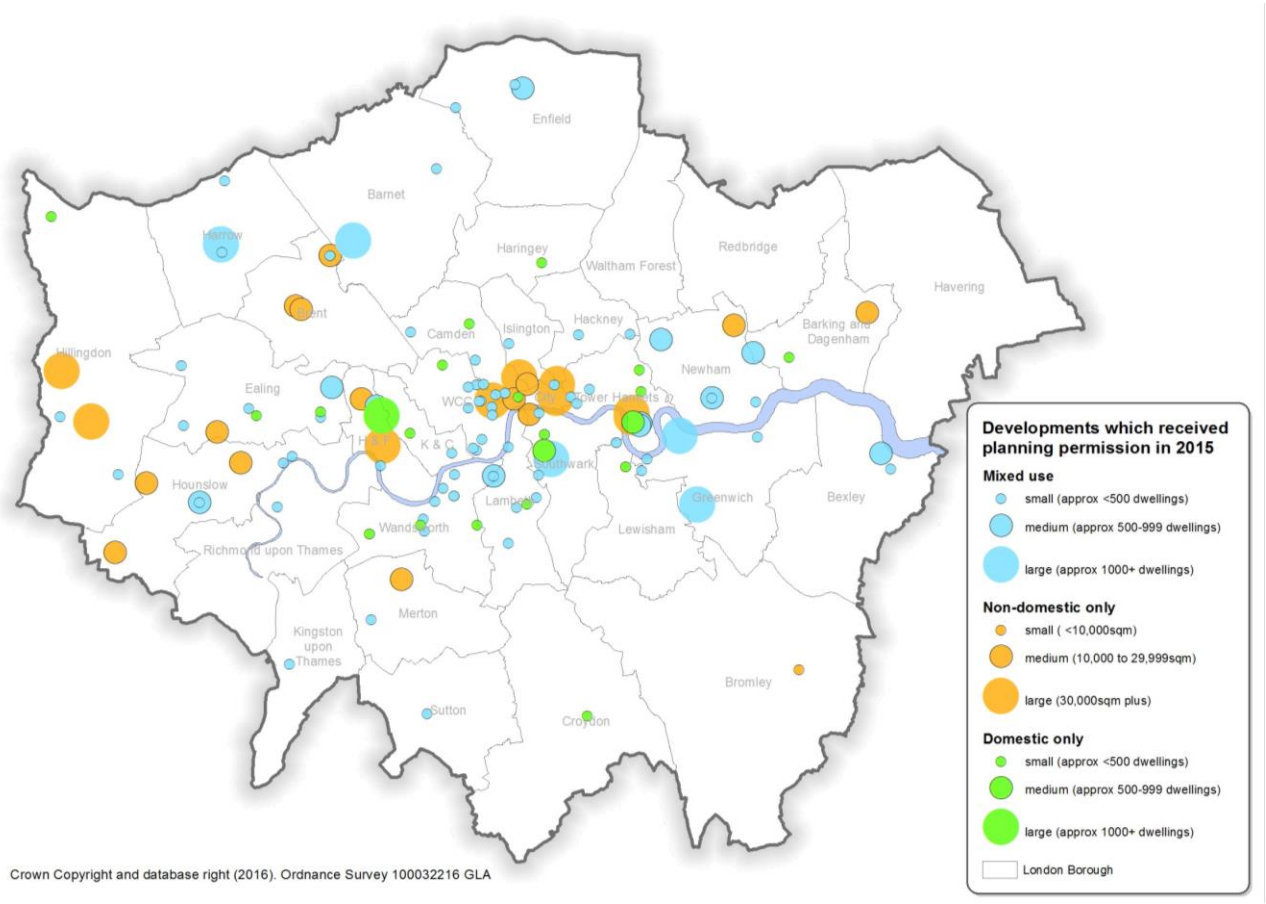
The overall reduction in CO_2 emissions for 2015 against the applicable Part L was 35 percent. This is a slightly smaller reduction than for 2014 (39 percent). However, when the figures are normalised to Part L 2010[1], the overall CO_2 savings for 2015 show a rise of 7 percent compared with the previous year.

Figure 1 shows the distribution, size and type of developments approved by the Mayor at Stage II in 2015 and hence considered in this report.

Applicants are able to meet the target of 35 percent beyond Part L 2013 in a number of ways, through different combinations of the energy hierarchy. As a precursor to determining the preferred energy supply solution, the standard of energy efficiency must at least meet Part L 2013. However, many applicants have demonstrated it is possible to significantly exceed this level in pursuit of the London Plan target.

[1] This was done to enable a like-for-like comparison with previous years, through measuring emissions reductions from the same baseline. The normalisation assumes that 2010 Building Regulation baseline emissions are uniformly 8 percent higher than 2013 Building Regulation baseline emissions.

Figure 1: Distribution of Stage II applications approved in 2015



Many solutions derive the greater part of the necessary savings from heat networks with CHP, either through on-site energy plant or by connecting to an existing network in the vicinity. Heat networks are fuel flexible; consequently some applicants have integrated renewable energy through the connection of a heat pump to a heat network.

While CHP remained the biggest contributor to CO_2 emission reductions, the importance of the other parts of the hierarchy remains clear. Almost 95 percent of the applications reaching Stage II in 2015 meet or exceed the Building Regulations through energy efficiency alone, while renewable energy is present in 78 percent of applications reaching their target. More than 50 applications deploying renewable resources would have missed their target had they not included renewable energy. Indeed, many applications make significant use of all three parts of the energy hierarchy. These differing approaches are exemplified through the case studies in Appendix 3.

Collectively the applications that have been assessed in 2015 through implementation of London Plan energy policies have continued to secure substantial energy related outcomes. Specifically, these include commitments to:

- Investment in demand reduction measures to exceed the requirements of Building Regulations through energy efficiency alone and reduce residential energy bills by circa £300,000 per annum.
- New heat network infrastructure and associated generation equipment including:
    - Circa £22 million of investment in combined heat and power (CHP) plant to produce almost 32MW of electricity and a similar amount of heat, broadly equivalent to the amount required to supply 62,000 homes.
    - Approximately £117 million of investment in heat network infrastructure for nearly 47,000 communally heated dwellings.
    - Approximately 60 new permanent jobs created in order to operate and maintain the heat network infrastructure and associated energy generation equipment.
- Investment in renewable energy equipment, including circa £15 million to install nearly 74,000m^2 of photovoltaic (PV) panels, accruing to about 7.5MW of new electrical capacity and equivalent to the demand of circa 15,000 homes.

The regulated CO_2 emissions after each stage of the energy hierarchy are shown in Figure 2 below. These are shown separately for those applications that were assessed against the 2010 Building Regulations, and those that were assessed against the 2013 Building Regulations.

Most of the applications considered at Stage II in 2015 were assessed against the target of 35 percent beyond Part L 2013, this having been introduced in 2014. This superseded, but was equivalent to, the London Plan target of 40 percent beyond Part L 2010 that was applied to earlier applications that were received at Stage I from October 2013. There were also still a few schemes reaching Stage II during 2015 whose Stage I submission preceded this, and these were consequently assessed against the earlier target of 25 per cent beyond Part L 2010.

Table 1 summarises 2013, 2014 and 2015 applications and the targets they were assessed against.

Table 1: Applications and targets in 2013, 2014 and 2015

Target applicable to developments	Number of applications 2013	Number of applications 2014[2]	Number of applications 2015[3]
25 percent beyond Part L 2010	173	44	6
40 percent beyond Part L 2010	1	89	21
35 percent beyond Part L 2013[4]	N/A	7	118

[2] Excludes refurbishment schemes
[3] Excludes schemes not assessed against Part L (one refurbishment and one other)
[4] Equivalent to 40 percent beyond Part L 2010

Figure 2: Cumulative reductions secured in CO_2 emissions at each stage of the London Plan hierarchy for developments assessed against Part L 2010 and Part L 2013

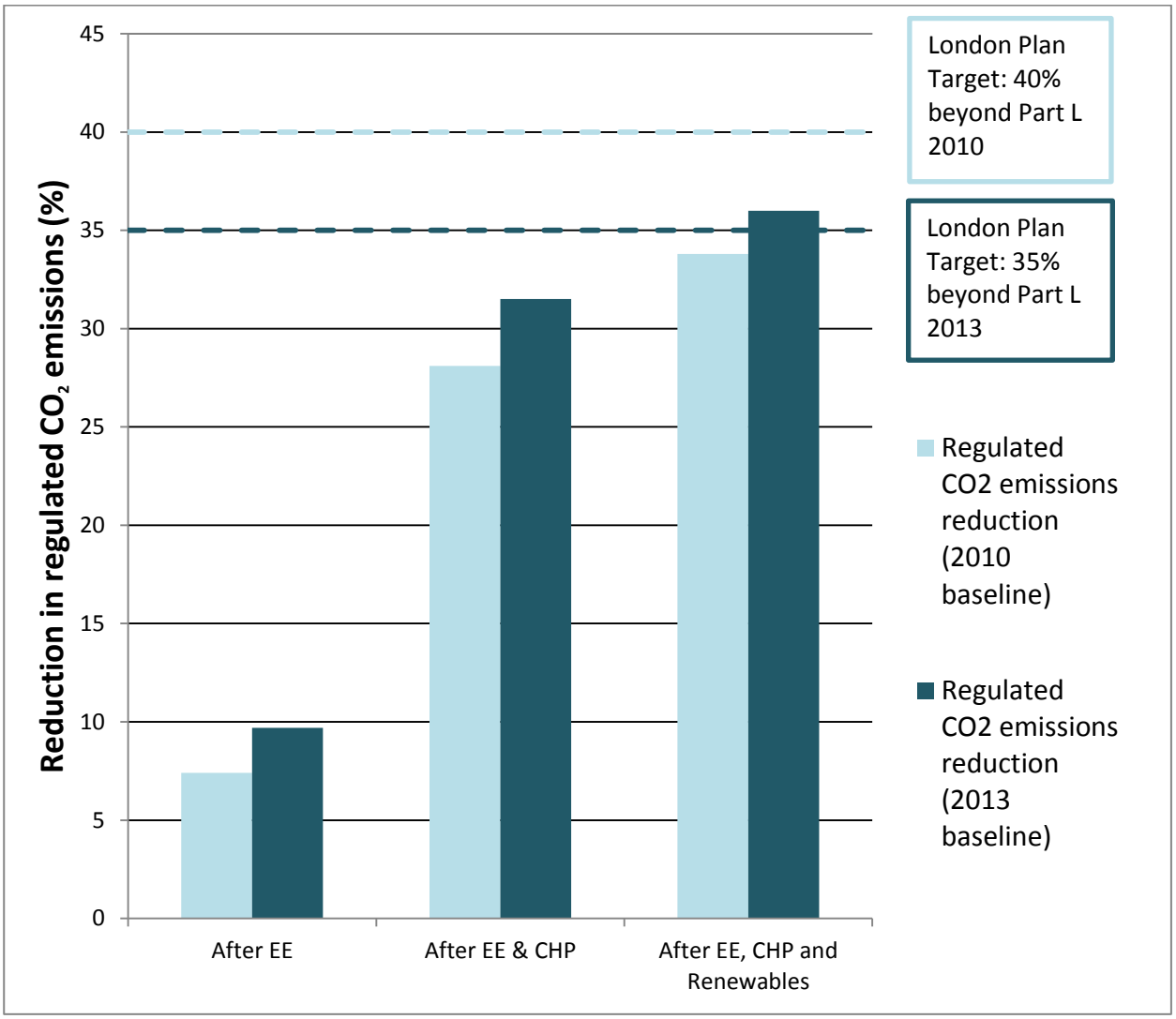


Table 2 compares the statistics for applications received each year from 2010 to 2015. There was a small increase in the number of applications reaching Stage II compared with 2014, and a substantial increase both in the total number of dwellings and also the non-domestic floor area across all applications.

Table 2: Comparison of 2010, 2011, 2012, 2013, 2014 and 2015 figures

	2010	2011	2012	2013	2014	2015
Stage II applications	112	118	171	174	142	**147**
Number of dwellings in development	28,181	32,051	55,879	43,178	43,814	**52,014**
Estimated domestic floor area[5] (million m^2)	2.0	2.2	3.9	3.0	3.1	**3.6**
Non-domestic floor area (million m^2)	2.2	1.5	2.3	2.3	2.0	**2.7**
Regulated CO_2 emissions reductions compared to appropriate Part L (2010 or 2013) Building Regulations (percent)	33%	33%	36%	36%	39%	**35%[6]**
Regulated CO_2 emissions reductions compared to appropriate Part L (2010 or 2013) Building Regulations (tonnes per annum)	35,598	41,136	59,817	49,474	53,423	**49,147[6]**
Regulated CO_2 emissions reductions normalised to Part L 2010 comparison (percent)	33%	33%	36%	36%	39%	**39%[6]**
Regulated CO_2 emissions reductions normalised to Part L 2010 comparison (tonnes per annum)	35,598	41,136	59,817	49,474	53,643	**57,305[6]**
Dwellings connected to heat networks	27,000	31,000	53,000	41,097	40,160	**46,717**
Proposed CHP electrical capacity (MW)	28	17	29	25	20	**32**
PV Panels (m^2)	22,500	49,000	87,000	71,354	82,405	**73,702**

[5] Assumes that the average dwelling receiving planning approval has an internal area of 70m^2

[6] These figures exclude the reduction of CO_2 emissions from the refurbishment of Deephams Sewage Works, which reached Stage II in 2015 (savings in carbon emissions have been estimated to accrue to 8,706 tonnes CO_2). Included in this data is the estimated CO_2 emissions reduction for the Greenwich Masterplan which reached Stage II in 2015; although not assessed against Part L, it has been assessed against standards that are comparable to Part L 2013.

The commitments secured during 2015 will reduce fossil fuel use leading to a total of more than 49,000 tonnes per annum of regulated CO_2 emission reductions, over and above those reductions required to comply with the appropriate Part L (2010 or 2013) of the Building Regulations. This is broadly equivalent to retrofitting loft insulation in more than 82,000 existing homes.

For 2015, 81 percent of applications were assessed against the stricter 2013 Part L, compared with only 5 per cent in 2014. For this reason additional rows have been included in Table 2 with carbon reduction quantities and percentages normalised to 2010 Part L. This enables the carbon saving trajectory to be fully appreciated. Thus when the figures are normalised to Part L 2010 for year on year comparison, the figure for regulated CO_2 emission reductions for 2015 is in excess of 57,000 tonnes per annum.

The figures in Table 2 refer purely to the on-site commitments. When developments are unable to reach the target on-site, the London Plan requires the developer to agree a cash-in-lieu contribution with the local borough to account for the shortfall in CO_2 emission reductions (see Policy 5.2E).

The total proposed CHP capacity has increased to over 32MWe, a substantial increase from the 2014 figure, a reversal to the decline seen since 2012 and the highest figure recorded for proposed CHP capacity. The amount of solar PV proposed fell back compared with 2014 but remains a large overall figure, and (Table 9) is actually spread over a higher number of schemes, thereby continuing to demonstrate the consolidation of the role played by renewable energy in contributing to developments reaching the London Plan target.

Table 3 presents a further comparison based on estimating CO_2 emissions per unit floor area for applications. This indicates a significant shift as more stringent targets have been introduced.

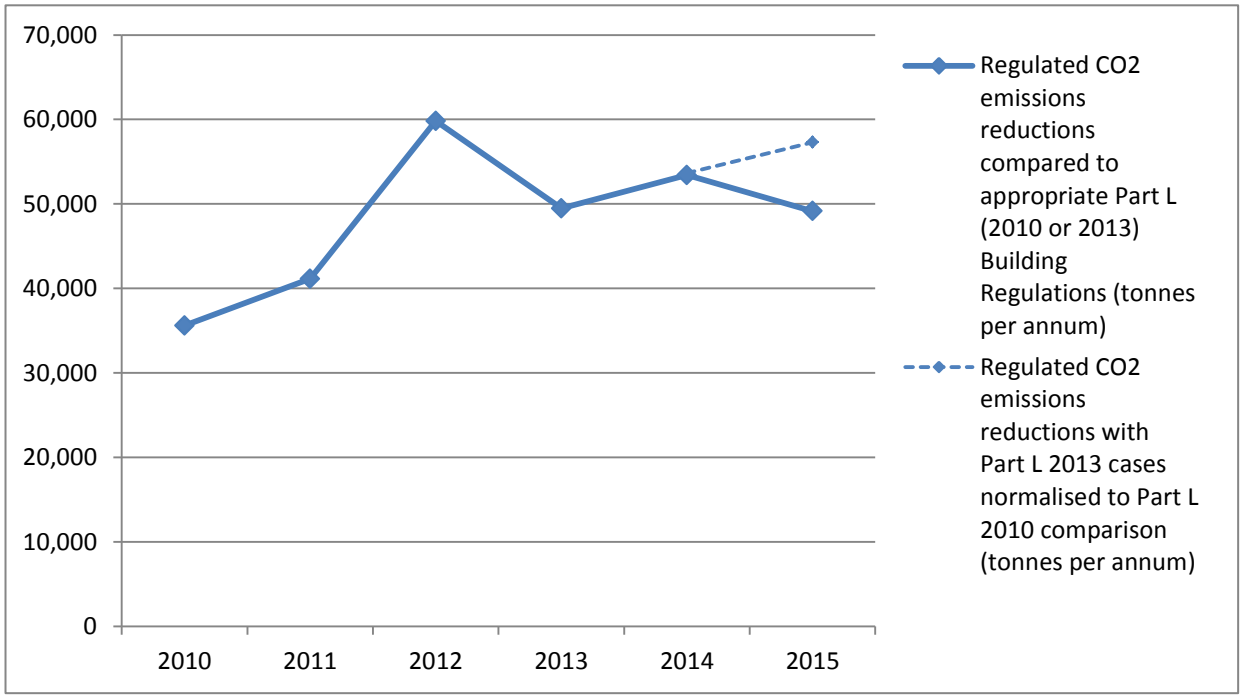
Table 3: CO2 emissions vs floor area 2013, 2014 and 2015

Year	Ratio of domestic: non-domestic[7]	Total Floor Area (million m²)	Baseline emissions (tCO_2)[8]	Baseline emissions/ floor area (tCO_2/ million m²)	Final emissions (tCO_2)	Final emissions/ floor area (tCO_2/ million m²)
2013	1.3	5.3	137,428	25,930	87,954	16,595
2014	1.55	5.1	136,982	26,859	83,559	16,384
2015	1.33	6.3	138,967	22,058	89,820	14,257

[7] Excludes refurbishment schemes
[8] Aggregated from the relevant Part L 2010 or 2013 baseline emission figures for each application

Figure 3 shows the reduction in carbon emissions referenced to the applicable Part L (2010 or 2013) and (dotted line) referenced to a common baseline of Part L 2010.

Figure 3: Annual reduction in regulated CO_2 emissions referenced to applicable Part L (2010 or 2013) and normalised to Part L 2010



INTRODUCTION

Many sites in London are experiencing a dynamic period of regeneration, with the skyline featuring bold new development as well as familiar heritage buildings. An integral part of this is the opportunity for the emergence of a low carbon, resource efficient city that provides Londoners with a high quality environment within which to live and work.

Through the implementation of the London Plan[9] this opportunity for transformation is being taken by boroughs across the city. By implementing high standards of buildings' energy efficiency together with the integration of low carbon and renewable technologies, boroughs and developers are demonstrating in diverse ways their commitment to a sustainable future. The targets that reflect London's energy policies have continued to substantially exceed those required by the national Building Regulations.

The construction of new buildings and homes, accompanied by increased investment in energy efficiency measures, infrastructure and low and zero carbon technologies, stimulated through London's policies, also has a positive effect on employment and job creation.

Policy 5.2 of the London Plan sets CO_2 emission reduction targets for new buildings, aligned to previous governments' plans for zero carbon homes from 2016 and zero carbon non-domestic buildings from 2019. The targets support the development of energy efficient new buildings and investment in infrastructure to supply the remaining building stock energy efficiently. These policies may also enable additional benefits for building occupants through provision of affordable energy and increased security of energy supply, while also minimising the impact on the existing energy network.

Policy 5.5 of the London Plan outlines how the Mayor expects 25 percent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025, and prioritises the development of heat networks at the development and area wide levels accordingly. The delivery of decentralised energy in London is supported through the planning process by prioritising connection to existing decentralised energy networks and requiring the implementation of site wide heat networks where appropriate in new developments which are the subject of strategic planning applications.

An energy assessment is required for each planning application referable to the Mayor. In preparing these, applicants are required to follow the Greater London Authority (GLA) guidance on preparing energy assessments.[10] Each energy assessment is then evaluated on a case by case basis by a dedicated energy planning team to ensure compliance with London Plan policies and ensure each development (where appropriate) contributes to the long term plans for decentralised energy in London. The evaluation recognises the particular circumstances of individual developments and the constraints that apply in each case.

The regulated CO_2 emission reductions and infrastructure commitments secured through the planning process from applications determined in 2015 have been evaluated. This report presents the results of

[9] The London Plan is available here https://www.london.gov.uk/priorities/planning/london-plan
[10] http://www.london.gov.uk/priorities/planning/strategic-planning-applications/preplanning-application-meeting-service/energy-planning-gla-guidance-on-preparing-energy-assessments

the evaluation; it also provides details of the uptake of measures that have led to those savings, including energy efficiency, implementation of CHP and renewable energy sources.

Strategic scale applications determined in 2015

The Mayor is responsible for London's planning at a strategic level.[11] The 32 London boroughs and the City of London are the local planning authorities for their areas.[12]

The Mayor is required to provide a statement of compliance with the London Plan within six weeks of receiving an application from the local planning authority (this statement is commonly referred to as a Stage I report). Once the planning authority has resolved to determine the application, the application is referred back to the Mayor to decide whether to direct refusal, take over the application for his own determination or allow the planning authority's decision to stand. The Mayor's decision (commonly known as Stage II) takes the form of an officer's report to the Mayor and a letter from the Mayor. For applications that are refused by the local planning authority but subsequently taken over by the Mayor, there is an additional Stage III.

A total of 147 applications which had been granted provisional permission by the local planning authority were considered by the Mayor at Stage II in 2015 and approved. There were also 15 additional applications that were refused by the local planning authority but not taken over by the Mayor in 2014, and a further 3 that were approved by the local planning authority but refused by the Mayor.

Table 4 gives a breakdown of the approved 147 applications by development type. 146 of these were new-build developments; the remaining one was for refurbishment of Deephams Sewage Works.

Table 4: Breakdown by category of applications at Stage II in 2015

Type of development	Number of developments	Number of dwellings	Non-domestic floor area (millions m^2)
Mixed use[13]	86	45,958	1.6
Domestic	21	6,056	N/A
Non-domestic	40	N/A	1.1
Total	**147**	**52,014**	**2.7**

[11] Criteria for referable planning applications can be found here - https://www.london.gov.uk/sites/default/files/archives/uploads-summary-of-order-2008_0.pdf

[12] The London Legacy Development Corporation is the local planning authority for parts of east London. The Old Oak and Park Royal Development Corporation is the local planning authority for the area around and including Old Oak and Park Royal. The Greater London Authority Acts 1999 and 2007 require the boroughs to consult the Mayor of London on planning applications that are of potential strategic importance to London, as defined by the government and set out in The Town and Country Planning (Mayor of London) Order 2008.

[13] All these developments have a residential and commercial component

Energy policies in the London Plan

In Policy 5.1 the Mayor states his intention to seek to achieve an overall reduction in CO_2 emissions of 60 percent (below 1990 levels) by 2025. It is expected that the GLA Group, London boroughs and other organisations will contribute to meeting this strategic reduction target, and the GLA will monitor progress towards its achievement.

The modelling which informed the 60 percent CO_2 reduction by 2025 target assumed all new homes will need to be zero carbon from 2016, and non-domestic buildings from 2019. Accordingly, the target for new homes has now increased, as detailed within the Housing Supplementary Planning Guidance document.[14]

The contribution of new-build developments to CO_2 reduction targets may be modest compared to the existing building stock; however, it has an important role to play in demonstrating best practice in building design, ensuring resilience to future climate and energy supply changes and catalysing new, area wide decentralised energy schemes.

Policy 5.2A requires that developments should make the fullest contribution to CO_2 emissions in accordance with the following hierarchy:

1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy

Policy 5.2B sets targets for CO_2 reductions in buildings. These targets are expressed as minimum improvements over the Target Emissions Rate (TER) outlined in Part L 2010 of the Building Regulations. When Part L 2013 of the Building Regulations came into effect on 6 April 2014 the London Plan target was recalibrated to take account of the overall six percent reduction in CO_2 emissions from new residential buildings and an overall nine percent reduction in CO_2 emissions from new non-residential buildings compared to 2010. To retain the existing simple approach to assessing CO_2 reductions across a development, a flat percentage target of 35 percent beyond Part L 2013 across both residential and non-domestic buildings is now applied by the Mayor. This is deemed to be broadly equivalent to the 40 percent target beyond Part L 2010 of the Building Regulations.

Table 5 sets out the time periods over which each London Plan target has been applied and the number of developments under each target considered by the Mayor at Stage II in 2015. This includes new build applications only so it excludes Deephams Sewage Works (a refurbishment). It also excludes the Greenwich Masterplan because this development was not assessed against Part L. However, this development has been assessed against standards that have been found to be comparable to Part L 2013; consequently, estimated CO_2 savings from this development are included in Table 2.

Major development proposals are required to provide a detailed energy assessment to demonstrate how the targets for CO_2 emissions reduction outlined above are to be met within the framework of the energy hierarchy. Where it is clearly demonstrated that the specific targets cannot be fully achieved

[14] Housing Supplementary Planning Guidance (SPG) is available at https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance

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 CO_2 savings elsewhere.

Table 5: Targets and their periods of applicability (for applications received by the GLA at Stage I)

Target	Applicable from	Applicable until	Number of developments in 2015
25 percent beyond Part L 2010	2010	30/09/2013	6
40 percent beyond Part L 2010	1/10/2013	5/07/2014	21
35 percent beyond Part L 2013[15]	6/04/2014	ongoing	118

[15] The 35 percent beyond Part L 2013 was devised to be equivalent to the existing 40 percent beyond Part L 2010 target. A transition period applied between 6/04/2014 and 5/07/2014 when applicants were able to present their CO_2 reductions relative to either a 2010 or 2013 baseline.

APPLICATION OF THE ENERGY HIERARCHY

Meeting the targets through the energy hierarchy

The energy hierarchy, which is an embedded part of the London Plan and underpins the energy policies it contains, follows the sequence:

- Step 1: use less energy (be lean)
- Step 2: supply energy efficiently, supporting plans for decentralised energy in London (be clean)
- Step 3: use renewable energy (be green)

All developments are expected to comply with the requirement to reach Part L of the Building Regulations through energy efficiency measures alone (Step 1). The vast majority of applicants, including each of the case study developments, have been able to comply with this. In reaching beyond this in order to achieve their London Plan target, developments are able to apply different combinations of these steps in different proportions.

The case studies in Appendix 3 demonstrate how five of the applications determined in 2015 applied the energy hierarchy to achieve the Mayor's target. The case studies feature both Inner and Outer London boroughs.

The regeneration of the residential Aylesbury Estate in LB Southwark will deploy 3MWe of CHP, by means of a site heat network, thereby contributing 28 percent towards the 35 percent target for carbon emissions reductions. However, both enhanced energy efficiency performance and the renewable contribution made by a substantial area of PV panels are also specified in order for this development to reach the 35 percent target.

It may be possible for the Aylesbury site heat network to connect at a later date to an existing district heating network in the vicinity. This approach is taken directly in the second case study: the mixed residential, retail and office development at Morgan House and Stratford Centre in LB Newham which is very close to the existing Stratford District Heating Network and is able to significantly exceed the target by directly connecting.

The 280m tower at 22 Bishopsgate in the City of London includes CHP and thermal storage, but plans to achieve 26 percent of its savings through innovative fabric design comprising a closed cavity façade that provides a high level of insulation while also integrating a retractable shading device to avoid potential overheating.

The redevelopment of the Chase Farm Hospital in LB Enfield will feature residential units and a school as well as the hospital itself. The approach here to meeting the 35 percent target includes significant contributions from all three steps in the hierarchy, most prominently from energy efficiency measures and renewables.

The Rectory Park Estate in Northolt (LB Ealing) provides an example of a residential development that reaches its target by means of energy efficiency and renewable energy only, with the latter contributing 23 percent towards the 35 percent target, by integrating more than 2000m^2 of PV panels.

Major refurbishment schemes are expected to apply the energy hierarchy. However the potential for CO_2 emission reductions is assessed on a case-by-case basis given the variability between schemes. Among the 147 schemes included in this report is one refurbishment project. The CO_2 reduction from this scheme is not included in the total savings because it is a refurbishment of an existing sewage works. The CO_2 savings are, however, substantial at 8,706 tonnes. In general, high CO_2 emission reductions can be achieved through refurbishment, while also improving the existing building stock.

Step 1: Energy efficiency in new developments

Policy 5.3 of the London Plan states that the highest standards of sustainable design and construction should be achieved to improve environmental performance of new developments and in order to adapt to the effects of climate change over their lifetime. Development proposals should demonstrate that sustainable design standards are integral to the proposal and ensure that they are considered at the beginning of the design process.

New developments are required to incorporate passive and active energy efficiency measures in order to minimise the demand for energy. In addition to enhancing the design of the building, developments are required to include active measures such as energy efficient lighting, heat recovery systems and advanced controls. They should also include measures to avoid internal overheating and contributing to the urban heat island effect.

As energy efficiency is the first element of the energy hierarchy, developers are required to commit to improving energy efficiency before deciding on CHP and renewable energy systems. This approach is reinforced by requiring developments to reduce regulated CO_2 emissions below those of a Building Regulations compliant development through energy efficiency alone.

Almost 95 percent of applications reaching Stage II in 2015 achieved the level required by the Building Regulations through Step 1 (energy efficiency measures) alone. The case studies (Appendix 3) provide examples of this, with effective measures taking the contribution from energy efficiency in three of the cases beyond the average through a combination of increased insulation and air tightness to reduce heating demand and design features that minimise associated cooling demand.

As well as being a cost effective way of achieving CO_2 reductions, improving fabric energy efficiency can have a positive benefit for building occupants through reduced energy bills. This is particularly relevant for low-income households in helping tackle fuel poverty.

Be Lean reductions

Overall, applications reaching Stage II in 2015 achieved, through energy efficiency measures alone, an average of 8.4 percent reduction in regulated CO_2 emissions against the relevant Part L baseline. However, when the tightening of the Building Regulations is taken into account, by normalising CO_2 emission reductions to Part L 2010, the contribution from energy efficiency measures alone is the same, at 14 percent, for 2015 as it was for 2014.

The majority of 2015 Stage II applications were assessed against Part L 2013 of the Building Regulations; these applications achieved an average 9.7 percent reduction in regulated CO_2 emissions from energy efficiency measures alone. This significantly exceeds the average 6 percent reduction accorded to the small number of applications that were assessed against Part L 2013 the previous year. This goes well beyond the Target Fabric Energy Efficiency (TFEE) standard introduced in Part L 2013 and is particularly impressive given the tightening of energy standards between Part L 2010 and Part L 2013 of the Building Regulations.

Overheating and cooling demand

Energy efficiency measures tend to focus mainly on reducing heating demand. However, it is increasingly important that attention is paid to avoiding discomfort arising from overheating, and minimising energy consumption and attendant CO_2 emissions resulting from cooling demand, particularly when considering the climate buildings may be operating in during decades to come.

The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of buildings to avoid overheating and excessive heat generation, and to reduce overheating due to the impacts of climate change and the urban heat island effect on an area wide basis.

Major development proposals are required to demonstrate the approach they have taken to reducing potential overheating and reliance on air conditioning systems, following the cooling hierarchy in policy 5.9. The cooling hierarchy prioritises passive measures, built into the design of buildings to reduce the overheating risk. These measures may include shading, orientation and fenestration to reduce solar gains, together with green roofs and walls. The presence of excess heat within the building can also be managed through coupling with thermal mass. Policy 5.9 sets out a cooling hierarchy that encourages passive ventilation, where possible to address any cooling demands.

This approach is evident in the case studies (Appendix 3), where examples of demand reduction include LED lighting, optimisation of solar transmittance of glass, and window solar controls, together with passive features including balconies and windows set back in recesses for shading, and design layout to promote natural cross and stack ventilation.

Step 2: New developments supporting the plans for decentralised energy in London

Opportunities for developing district heating

The Mayor has a target for 25 percent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025.[16] In order to achieve this target the Mayor prioritises decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

The implementation of the 'Be Clean' element of the energy hierarchy in Policy 5.2 plays an important role both in providing an opportunity, through large new developments, for new heat networks to be established and in ensuring new developments are ready to connect to decentralised networks as and when the opportunity arises.

[16] Mayor of London, *London Plan 2015. Consolidated with Alterations since 2011*, Policy 5.5A

Such networks are fuel flexible and very well suited to supply from low carbon technologies. The aggregation of the heat demands from many buildings produces a smoother overall heat demand which enables plant to run for a high proportion of the time, in turn assisting its efficiency and cost-effectiveness, notably important for CHP plant.

New developments have an important role to play in catalysing the emergence of area wide networks. If they are large they may form the focal point of an area wide initiative, but even if they are smaller, they will often be important heat loads to support wider connections of multiple existing and new buildings that can also grow to area wide size. This growth extends benefits and economies of scale.

Secondary heat sources

The report, *London's Zero Carbon Energy Resource* (July 2013)[17] examined London's potential for harnessing secondary heat sources, including industrial and commercial waste heat, and sources of heat that exist naturally in the environment. It concludes that substantial potential exists for using these sources across London. Heat networks often present a suitable local demand for integrating such sources, particularly if the network is able to assimilate the heat at a low temperature.

Secondary heat sources are already being explored in London. As part of the Sharing Cities international EU-funded project together with Milan and Lisbon, a large river-source heat pump at Greenwich Power Station is set to be integrated into a social housing scheme supplying 3 – 5 blocks.

Low temperature systems

When the specifications for a new heat network are being defined, it is well worth investigating the potential for applying new techniques highlighted, for instance, in the IEA District Heating & Cooling programme.[18] For example, heat networks should not be configured to run at higher temperatures than is necessary.

The potential for developing a low temperature network is of particular relevance to new build developments where the heat demands are relatively small, and where the high level of energy efficiency means that a lower temperature supply may be adequate.

The overall potential for integrating locally available heat from renewable or secondary sources will be enhanced, because these can become useful even at relatively low temperatures. Where heat pumps are considered for heat supply, they can achieve a higher Coefficient of Performance (COP) if the required temperature elevation is modest, and they can also be used in tandem with low temperature sources. Additionally, it may be possible to make use of plastic pipes which are significantly cheaper (but which should not be used for high temperature systems).

New district heating systems can in many cases operate at 70ºC flow temperature, and although relevant engineering details are always case-specific this makes a good starting point from which to

[17] https://www.london.gov.uk/sites/default/files/031250%20GLA%20Secondary%20Heat%20-%20Summary%20Report.pdf
[18] www.iea-dhc.org

investigate further. Whilst London Plan policy does not require the use of low temperature systems, consideration of these is encouraged in the latest version of the Energy Planning Guidance for developers.[19]

Energy Masterplans

The development of area wide heat networks depends on the identification of areas with the right mix of heat demands, connecting buildings and a motivated project owner. Area wide heat networks identified with the energy masterplans provide the flexibility to switch fuel and heat generation technologies, thereby allowing heat supplies to be decarbonised by moving away from fossil fuels.

The Energy Masterplanning (EMP) process was developed by the GLA's Decentralised Energy Project Delivery Unit (DEPDU) to identify opportunities for new networks in London, and to set out a long-term vision for heat network development. Energy Masterplans were commissioned by the local boroughs and supported by the GLA with up to £10,000 of direct funding plus assistance with procurement. A total of 12 were supported by this programme with two boroughs, Bexley and Lambeth, receiving this funding in 2015. The Energy from Waste plant at Belvedere, within the borough of Bexley, is considering the potential for a heat network under the Thames in order to supply the London Riverside development.

Energy masterplans are often followed by feasibility studies which consider in detail the technical and economic opportunities and constraints to establishing heat networks serving part or all of the area covered by a masterplan. Should a network be considered feasible, a business plan for implementation will be required, and an organisational model formulated in order to proceed to a procurement process for delivery.

New developments supporting plans for heat networks

Large New Developments

Table 6 shows large new developments with more than 1,000 homes that obtained planning approval in 2015, most of which were mixed use. The energy infrastructure (e.g. site heat network) planned for these developments can be a key element in realising the plans for area wide district heating networks. Due to the scale of these developments they are inevitably multi-phase and often envisaged to take over a decade to complete.

One such development is the Greenwich Peninsula Masterplan; Greenwich received a DEPDU grant in 2014, and GIS Heat Mapping identified the Greenwich Peninsula as a potential site for district heating. There is also a potential link with the secondary heat source project at Greenwich Power Station.

[19] Greater London Authority, *Energy Planning: Greater London Authority guidance on preparing energy assessments* (March 2016)

Additionally, as part of the planning process a further large scheme, the refurbishment of Deephams Sewage Works, was approved. It is estimated that this scheme could secure 8,706 tonnes of CO_2 savings. Surplus heat may in future be fed into the Lea Valley heat Network.

Table 6: New developments with > 1000 dwellings obtaining planning permission in 2014

Development Name	Borough	Number of dwellings	Non-domestic floor area (m^2)
M&S site White City	Hammersmith & Fulham	1,465	-
Kodak site	Harrow	1,800	48,900
Aylesbury Estate	Southwark	2,733	10,700
Peel Centre	Barnet	2,900	14,140
Kidbrook Village	Greenwich	4,763	10,000
Greenwich Peninsula Masterplan	Greenwich	12,678	305,402

Ensuring smaller developments in dense areas are future proofed

The majority of residential units receiving planning approval from the Mayor in 2015 were located in developments of less than 1,000 homes. In these developments the average number of units was 258. If they are close to an existing heat network they will invariably benefit from connection. If not, developments at this scale will generally not be the catalyst for an area wide network. However they will frequently be well-suited to a site heat network and so it is important to secure commitment to them being future proofed to enable later connection.

Site heat networks

Out of 79 developments reaching their target, 66 propose a site heat network. This ensures future flexibility in energy supply and also for connecting to a wider heat network when this becomes possible.

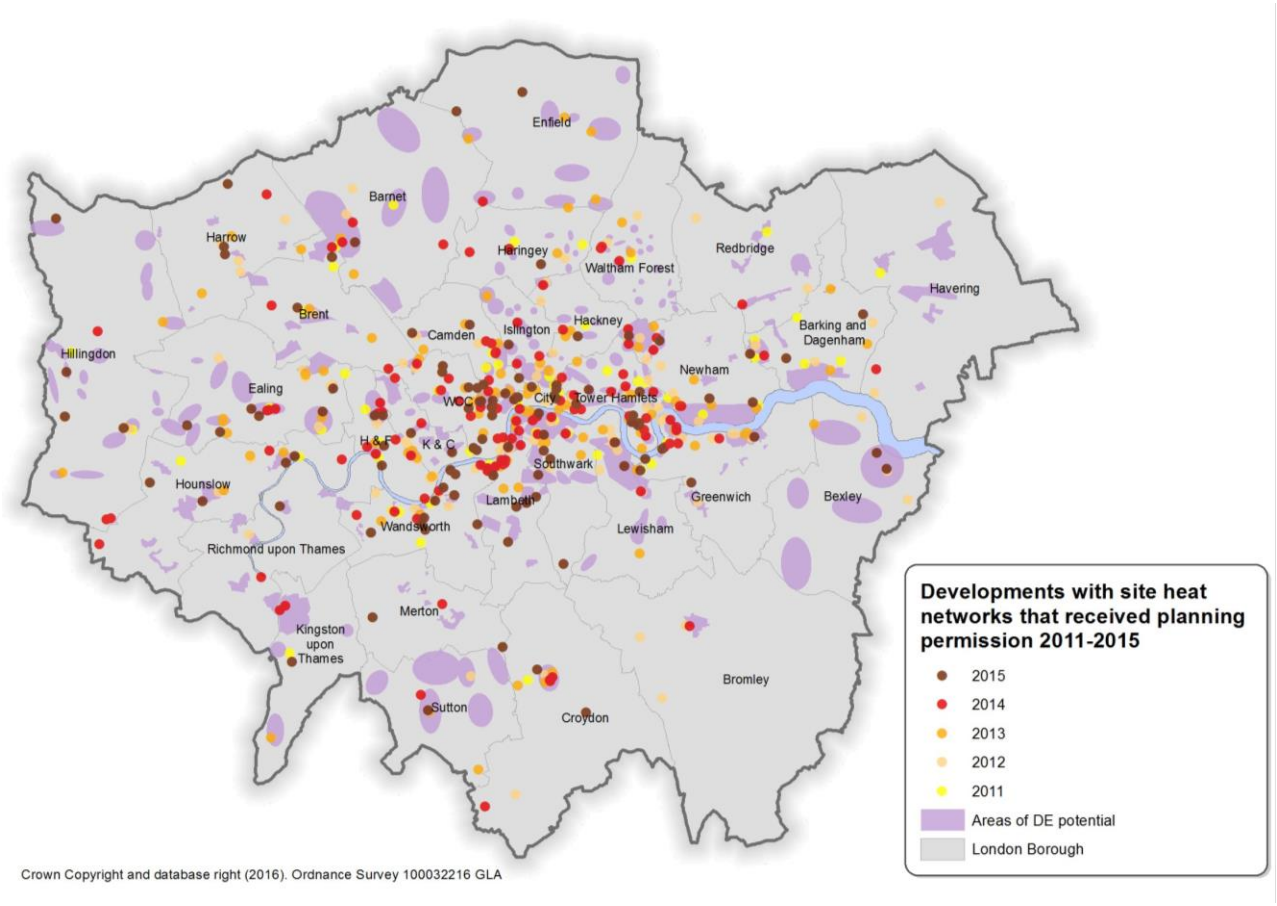
This approach for developments of less than 1,000 homes resulted in commitments to 27,335 residential units being supplied by a site heat network. Including the 19,382 dwellings connecting to heat networks in the very large developments, this amounts to total commitments to **46,717 dwellings** (72 percent of the total dwellings receiving approval) connecting to heat networks.

Figure 4 illustrates the distribution of the developments which committed to the provision of site wide heat networks between 2010 and 2015, mapped against identified areas of decentralised energy potential.[20] This shows that site heat networks feature in boroughs across London, with particular

[20] Data on areas of decentralised energy potential sourced from the London Heat Map - www.londonheatmap.org.uk/

concentation in the Inner London boroughs, but also significant activity further out, for example in Barnet and Croydon.

Figure 4: Distribution of developments committed to providing site heat networks



Combined heat and power (CHP) capacity serving new developments

109 of the strategic developments for which CO_2 data was provided proposed to meet a proportion of their energy requirements through CHP. Of these, 93 plan on-site CHP installations, with the remainder of the schemes committing to connect to an existing district heating network in the vicinity. This resulted in commitments to provision of circa 32MW of CHP electrical capacity[21]. This compares favourably with commitments in recent years ranging from 17MW to 29MW (Table 2).

As shown in Table 7 below, the vast majority of the capacity was found in the middle and larger installation tranches. The largest single CHP installation proposed was for 6.3MW_e.

[21] There were 6 developents that did not provide a value for the size of their proposed CHP installation. Recursion analysis on the other 86 developments incorporating CHP was used to derive a relationship between the size of CHP and the emissions savings from the 'Be Clean' aspect of the energy hierarchy. This was then used to estimate the size of CHP in the 6 developments that did not provide a value, these estimated values total 2.8MW and are included in the value for total CHP electricity capacity.

The most recent guidance for developers provides clarity on the applicability of CHP for small developments. The smaller a system is the less demand diversity there is, so that it becomes progressively more difficult to achieve high CHP run hours. It is therefore important to be confident of the simultaneous requirement for heat and electricity. The arrangements for electricity use and/or sales are an important associated element in this.

Table 7: Size distribution of CHP installations secured through planning in 2015

	Number of installations	Total electrical capacity (MW_e)	Average size of installation (MW_e)
Less than 100kWe	40	2.102	0.05
100kWe to 999kWe	45	11.86	0.26
1MWe and above	8	18.05	2.25
Total	**93**	**32.02**	**-**

Step 3: Renewable energy in new developments

Renewable energy plays an important role for developments meeting the requirements of the London Plan. Policy 5.7 of the London Plan requires that, after considering the first two elements of the energy hierarchy, major development proposals should provide CO_2 emissions reductions through the use of on-site renewable energy generation, where feasible. More than 80 percent of developments being assessed against the higher London Plan target have done so, as shown by the data in Table 8. Furthermore, without their renewable energy component, more than 50 applications that successfully met or exceeded their target would have failed to meet that target.

Table 8: Proportion of developments incorporating renewable energy

	Number of developments for which data was available	Number of developments incorporating renewable energy
25% beyond 2010	6	4 (57%)
40% beyond 2010	21	17 (85%)
35% beyond 2013	118	96 (81%)

In 2015 the dominant renewable energy technologies remained PV and heat pumps. The number of applicants pursuing solutions with these technologies over the past few years appears to be broadly stable. However, compared only against the figure for 2014, PV has seen a sharp rise (albeit a fall in

total panel area) and heat pumps a fall, reversing the trend from last year. Table 9 (below) gives a breakdown of renewable technologies proposed by applicants over the past five years.

Table 9: Number of installations of different types of renewable energy systems

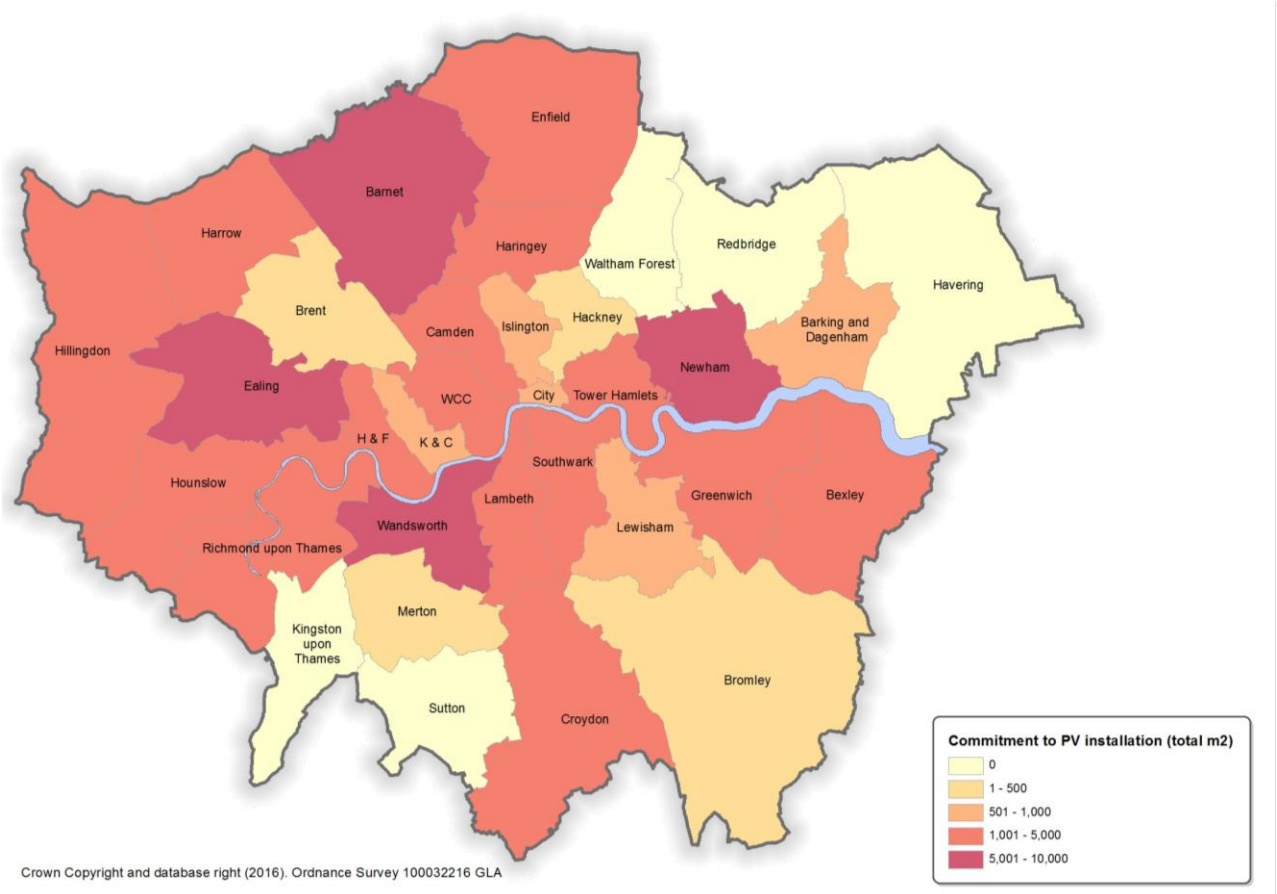
	2011	2012	2013	2014	2015
PV	60	107	123	98	111
Biomass boilers	14	7	8	2	4
Heat pumps	19	21	27	43	25
Solar thermal	10	6	12	9	4

Figure 5 shows by borough the total area of PV commitments in 2015 approved developments. Although high aggregate PV commitments have been made in both inner and outer boroughs, the average commitment per application in inner London boroughs is almost exactly half that of the outer boroughs. This is exemplified by Barnet where an aggregate area of PV of 5,127m^2 is shared across only 5 applications, compared with 6,654m^2 spread across 10 commitments in Wandsworth.

Although the trend over the past few years for an increasing number of schemes featuring heat pumps has not been maintained during 2015, there are still a substantial number of schemes that have a commitment to this technology. For 2015, 80 percent of the 25 applications specifying use of heat pumps proposed air source heat pumps with ground source heat pumps accounting for the remainder. Almost three-quarters of the schemes proposing a heat pump solution also feature a heat network. There are also 56 percent of schemes proposing to include CHP as well as heat pump(s); this approach is not encouraged because it often leads to an expensive solution where the CHP and heat pump plant compete to serve the same heat demand.

Biomass applications are few in number, and are discouraged in many parts of London due to the air quality implications. There are similarly few schemes featuring solar thermal, and the number appears to be dropping away; this is likely to be partly due to the popularity and optimisation of CHP systems in the energy hierarchy, and also the preference to use suitable available roofspace for electricity production.

Figure 5: Commitments to PV by borough



REDUCTIONS IN REGULATED CO_2 EMISSIONS ACHIEVED IN 2015

Energy targets applied to developments in 2015

The majority of applications reaching Stage II during 2015, and therefore considered in this report, were assessed against the requirement of a 35 percent improvement beyond Part L 2013 of the Building Regulations. Although this target was introduced on 6 April 2014, there were still some applications reaching Stage II in 2015 that were assessed against Part L 2010.

Specifically, those applications that were submitted prior to 1 October 2013 were assessed against a target of 25 percent beyond Part L 2010. For applications submitted on or after this date a new target was used of 40 percent beyond Part L 2010. This endured until the advent of the Part L 2013 target.

Consequently, one of three targets applied (as in Table 5) for schemes that reached Stage II in 2015.

Of the 147 developments approved at Stage 2 in 2015, for which CO_2 reduction information was provided, there was one refurbishment scheme for which Part L does not apply (Deephams Sewage Works). A further scheme, the Greenwich Peninsula Masterplan, has also not been assessed against Part L; however for this scheme a comparable assessment has been carried out.

Overall regulated CO_2 reductions

Tables 10 and 11 (below) show the emissions after each stage of the energy hierarchy for new developments that were referred to the GLA and obtaining planning approval in 2015: Table 10 for developments assessed against Part L 2010, Table 11 for those assessed against Part L 2013.

Table 10: On-site CO_2 emission reductions from all applications assessed against Part L 2010 Building Regulations

	Regulated CO_2 emissions	**Cumulative regulated[22] CO_2 emissions reductions relative to Part L 2010 Building Regulations**	
	(tCO_2/year)	**(tCO_2/year)**	**(percent)**
Baseline	30,730	-	-
After energy efficiency	28,465	2,265	7.4
After energy efficiency & heat networks / CHP	22,092	8,638	28.1
After energy efficiency, heat networks / CHP & renewables	20,346	10,384	33.8

[22] Excluding unregulated energy

Table 11: On-site CO_2 emission reductions from applications assessed against Part L 2013 Building Regulations where a **35%** target applied[23]

	Regulated CO_2 emissions	Cumulative regulated CO_2 emissions reductions relative to Part L 2013 Building Regulations	
	(tCO_2/year)	(tCO_2/year)	(percent)
Baseline	108,236	-	-
After energy efficiency	98,767	9,469	8.7
After energy efficiency & heat networks / CHP	73,445	34,791	32.1
After energy efficiency, heat networks / CHP & renewables	69,474	38,762	35.8

2015 was the first year for which a majority of applications were assessed against the target of 35 percent beyond Part L 2013. With the majority of applicants succeeding against this target to reach an average of 35.8 percent beyond Part L 2013, it is clear that applicants have responded well to the new target.

Indeed the schemes being assessed against Part L 2013 have fared better than those being assessed against the earlier targets, where the average accrues to 33 percent better than Part L 2010. Overall, the figures suggest a significant improvement for the majority of applications responding to the latest rate, particularly in view of the fact that 35 percent beyond Part L 2013 is regarded as equivalent to 40 percent beyond Part L 2010.

Given the better reductions achieved by developments assessed against Part L 2013, it appears that the change in the Building Regulations has proved a decisive factor in improving the performance of submissions.

Table 12 summarises the total CO_2 emission reductions in tonnes per annum for applications in 2015 (excluding the refurbishment scheme), beyond the relevant Building Regulations requirements.

The application of the London Plan energy policies in these new developments resulted in cumulative regulated CO_2 emission reductions for applications reaching Stage II during 2015 of 49,147 tonnes per annum. This is broadly equivalent to the savings achieved from retrofitting loft insulation in over 82,000 existing houses.[24]

[23] Estimated reductions from the Greenwich Peninsula Masterplan application are included here (although not assessed against Part L, the application has been assessed against standards that are comparable to Part L 2013).
[24] Assumes average saving per dwelling of 0.6 tonnes of CO_2 per annum for virgin loft insulation, based on EST calculations

Table 12: Total CO_2 emission reductions for each step from all applications assessed against the appropriate Part L (2010 or 2013) Building Regulations[25]

	Regulated CO_2 emissions reductions (tCO_2/year)
Energy efficiency	11,734
Heat networks / CHP	31,696
Renewables	5,717
TOTAL	**49,147**

This a lower figure than for 2014. This is not surprising because the Building Regulations applicable to most of the applications have been tightened. However, it should be noted that, while this is the extent of the savings relative to the appropriate Part L (2010 or 2013) of the Building Regulations, when CO_2 reductions are normalised to a comparison against Part L 2010, the resultant figure for savings in 2015 reveals savings in excess of 57,000 tonnes per annum, a substantial increase.

It is particularly noticeable that the contribution from energy efficiency has diminished significantly: for 2014 the reduction from energy efficiency was 21,562 tonnes of CO_2, compared with (Table 12) 11,734 tonnes of CO_2 in 2015. This is not surprising; the Building Regulations applicable to most of the applications have been significantly tightened. However, the contribution from energy efficiency remains fundamental and indeed underpins why the target was raised. The first element of the energy hierarchy, energy efficiency, achieved an average reduction of 8.4 percent.

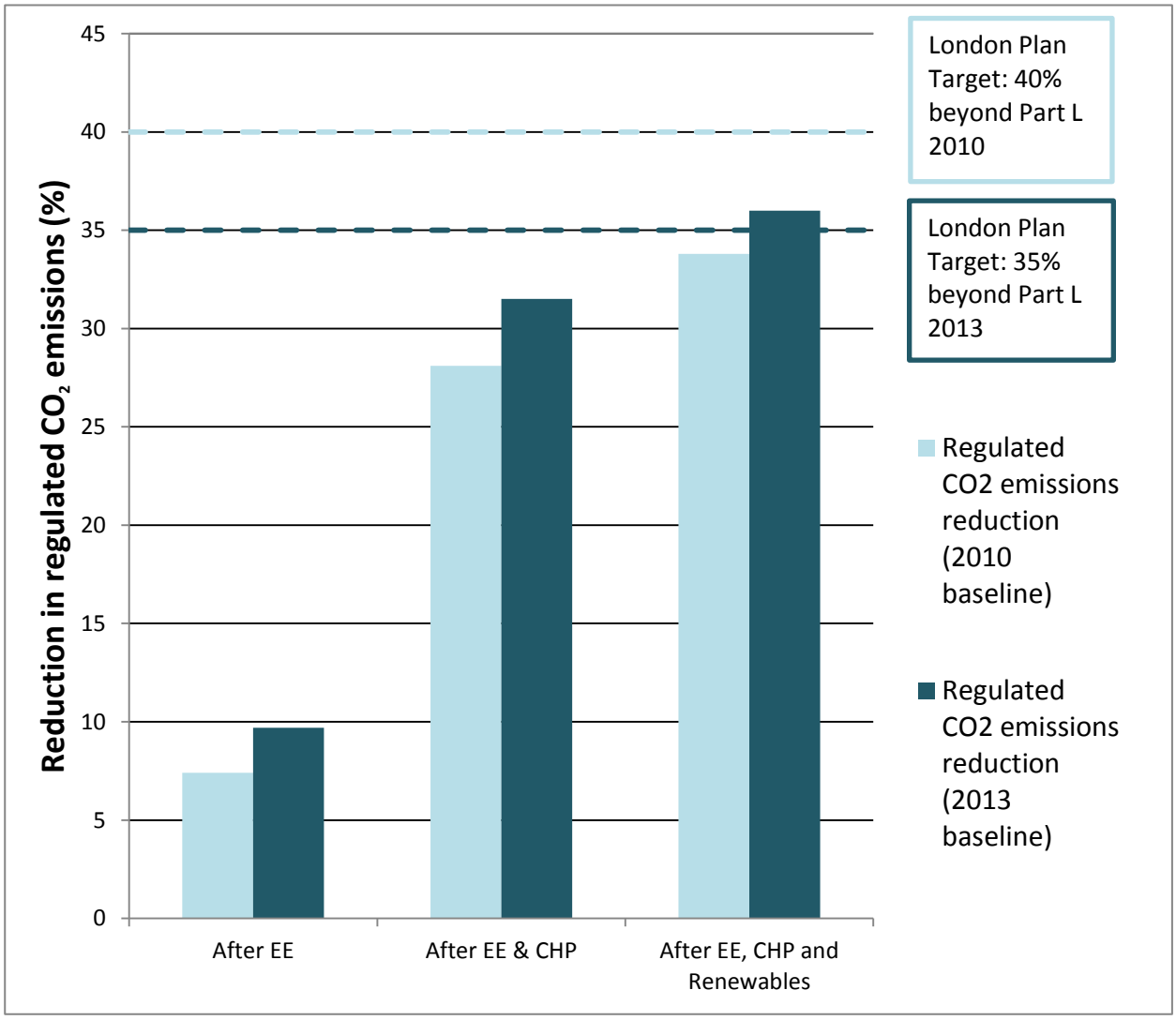
As in previous years, the largest contribution was due to connection to heat networks and on-site CHP, which amounted to 31,696 tonnes of CO_2 per annum – nearly two-thirds of the overall reduction.

Renewable energy, the final element of the hierarchy, was responsible for the smallest reduction of the three elements, but remains an important additional enabling element for applicants reaching the target. Indeed there were 54 applications in 2015 that would have failed to reach the target if their renewable energy contribution was removed.

Figure 6 illustrates the cumulative percentage savings at each stage of the hierarchy for applications assessed against both Part L 2010 and Part L 2013.

[25] Estimated reductions from the Greenwich Peninsula Masterplan application are included here (although not assessed against Part L, the application has been assessed against standards that are comparable to Part L 2013).

Figure 6: Cumulative reductions secured in CO_2 emissions at each stage of the London Plan hierarchy for developments assessed against Part L 2010 and Part L 2013



Proportion of developments meeting the target through on-site measures

In recent years, London Plan targets have become more stringent, with the introduction of the 40 percent beyond Part L 2010 and the 35 percent beyond Part L 2013 targets. The average savings figure achieved in 2015 is in line with the current target of 35 percent beyond Part L 2013 of the Building Regulations. This indicates that the target, though substantially more challenging, can be met. Indeed, for applications reaching Stage II in 2015, 54 percent of them met or exceeded the target through on-site measures alone.

The cumulative shortfall in CO_2 reductions

Where developments may not be able to meet the target in Policy 5.2 solely through on-site measures, a cash-in-lieu contribution may be made by the developer to the local borough to account for the shortfall in CO_2 emission reductions. The GLA supplementary planning guidance (SPG) for

Sustainable Design and Construction contains guidance to promote a consistent approach to CO_2 off-setting and collection of cash in lieu contributions across boroughs.

The total shortfall from developments not meeting the target in 2015 accrued to approximately 3,071 tonnes of regulated CO_2 emissions per annum, a significant drop from the 2014 figure of 4,772 tonnes. The 2015 shortfall equates to circa £5.53 million assuming an indicative CO_2 price of £60 per tonne[26] and a 30 year lifetime. Over 99 percent of this shortfall was due to developments where the higher 40 percent and 35 percent targets applied, reflecting the flexibility of this policy approach where it may not be achievable to fully meet the required level of CO_2 reductions on-site.

Additional CO_2 reductions from refurbishment projects

Among the applications coming forward for Stage II assessment during 2015 was the refurbishment of Deephams Sewage Works in Enfield. Refurbishment projects are not subject to Part L targets. Compared with the existing system, the improvements to Deephams Sewage Works are expected to contribute a further 8,706 tonnes CO_2 per annum savings.

[26] £60 per tonne of CO_2 was the central price assumption used in government's consultation on Allowable Solutions

INVESTMENT DUE TO LONDON PLAN ENERGY POLICIES

Finding new and innovative ways to deliver energy which is secure, sustainable and affordable is a challenging task which the London Plan energy policies are helping to achieve. For example, the London Plan policies around the promotion of decentralised energy networks are driving investment in site wide heat networks which provide for ease of connections to future low-carbon decentralised energy networks, avoiding the need for costly retro-fitting in the future.

Delivering the commitments associated with the implementation of London Plan energy policies in 2015 consequently involves substantial investment in infrastructure and technologies. Overall, this is expected to total more than £150 million.

Implementing these energy efficiency measures is estimated to result in annual energy cost savings for dwelling occupants of £300,000 per annum, with additional energy cost savings for non-domestic building occupants. This figure is not as high as for the previous year; total savings are likely to be equivalent but a portion of these is due to the tightening of the Building Regulations, and cannot be attributed to the London Plan.

Assuming an installed capital cost of £700 per kilowatt of electrical capacity, the 32MW of CHP electrical capacity committed to in 2015 is estimated to require investment of circa £22million.[27] With the estimated reduction of 31,696 tonnes of CO_2 emissions associated with this invesment, this accrues to approximately £47 per tonne of CO_2. When compared with a typical carbon offset scheme cost of £60 per tonne, this demonstrates the cost-effectiveness of CHP as an emissions reduction mechanism.

The site heat network infrastructure into which CHP will supply heat energy will also require significant investment. It is estimated that an outlay of circa £117 million[28] will be required to fund the heat network infrastructure for the nearly 47,000 dwellings with communal heating. The non-domestic buildings will require additional further investment for the associated heat network infrastructure. A workforce will be required to operate and maintain the heat network infrastructure and associated energy generation equipment serving the new developments. It is estimated that the developer commitments obtained in 2015 will result in approximately 60 permanent jobs,[29] the majority of them being in energy services companies (ESCOs).

Investment in renewable energy systems was also proposed to help achieve the CO_2 reduction commitments. Using an installed capital cost estimate of £2,000 per kilowatt, providing circa 7.5MW of PV panel electrical capacity will require an investment of approximately £15 million. Further investment will happen in other renewable energy technologies, e.g. heat pumps, solar thermal panels and biomass boilers.

[27] i.e. 700 x 32 x 1000 = £22,400,000
[28] Assumes a heat distribution cost of £2,500 per flat for district heating, taken from Table 51 of Code for Sustainable Homes: A cost review (CLG March 2010)
[29] Assumes 0.5 jobs per mixed use/residential development for maintaining a site network and 120 networks

CONCLUSION

The continued implementation of the London Plan energy policies in 2015 has resulted in the following commitments being secured:

- Regulated CO_2 emission reductions of 35 percent percent against a baseline in which developments complied with the Part L of the Building Regulations in place at the time of application.
- Cumulative regulated CO_2 emission reductions of 49,147 tonnes CO_2 per annum against the relevant Part L baseline.
- Significant investment at each stage of the energy hierarchy including:
    - Investment in energy demand reduction measures to reduce residential energy bills by circa £300,000 per annum
    - £139 million in heat network infrastructure and associated CHP capacity
    - £15 million in PV panels and additional investment in other renewable energy technologies.
- The equivalent of approximately 60 permanent jobs in operating and maintaining heat network infrastructure and associated energy supply plant.

APPENDIX 1

Bibliography

The London Plan, Mayor of London, March 2015

Energy Planning: Greater London Authority guidance on preparing energy assessments, Greater London Authority, March 2016

London Heat Map - www.londonheatmap.org.uk/

Supplementary Planning Guidance (SPG) on Sustainable Design and Construction, Mayor of London, April 2014

District Heating Manual for London, Mayor of London supported by Intelligent Energy Europe, February 2013[30]

London's Zero Carbon Energy Resource – secondary heat, Mayor of London, July 2013

Homes for London: The London Housing Strategy – Draft for consultation, Mayor of London, November 2013

International Energy Agency District Heating and Cooling programme: www.iea-dhc.org

[30] Available at: www.londonheatmap.org.uk

APPENDIX 2

Glossary

Building Emissions Rate (BER) or Dwelling Emission Rate (DER) is the actual building/dwelling CO_2 emission rate. In order to comply with Part L of the Building Regulations, the BER/DER must be less than the TER (see below).

Combined Heat and Power (CHP) is defined as the simultaneous generation of heat and power in a single process. The power output is usually electricity, but may include mechanical power. Heat outputs include hot water for space heating or domestic hot water production.

CHP Electrical Capacity is the maximum power generation capacity of CHP.

Communal heating is a general term for a shared heating system where heat is supplied to multiple dwellings and/or non-domestic buildings using pipes containing hot water.

kilowatt (kW) – One thousand watts. A watt is a measure of power.

Megawatt (MW) – One million watts. A watt is a measure of power.

Part L of the Building Regulations – Approved documents L1A and L2A of the Building Regulations relate to the conservation of fuel and power in new dwellings and new buildings other than dwellings respectively.

Regulated CO_2 emissions – The CO_2 emissions arising from energy used by fixed building services, as defined in Approved Document Part L of the Building Regulations. These include fixed systems for lighting, heating, hot water, air conditioning and mechanical ventilation.

Simplified Building Energy Model (SBEM) is a computer program that provides an analysis of a building's energy consumption. The purpose of the software is to produce consistent and reliable evaluations of energy use in non-domestic buildings for Building Regulations compliance.

Site heat network – a set of flow and return pipes circulating hot water to the apartment blocks (and apartments contained therein) and non-domestic buildings on a development.

Standard Assessment Procedure (SAP) is a methodology for assessing and comparing the energy and environmental performance of dwellings. Its purpose is to provide accurate and reliable assessments of a dwelling's energy performance that are needed to underpin building regulations and other policy initiatives.

Target CO_2 Emission Rate (TER) is the minimum energy performance requirement for a new dwelling/building. It is expressed in terms of the mass of CO_2 emitted per year per square metre of the total useful floor area of the building ($kg/m^2/year$).

APPENDIX 3

Case Study 1: AYLESBURY ESTATE, SOUTHWARK

This case study is an example of a large, predominantly residential development that complies with the required reduction of carbon emissions principally by means of CHP and a site heat network. There is also the prospect of future connection to a larger heat network.

The Aylesbury Estate is situated approximately 0.6 miles to the south east of Elephant and Castle station in the London Borough of Southwark, and it lies to the north of Burgess Park. The Estate is currently home to approximately 7,500 residents. It was quickly constructed between 1966 and 1977 to ease the shortage of modern housing and followed extensive slum clearance, but itself became a notorious example of urban decay. One of the most deprived estates in London, the aspiration is for the Aylesbury area to become a successful neighbourhood with an outstanding environment and strong sense of community.

The regeneration of the estate is set to take place over a period of approximately 20 years. This has already commenced with the earliest phases; further new development is now planned for the rest of the estate extending to more than 30 hectares in all. This could comprise approximately 3,500 dwellings as well as a variety of non-domestic buildings accruing to approximately 10,700m^2 floor area. The new development will comprise a mix of high-density perimeter blocks up to 20 storeys along the park perimeter, medium-density blocks from 4 to 8 storeys, and low-density blocks of no more than 4 storeys.

Figure 7: Mix of high and low rise development at the Aylesbury Estate

Figure 8: The proposed development at the Aylesbury Estate

A combination of energy efficiency measures together with up to 3MWe of CHP and more than 2000m^2 of solar PV are proposed to enable the development to reach the target for carbon emissions reduction of 35 percent beyond Part L 2013 of the Building Regulations.

Energy efficiency measures, required not only by the London Plan but also by the Southwark Local Plan, have been designed to achieve on their own 5 percent better than Part L 2013. These include high performance building fabric beyond the minimum values set by the Building Regulations; the low level of losses from thermal bridging and permeability are particularly impressive.

As well as these measures to restrict heat losses, significant attention is also being paid to avoiding overheating. This is achieved through design features including balconies and the insetting of windows from facades, and also by stimulatring netural ventilation. A further attractive design feature that helps to reduce overheating is the integration of extensive areas of green roofing.

The Aylesbury Estate is located midway between the SELCHP waste incinerator and the long established heat network at Pimlico. In addition to this the ongoing large developments at the Elephant and Castle and across the Vauxhall Nine Elms site mean that there is a substantial and growing amount of heat network infrastructure in the wider area stretching to 3 – 4km in each direction.

The possibility of connection to SELCHP or Pimlico was investigated but deemed too distant and too costly at present. However, well-designed heat networks tend to grow because the business case for local buildings to connect becomes ever more favourable once the network is established. Consequently, longer term network connections are not ruled out.

The proposed Heygate development is significantly closer, within 1km of the closest part of the site. Consequently, for the shorter term, connection to this network is envisaged for the later phase of the Aylesbury Estate redevelopment.

In the meantime, the development is in itself easily large enough to justify its own heat network with CHP supply. Two CHPs are envisaged: initially a 500kWe unit, followed at a later stage by a 2.5MWe unit. The consequent envisaged reduction of carbon emissions from CHP is 28 percent.

Although CHP accounts for most of the carbon savings achieved by this development, the further reduction from the integration of PV panels is also needed to enable it to comply with the London Plan target of 35 percent better than Part L 2013 of the Building Regulations.

Case Study 2: STRATFORD CENTRE AND MORGAN HOUSE, NEWHAM

This case study is an example of a mixed use development that is situated sufficiently close to an existing major existing heat network for connection from the outset; this enables the development to significantly exceed the target of 35 percent beyond Part L 2013.

The development at Morgan House and the Stratford Centre will combine the refurbishment and change in use of an existing building, together with the addition of further large buildings. Situated in Stratford close to the Olympic Park the new development will not only put to use currently unused land but will also improve its overall appearance.

The site comprises the existing Morgan House, part of the Stratford Centre, and a substantial area of land that is currently either used for car parking or not used at all. Along the Northern boundary is the Shoal, a visual feature introduced as part of the wider environmental improvements prior to the 2012 Olympic and Paralympic Games; it was designed partly to mask the unattractive open service yard at the base of Morgan House.

The site lies in the Lower Lea Valley Opportunity Area; such areas have been identified as having significant capacity to accommodate new housing, commercial and other developments linked to potential improvements in public transport accessibility. This also aligns with Newham Council's Core Strategy (2012)

Newham Council has specifically identified the need for homes within Stratford and West Ham; this development stands to provide approximately 3 percent of the additional homes required. The application site is also within the Mayor's Olympic Legacy Supplementary Planning Guidance (OLSPG) with its emphasis on convergence, specifically assisting local employment and supply chain opportunities and improving pedestrian connectivity feature.

Morgan House itself is an existing 15 storey building last in use as offices; the plan is to extend both horizontally and vertically and convert the building to residential use. The overall development also features several other buildings including the 42 storey Great Eastern Tower overlooking a new public square, and the 25 storey Meridian Tower. In all, the development will provide 583 new residential units, 4,539m^2 of retail and leisure floorspace and 1,359m^2 of office floorspace.

A reduction of 450 tonnes of CO_2 per year in regulated emissions compared to a 2013 Building Regulations compliant development is expected, equivalent to an overall saving of 58 percent, significantly exceeding the target set within Policy 5.2 of the London Plan. By far the largest proportion of this savings arises from the planned connection to the Stratford District Heating network which lies close by.

The buildings themselves will integrate a range of passive design features and demand reduction measures to enable them to comply with and exceed Part L of the Building Regulations. Both air permeability and heat loss parameters will be improved beyond the minimum required backstop values, and the buildings will be serviced with low energy lighting, and mechanical ventilation with heat recovery. The need to minimise cooling demand has also been addressed through self-shading overhangs on all west, south and east facing façades, together with the inclusion of solar control glazing.

The Stratford district heating network is very close to the development and consequently the intention is to connect all the buildings to the network. This network serves the Olympic Park and has

the capacity to expand to serve other buildings in the vicinity. It is estimated by the scheme operator that connection to this existing network will by itself achieve a 55 percent reduction in regulated CO_2 emissions. Consequently this development is able to substantially exceed the 35 percent target by means of the second part of the energy hierarchy.

Figure 9: Proposed development at Morgan House and the Stratford Centre

Figure 10: Proposed development at Morgan House and the Stratford Centre

Case Study 3: 22 BISHOPSGATE, CITY OF LONDON

This case study is an example of a non-domestic development that has achieved a significant proportion of the required carbon emission reductions beyond Part L 2013 through energy efficiency, by means of interesting building fabric measures.

The development at 22 Bishopsgate is located in the City of London, just 0.3 miles from Liverpool Street, Bank and Monument stations. The site is 0.52ha in size and is currently occupied by the beginnings of a former proposal which has been discontinued in favour of the current proposal.

The proposal consists of a 280m tower, with three basement floors, one ground floor and sixty-one upper floors plus mezzanines. The tower is primarily designed as office space, with some retail, restaurant and viewing facilities, and pedestrian access through the ground floor.

Figure 11: The proposed development at 22 Bishopsgate

The development is in an area of the City of London known as the Eastern Cluster which is employment focused and is designated to accommodate a significant growth in office floorspace and employment, delivering tall buildings on appropriate sites. The area contains several existing and proposed tall buildings, the most well-known of which is likely the 'Gherkin'. The site in question has long been identified for a tall building to deliver the 'apex' of the Eastern Cluster.

The City of London local plan aims to increase employment floorspace in the borough by 1.15 million m^2 between 2011and 2026; this proposal provides 185,424m^2 of floorspace, over 16 percent of that required, and it will be delivered by 2019.

The site achieves an emissions reduction of 1417 tonnes CO_2 per annum compared to a 2013 Building Regulations compliant development, meeting the London Plan target of 35 percent beyond 2013 Building Regulations.

The development's energy compliance is achieved through a mix of energy efficiency measures and providing heat through a site-wide heat network using CHP.

The development significantly exceeds minimum building fabric requirements, primarily through the inclusion of a closed cavity façade. A fairly new design in building fabric, a closed cavity façade is a low maintenance double skin glass façade comprising a single layer of glass outside a low-e (thermally insulated) double glazed unit, with a retractable shading device of automatically operated blinds in the cavity. This provides improved insulation and solar control, improved visual comfort and increased protection from solar heat gains. Also, by controlling solar gain through automatically operated blinds, clearer glass can be used, further enhancing daylight to interior spaces. Thanks to this, and other energy efficiency measures, such as energy efficient building services plant, the development achieves energy reductions of 26 percent beyond 2013 Building Regulations through energy efficiency alone.

Figure 12: The closed cavity facade

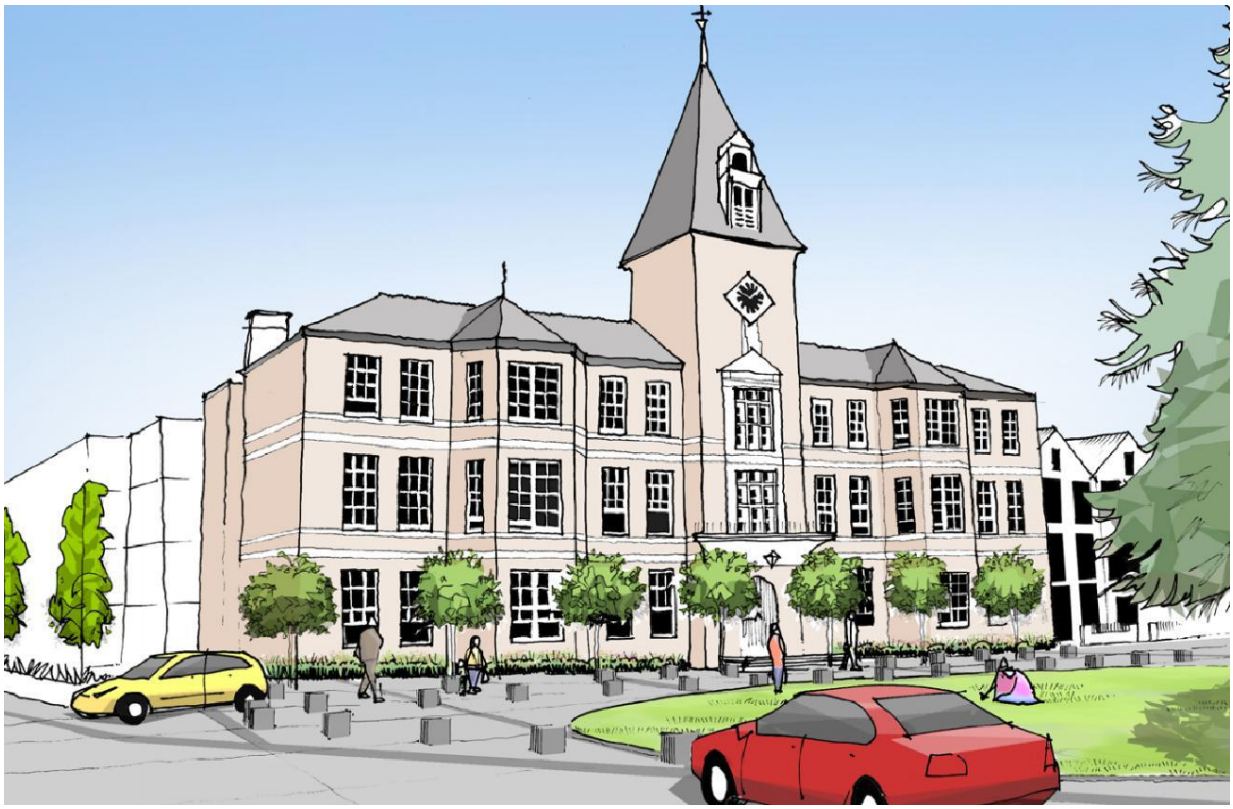
The remaining carbon reduction comes from a centralised 800kW_{th} CHP plant, supported by 60m^3 of thermal storage. This will be capable of meeting 60 percent of hot water and space heating demand, with the rest provided by high- efficiency, ultra-low NOx, boilers.

Case Study 4: CHASE FARM, ENFIELD

While many developments involve relatively high contributions from one or two of the steps in the energy hierarchy, there are also those that envisage a substantial contribution from all three steps. This is the case with the Chase Farm Hospital.

Situated in the London Borough of Enfield, this redevelopment at the Chase Farm Hospital will provide up to 32,000m^2 of replacement hospital facilities, a three-form entry primary school and residential development comprising 500 new homes. The proposed development will involve comprehensive demolition of various existing hospital and residential blocks, retaining a Victorian clock tower building and 4,723m^2 of existing hospital floorspace.

Figure 13: Retained clock tower with surrounding new development



This development involves the demolition of most of the existing hospital buildings, and more efficient use of the available space such that the existing footprint will be able to accommodate not just modern hospital buildings and facilities but also residential areas and a school.

The proposed development achieves nearly 16 percent savings in regulated CO_2 emissions compared with the Part L 2013 baseline through energy efficiency measures. Both air permeability and heat loss parameters will be improved beyond the minimum values required by the building regulations. There will also be significant savings in the hospital and the school from LED lighting and efficient fan technologies.

As well as reducing heating demand, attention has been paid to minimising overheating with passive measures sufficient to ensure no active cooling in the residential buildings. Measures include both external and internal shading, recessed windows and high levels of thermal mass that can potentially

be combined with night ventilation for effective passive cooling. Particular attention has been paid to the hospital which has a substantial cooling requirement.

There are no existing or planned heat networks in the vicinity, but the applicant plans to install a site heat network with 770kWe gas fired CHP as the lead heat source for the network. The network will connect the hospital buildings and high density apartment blocks, but it is not planned to extend to the lower density residential areas or the school. The CHP contributes 7% savings in regulated CO_2 emissions.

Completing the contributions in this development from all three steps in the energy hierarchy, is an aggregate area of 4,090m^2 of PV panels; these are to be accommodated in the residential parts of the development especially the terraced housing area, leading to a further 13% of carbon emission reductions.

Case Study 5: RECTORY PARK ESTATE, EALING

This case study is an example of a residential development that achieves the largest proportion of the required reduction in carbon emissions by means of photovoltaic panels.

The Rectory Park Estate is located in Northolt, adjacent to Rectory Park itself and 25 minutes from Northolt station, in the west of the London Borough of Ealing. It is currently undergoing renovation, replacing the 270 homes dating back to the 1970s with 449 new homes and a community centre. The first two phases of renovation have been completed, comprising 160 homes, and this application is for the final three phases, comprising the remaining 289 homes and the community centre (235m^2 floor area). The homes consist of 238 1-3 bedroom flats, in apartment blocks three to five storeys in height, and 32 3-4 bedroom terraced houses.

Figure 14: Proposed apartment blocks at the Rectory Park Estate

A combination of energy efficiency measures together with more than 2000m^2 of solar PV are proposed to enable the development to reach the target for carbon emissions reduction of 35 percent beyond Part L 2013 of the Building Regulations.

Energy efficiency measures have been applied to achieve reductions of 12 percent beyond Part L 2013, by means of an airtight building envelope and high density structure which will provide high thermal mass. Overheating is avoided through passive measures such as external shading from trees, balconies and other buildings, along with natural ventilation and efficient mechanical ventilation.

The development is well suited to photovoltaic installation as all units have pitched roof areas with a south-west to south-east orientation. Each of the blocks has its own PV array, totalling 2,200m^{2}of PV

area. This amounts to roughly 0.4 - 1kWp per dwelling, providing a further 23 percent of emissions reduction.

Any excess generated electricity can be exported to the local electricity grid and current 'Feed-in-Tariffs' will provide financial rewards.

Figure 15: Proposed housing at the Rectory Park Estate

Other formats and languages

For a large print, Braille, disc, sign language video or audio-tape version of this document, please contact us at the address below:

Public Liaison Unit
Greater London Authority
City Hall
The Queen's Walk
More London
London SE1 2AA

Telephone **020 7983 4100**
Minicom **020 7983 4458**
www.london.gov.uk

You will need to supply your name, your postal address and state the format and title of the publication you require.

If you would like a summary of this document in your language, please phone the number or contact us at the address above.

Chinese
如果需要您母語版本的此文件，
請致電以下號碼或與下列地址聯絡

Hindi
यदि आप इस दस्तावेज की प्रति अपनी भाषा में चाहते हैं, तो कृपया निम्नलिखित नंबर पर फोन करें अथवा नीचे दिये गये पते पर संपर्क करें

Vietnamese
Nếu bạn muốn có văn bản tài liệu này bằng ngôn ngữ của mình, hãy liên hệ theo số điện thoại hoặc địa chỉ dưới đây.

Bengali
আপনি যদি আপনার ভাষায় এই দলিলের প্রতিলিপি (কপি) চান, তা হলে নীচের ফোন্ নম্বরে বা ঠিকানায় অনুগ্রহ করে যোগাযোগ করুন।

Greek
Αν θέλετε να αποκτήσετε αντίγραφο του παρόντος εγγράφου στη δική σας γλώσσα, παρακαλείστε να επικοινωνήσετε τηλεφωνικά στον αριθμό αυτό ή ταχυδρομικά στην παρακάτω διεύθυνση.

Urdu
اگر آپ اِس دستاویز کی نقل اپنی زبان میں چاھتے ھیں، تو براہ کرم نیچے دئے گئے نمبر پر فون کریں یا دیئے گئے پتے پر رابطہ کریں

Turkish
Bu belgenin kendi dilinizde hazırlanmış bir nüshasını edinmek için, lütfen aşağıdaki telefon numarasını arayınız veya adrese başvurunuz.

Arabic
إذا أردت نسخة من هذه الوثيقة بلغتك، يرجى الاتصال برقم الهاتف أو مراسلة العنوان أدناه

Punjabi
ਜੇ ਤੁਹਾਨੂੰ ਇਸ ਦਸਤਾਵੇਜ਼ ਦੀ ਕਾਪੀ ਤੁਹਾਡੀ ਆਪਣੀ ਭਾਸ਼ਾ ਵਿਚ ਚਾਹੀਦੀ ਹੈ, ਤਾਂ ਹੇਠ ਲਿਖੇ ਨੰਬਰ 'ਤੇ ਫ਼ੋਨ ਕਰੋ ਜਾਂ ਹੇਠ ਲਿਖੇ ਪਤੇ 'ਤੇ ਰਾਬਤਾ ਕਰੋ:

Gujarati
જો તમને આ દસ્તાવેજની નકલ તમારી ભાષામાં જોઇતી હોય તો, કૃપા કરી આપેલ નંબર ઉપર ફોન કરો અથવા નીચેના સરનામે સંપર્ક સાધો.