

# Monitoring the London Plan Energy Policies - Phase 3

## Part 1 report FINAL

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## Executive Summary

The London Plan<sup>1</sup> was first published in February 2004. It included a requirement for all major new developments to maximise energy efficiency (EE) design and seek further carbon dioxide (CO<sub>2</sub>) savings through the use of decentralised energy including combined heat and power (CHP) and renewable energy (RE) technologies where feasible. In September 2006, the draft Further Alterations to the London Plan<sup>2</sup> was published for public consultation and proposed a number of changes to the original energy policies. This included a target of 20% CO<sub>2</sub> savings from individual developments through the use of renewable energy. Other alterations included a change in the Mayor's original energy hierarchy (outlined in the 2004 Energy Strategy) from "be lean, be green and be clean" to "be lean, be clean and be green" and set this as planning policy. This increased the importance of investigating opportunities to incorporate decentralised energy systems in new developments.

As a result, greater emphasis has been placed in the planning process of the Greater London Authority (GLA) on connecting new development proposals to district heating networks and securing site wide networks and on-site CHP where feasible. Following publication of the proposed alterations, additional staff joined the GLA energy team in 2007. As the draft Further Alterations to the London Plan went through the Examination in Public (EiP) process in June-July 2007, the revised energy hierarchy and 20% renewable target gained more weight in planning decisions. In February 2008, the London Plan (Consolidated with Alterations since 2004)<sup>3</sup> was published and the changes were formally adopted as policy for London.

This report provides the findings from Part One of a two-part study conducted for the GLA by London South Bank University (LSBU). The objective of this part of the study was to analyse and report the energy and CO<sub>2</sub> savings achieved through the GLA's planning process and application of the London Plan energy policies. This report has been based on data from energy statements submitted with planning applications for strategic developments referred to the Mayor. The second part of the study will focus on the actual CO<sub>2</sub> savings gained from the implementation of these policies, based on 'as-built' data from developers/designers and site visits and will be available early 2010.

The first part of this study involved a review and analysis of a sample of 147 applications out of about 340 strategic planning applications referred to the Mayor and approved<sup>4</sup> between November 2006 and June 2009. These 147 developments represent the relevant planning cases for which detailed energy information was available. The main findings are as follows:

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<sup>1</sup> Greater London Authority (February 2004), The London Plan – Spatial Development Strategy for Greater London, Available from: [http://www.london.gov.uk/mayor/strategies/sds/london\\_plan/lon\\_plan\\_all.pdf](http://www.london.gov.uk/mayor/strategies/sds/london_plan/lon_plan_all.pdf) Accessed 24th August 2009

<sup>2</sup> Greater London Authority (September 2006), Draft Further Alterations to the London Plan (Spatial Development Strategy for Greater London), Available from: <http://www.london.gov.uk/mayor/strategies/sds/further-alt/alt-all.pdf> Accessed 24th August 2009

<sup>3</sup> Greater London Authority (February 2008), The London Plan - Spatial Development Strategy for Greater London, Consolidated with Alterations since 2004, Available from: <http://www.london.gov.uk/thelondonplan/docs/londonplan08.pdf> Accessed 24th August 2009

<sup>4</sup> Approved at Stage II with reports available from: [http://www.london.gov.uk/mayor/planning\\_decisions/](http://www.london.gov.uk/mayor/planning_decisions/)

- The Mayor's climate change mitigation and energy policies in the London Plan **have been successful in significantly reducing energy consumption and CO<sub>2</sub> emissions in new developments** and go well beyond the national requirements set out in 2006 Building Regulations Part L;
- Since the publication of the draft FALP in September 2006, **more than half of the planning applications analysed achieved CO<sub>2</sub> savings of at least 30%** and approximately **a quarter met or exceeded 40% CO<sub>2</sub> savings** through the use of a combination of energy efficiency, CHP and renewable energy measures.
- The CO<sub>2</sub> savings achieved demonstrate the impact that London Plan policies have had to date over and above building regulations. They also show the potential that the London Plan<sup>5</sup> has to drive CO<sub>2</sub> reductions. A number of the applications sampled through this study would meet the draft replacement Plan's tougher CO<sub>2</sub> standards for 2010-13, demonstrating that more challenging CO<sub>2</sub> targets are achievable and can drive even more efficient design solutions.
- On average, **30% reductions in CO<sub>2</sub> were achieved from the sample between November 2006 and June 2009**. These savings amount to just over 116,000 tonnes of CO<sub>2</sub> per year. The **average savings from the applications sampled has increased from 29% in 2006 to 33% in 2009**, and has consistently exceeded 30% from mid-2007 onwards;
- By 2009, the average step-by-step CO<sub>2</sub> savings achieved were 33%. This is made up of 14% from energy efficiency measures beyond the baseline, 9% related to the use of gas-fired<sup>6</sup> CHP and a further 10% from renewable energy technologies. Many applications were able to go well beyond the average savings, although many of the developments achieved well beyond these averages. The baseline reflects whole emissions i.e. both the emissions from regulated energy uses under the 2006 Building Regulations Part L minimum standard and the additional emissions from non-regulated energy uses such as cooking and equipment;
- **The number of gas-fired CHP installations has increased from 34 in the 2007 report<sup>7</sup> to 94 in the current sample**. Also, an additional 6 installations each of biomass and fuel cell CHP have recently been proposed compared to 2 installations each reported<sup>8</sup> in 2007;
- The emphasis on maximising overall CO<sub>2</sub> savings through the hierarchy, including the encouragement of district heating and on-site CHP has in some developments affected the opportunity for certain types of renewable energy technology. Following changes to London Plan energy policies, greater emphasis has been placed on connecting new developments into existing district heating schemes and

<sup>5</sup> <http://www.london.gov.uk/shaping-london/london-plan/strategy/download.jsp>

<sup>6</sup> Refers to natural gas from fossil fuels

<sup>7</sup> A.R. Day, P.G. Jones and P. Ogumka (July 2007), Review of the impact of the energy policies in the London plan on applications referred to the Mayor (Phase 2), London South Bank University/Greater London Authority, Available from:

<http://www.london.gov.uk/mayor/planning/docs/lbu-research.pdf> Accessed 26th March 2009

<sup>8</sup> Ibid

incorporating on-site CHP with site-wide communal heating networks where feasible. In certain schemes where gas-fired CHP has been proposed, the requirement to optimise the size of the CHP, based on total site thermal load has meant that the available demand met by from renewable energy (particularly renewable heat) became more limited. Thus, developments that achieved high CO<sub>2</sub> savings from CHP, delivered lower CO<sub>2</sub> savings from renewable energy technologies and vice versa;

- **A quarter of the sample met or exceeded 20% CO<sub>2</sub> savings from renewable energy technologies, a third of developments achieving between 10% and 20% CO<sub>2</sub> savings, and a further 38% achieving up to 10% savings;**
- The overall CO<sub>2</sub> savings made are continuing to increase. The share of how those savings are made varies from development to development. The contribution that energy efficiency, CHP and renewable energy can make varies from development to development. For example in some applications renewable energy was able to contribute well over 30 per cent of savings, but in some cases contributed under 10 per cent. Flexibility is important to achieve the maximum overall CO<sub>2</sub> savings from developments.
- Biomass boilers, photovoltaics (PV), ground source heat pumps (GSHP) and solar thermal were the most popular renewable technologies (in that order). This order of popularity differs from that observed in the 2007 study (solar thermal, biomass boilers, PV and GSHP). The sudden growth in the proposed number of biomass boilers may be an indication of growing confidence in fuel source and its CO<sub>2</sub> saving potential, while the growth in proposed PV installations may be related to its compatibility with CHP as well as its ease of specification and installation;
- The order of technologies in terms of overall savings is similar to the previous study with CHP, biomass and GSHP systems in the lead. This is greatly influenced by the large scale nature of these technologies;
- Table 1 summarises the contribution from major renewable energy and CHP technologies of the applications assessed within this study, covering the period between November 2006 and June 2009. Biomass and fuel cell CHP schemes give comparatively higher tonnes CO<sub>2</sub> saved per megawatt (MW) and per installation. However, it should be noted that these are relatively novel applications and whilst supported in the London Plan, there are still uncertainties surrounding their installation and operation compared to the more conventional gas-fired option. Hence, in planning terms the use of such novel systems are approved on the condition that if they do not prove operationally viable, the conventional gas-fired option should be adopted. It is an aim of part two of this study to investigate some of these installations in order to provide a better indication of what is practically achievable.

**Table 1 Contribution by main renewable energy and CHP technologies in study  
(147 applications)**

|  | Biomass<br>boilers | Ground<br>source<br>heating/<br>cooling | Photo-<br>voltaics | Solar<br>thermal | Wind  | Gas-<br>fired<br>CHP | Fuel<br>cell<br>CHP | Biomass<br>CHP |
|--|--------------------|---|--------------------|------------------|-------|----------------------|---------------------|----------------|
| <b>number of installations</b>                           | 74                 | 31                                      | 55                 | 26               | 10    | 94                   | 6                   | 6              |
| <b>tonnes CO<sub>2</sub> saved</b>                       | 11,695             | 3,351                                   | 1,718              | 560              | 2,735 | 25,331               | 5,575               | 6,946          |
| <b>MW reported</b>                                       | 28.6               | 5.8                                     | 0.9                | 0                | 2.6   | 12.4                 | 3.0                 | 0.3            |
| <b>MW estimated</b>                                      | 21.7               | 8.9                                     | 2.1                | 3.5              | 0     | 8.0                  | 0                   | 1.2            |
| <b>MW<sup>9</sup> TOTAL<br/>(reported and estimated)</b> | 50.3               | 14.7                                    | 3.0                | 3.5              | 2.6   | 20.4                 | 3.0                 | 1.5            |
| <b>tonnes CO<sub>2</sub> saved per<br/>MW specified</b>  | 233                | 228                                     | 567                | 159              | 1,047 | 1,239                | 1,834               | 4,567          |
| <b>tonnes CO<sub>2</sub> saved per<br/>installation</b>  | 158                | 108                                     | 31                 | 22               | 274   | 269                  | 929                 | 1,158          |

## Recommendations

In view of the success of the Mayor's policies, the following are recommended:

1. The GLA should consider moving towards overall carbon emissions reduction targets for development proposals whilst maintaining an obligation for renewable energy in accordance with the current energy hierarchy. This will encourage diversity of solutions and maintain the uptake of renewables. The evidence from this study suggests that total carbon savings of at least 30% with at least 10% renewables is being routinely met on average. Therefore as a starting point a more challenging

<sup>9</sup> This refers to either megawatts thermal or megawatts electric as appropriate for different technologies

target of at least 40% total carbon savings should be proposed, whilst bearing in mind that proposed tightening of Building Regulations Part L will make these savings even more challenging in future;

2. Further work should be conducted to analyse technology savings in relation to building types and sizes. This will help provide an indication of the best technology applications for different building types. There may well be a trend in the type and size of technologies used on specific building types;
3. A standard template for energy statement submissions to the GLA should be developed. This will help improve the quality of data submitted, make the submission process simpler and more precise, and ensure monitoring of data is easier in the future. The template developed by LSBU which has been used for gathering data for this study could serve as a first draft in taking this forward. In particular, recording installation sizes and capacities should be a standard requirement in any reporting;
4. The GLA should ensure that all planning applications, in particular the required energy statements, are submitted and filed electronically, with key information held on a central database and updated on a regular basis. This would enable future analysis to be conducted rapidly and reliably.

## 1. Introduction

The Mayor's climate change programmes and energy policies aim to reduce London's contribution to global climate change, tackle the problem of fuel poverty and promote London's economic development through increased energy efficiency and use of decentralised low carbon and renewable energy technologies. The energy policies in the London Plan (Consolidated with Alterations since 2004) promote energy efficiency (EE) and decentralised energy, including connection to district/community heating networks, use of combined heat and power (CHP) and other efficient sources of energy supply. In addition, they include a 20% CO<sub>2</sub> reduction target through the use of on-site renewables in individual developments referred to the Mayor. To demonstrate compliance, development proposals submitted to the Mayor are expected to include energy statements detailing the contribution and impact of proposed measures on the developments expected emissions.

LSBU was commissioned in March 2006 to conduct a review of the energy statements submitted on planning applications referred to the Mayor. 46 cases were identified with robust information that could be analysed from a list provided by the GLA. The LSBU team developed a Microsoft Access database to store and analyse the data. In April 2007 the study continued to review energy statement submissions to the Mayor between May 2004 and January 2007, boosting the sample size to 113 developments. The study formally reported to the GLA in July 2007. The report<sup>10</sup> was submitted as evidence to the Examination in Public (EiP)<sup>11</sup> on the draft Further Alterations to the London Plan (2006) to demonstrate the results of the application of the London Plan energy policies.

In March 2009, a new study was commissioned with the following objectives:

**Part one:** Analyse and report the estimated energy and carbon savings gained from the application of the energy policies contained in the London Plan, based on data collected from energy statements submitted for planning approval. Provide recommendations to feed into the GLA's London Plan energy policies and planning process.

**Part two:** Gather and report the actual energy and carbon savings gained from the application of the energy policies contained in the London Plan, based on 'as-built' data from developers/designers and site visits. Compare "as-built" data with planning submissions in order to identify relationships, areas of improvement and optimisation. Provide recommendations to feed into the GLA's London Plan energy policies and planning process.

<sup>10</sup> A.R. Day, P.G. Jones and P. Ogumka (July 2007), Review of the impact of the energy policies in the London plan on applications referred to the Mayor (Phase 2), London South Bank University/Greater London Authority, Available from: <http://www.london.gov.uk/mayor/planning/docs/lsbu-research.pdf> Accessed 26th March 2009

<sup>11</sup> The EiP panel report is available from: <http://www.london.gov.uk/mayor/strategies/sds/eip-report07/panel-report-further-alt-eip.pdf>

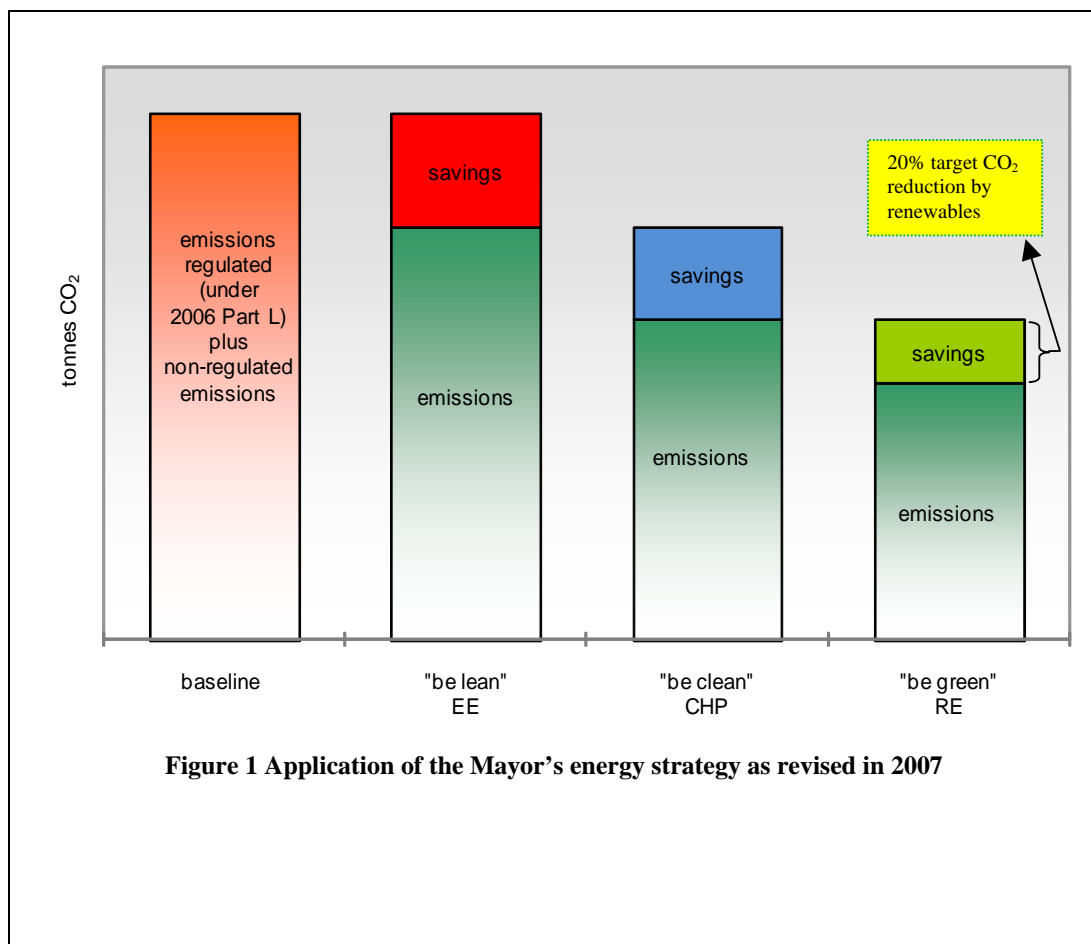
This report (based on part one) presents the findings from a sample of 147 new applications approved<sup>12</sup> by the Mayor between September 2005 and March 2009 out of about 340 total planning applications referred to the Mayor in the study period. The subset of 147 approved developments (see Appendix 1 – List of applications analysed) represents the relevant planning cases for which detailed energy information were available from the GLA. Some developments that were considered either unsuitable (e.g. golf courses, wharf and road extensions, application for floodlights, etc.) or too small, have been excluded from the analysis. In particular, one significantly sized development with zero carbon ambitions has been excluded as it distorted the results of the analysis. While the quality of the energy statement submissions has improved since the last study conducted in 2007, there is still the absence of a standard template for submissions. The variability in submissions affects the quality of the data extracted from them and makes the process of analysing and reporting more time consuming. In a few instances, assumptions were made in order to fill gaps where data was incomplete or ambiguous.

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<sup>12</sup> Approved at Stage II with reports available from: [http://www.london.gov.uk/mayor/planning\\_decisions/](http://www.london.gov.uk/mayor/planning_decisions/)

## 2. Results

The 2006 Building Regulations Part L<sup>13</sup> document requires all new developments to achieve 20 – 28% reductions<sup>14</sup> in CO<sub>2</sub> emissions as a minimum over the 2002 Building Regulations requirement. This can be achieved through the use of energy efficient design and the inclusion of low and zero carbon technologies. As a requirement of the energy policies of the London Plan, the baseline emissions in individual developments go beyond 2006 Part L and must reflect “whole” emissions. This requirement includes both the emissions from regulated energy uses under the 2006 standard, and the additional emissions from non-regulated energy uses such as cooking and small power equipment. Compliance with the London Plan requires individual developments to meet the requirements of Building Regulations 2006 (and exceed where possible) through energy efficiency measures first before the introduction of low and zero carbon technologies as indicated in Figure 1.



**Figure 1 Application of the Mayor's energy strategy as revised in 2007**

<sup>13</sup> Office of the Deputy Prime Minister (2006), Approved Document L - Conservation of Fuel & Power (England & Wales)

<sup>14</sup> For individual new dwellings no greater than 450m<sup>2</sup> (ADL1A), the improvement factor is 20% over notional dwellings built to SAP 2005 standard while for individual new buildings other than dwellings (ADL2A), the improvement factor is 23 – 28% over notional buildings built to 2002 Part L standards.

## 2.1. Emissions

Figure 2 shows the CO<sub>2</sub> emissions from the 147 new developments analysed in this study. The baseline emissions (388 kilo tonnes) are reduced after the adoption of energy efficiency measures (335 kilo tonnes), implementation of gas-fired CHP (304 kilo tonnes) and inclusion of renewable technologies (272 kilo tonnes) per annum. The red and black lines indicate the target emissions if 10% and 20% CO<sub>2</sub> savings respectively were met on all developments through the use of on-site renewable generation. It should be noted that about a third of these developments were approved prior to the publication of the London Plan (Consolidated with Alterations since 2004) in February 2008, at which time the 20% renewable target was fully adopted.

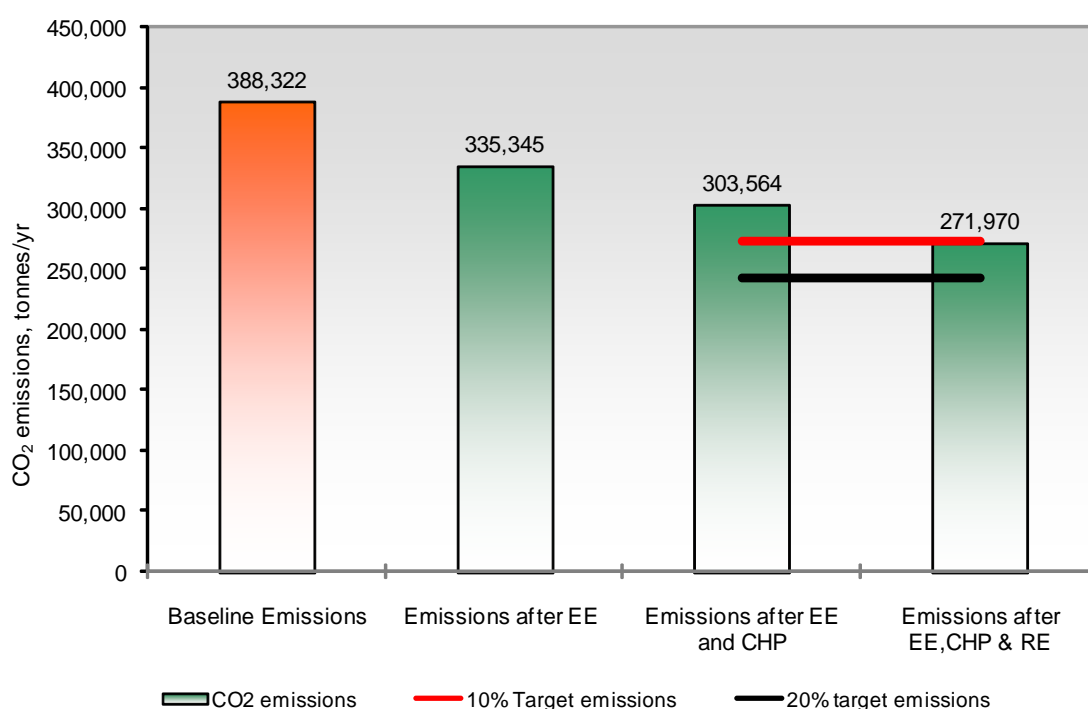


Figure 2 CO<sub>2</sub> emissions in tonnes/year (across 147 developments)

Adding the reported contribution<sup>15</sup> from 113 developments previously analysed, provides Figure 3. This shows the reduction in overall emissions as a result of the application of the energy policies of the London Plan on the sample of planning applications analysed since the first publication in 2004. It indicates total savings of 251,880 tonnes CO<sub>2</sub> per year through the use of energy efficiency, CHP and renewable energy technologies across 260 developments.

<sup>15</sup> A.R. Day, P.G. Jones and P. Ogomka (July 2007), Review of the impact of the energy policies in the London plan on applications referred to the Mayor (Phase 2), London South Bank University/Greater London Authority, Available from: <http://www.london.gov.uk/mayor/planning/docs/lbu-research.pdf> Accessed 26th March 2009 – See page 8-10

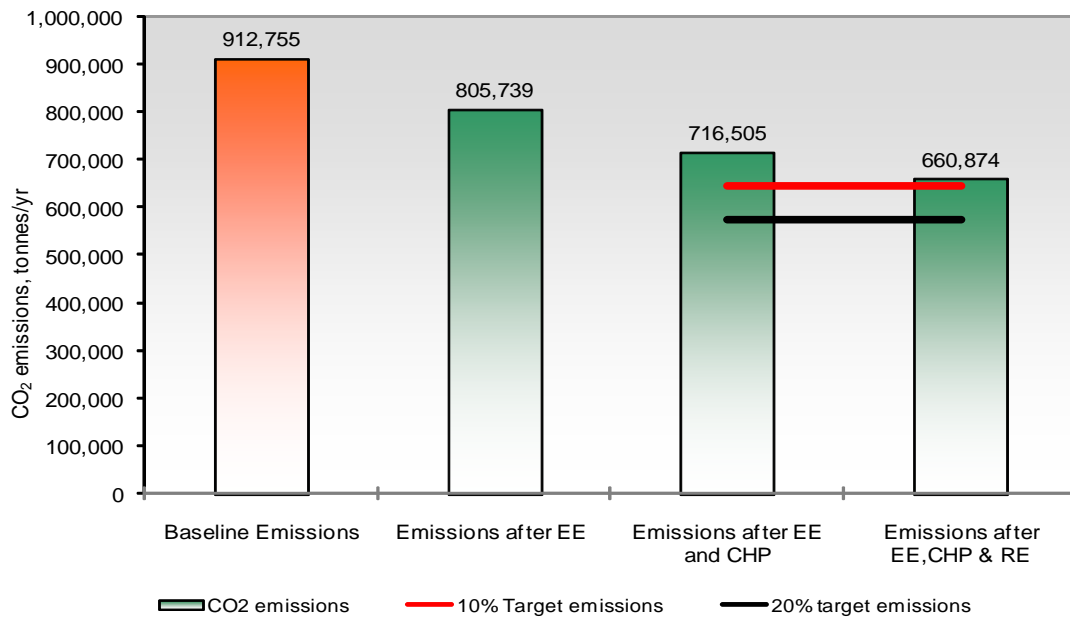


Figure 3 CO<sub>2</sub> emissions in tonnes/year (across 260 developments)<sup>16</sup>

## 2.2. Savings

The CO<sub>2</sub> savings per annum are shown in Figure 4 as 53 kilo tonnes from energy efficiency, 32 kilo tonnes from CHP and 32 kilo tonnes from renewable energy technologies across the sample of 147 planning applications analysed in the current study. Altogether, these give total savings of 116,352 tonnes of CO<sub>2</sub> per annum which represent an average 30% CO<sub>2</sub> savings from the whole emissions baseline. Table 2 summarises the step by step contribution in terms of CO<sub>2</sub> savings (tonnes per year) and percentages over adjusted baselines.

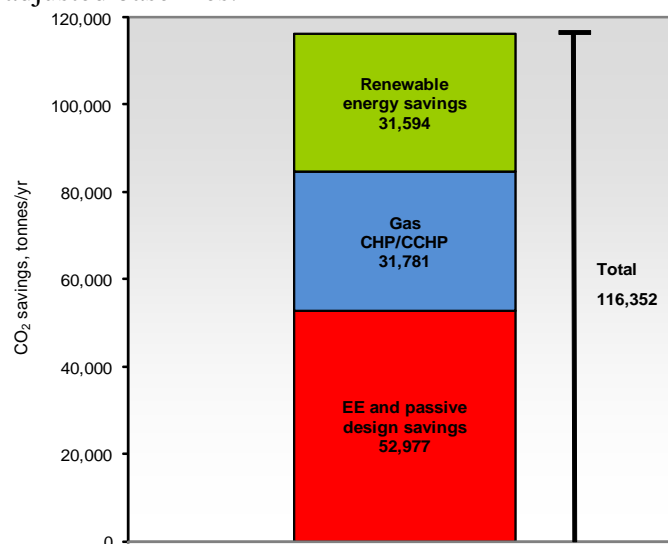


Figure 4 Overall CO<sub>2</sub> savings from EE, gas-fired CHP and RE (across 147 developments)

<sup>16</sup> This figure represents the total emissions from the developments studied in 2007 (113) and the developments in this current study (147) – a total of 260 developments studied so far

**Table 2 Breakdown of CO<sub>2</sub> savings (across 147 developments)**

|              | tonnes CO <sub>2</sub> /year | percentage savings      |
|--------------|------------------------------|-------------------------|
| <b>EE</b>    | <b>52,977</b>                | <b>14%</b>              |
| <b>CHP</b>   | <b>31,781</b>                | <b>9%</b>               |
| <b>RE</b>    | <b>31,594</b>                | <b>10.4%</b>            |
| <b>Total</b> | <b>116,352</b>               | <b>30%<sup>17</sup></b> |

The growth in CO<sub>2</sub> savings over time<sup>18</sup> from energy efficiency, CHP, renewable energy technologies and the combined total (for 147 developments) are presented in Figure 5.

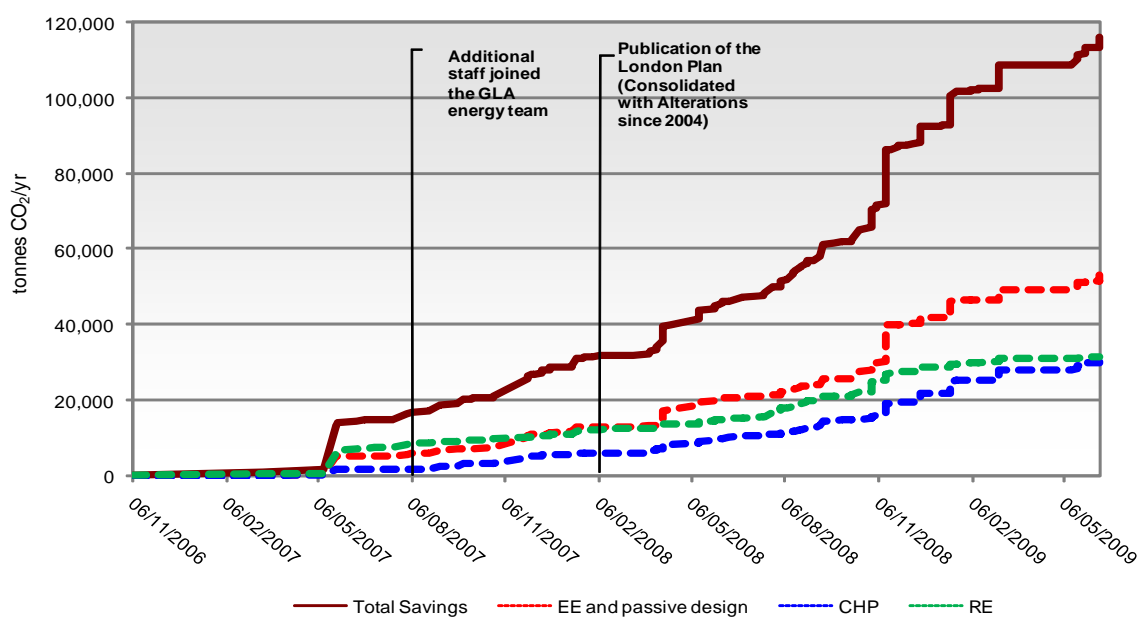
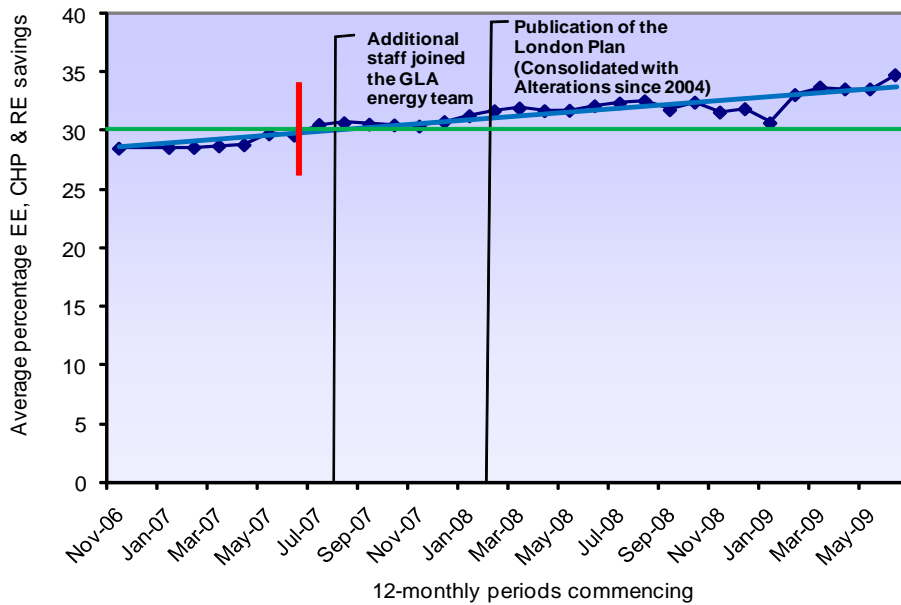
**Figure 5 Cumulative CO<sub>2</sub> savings over time (across 147 developments)**

Figure 6 represents the average percentage savings from a combination of energy efficiency, CHP and renewable energy technologies over progressive 12-monthly periods. The blue trend line indicates that average savings rose from 29% to 34%. On average, developments started to regularly meet 30% (indicated by the horizontal green line) annually after July 2007 (indicated by the vertical red line).

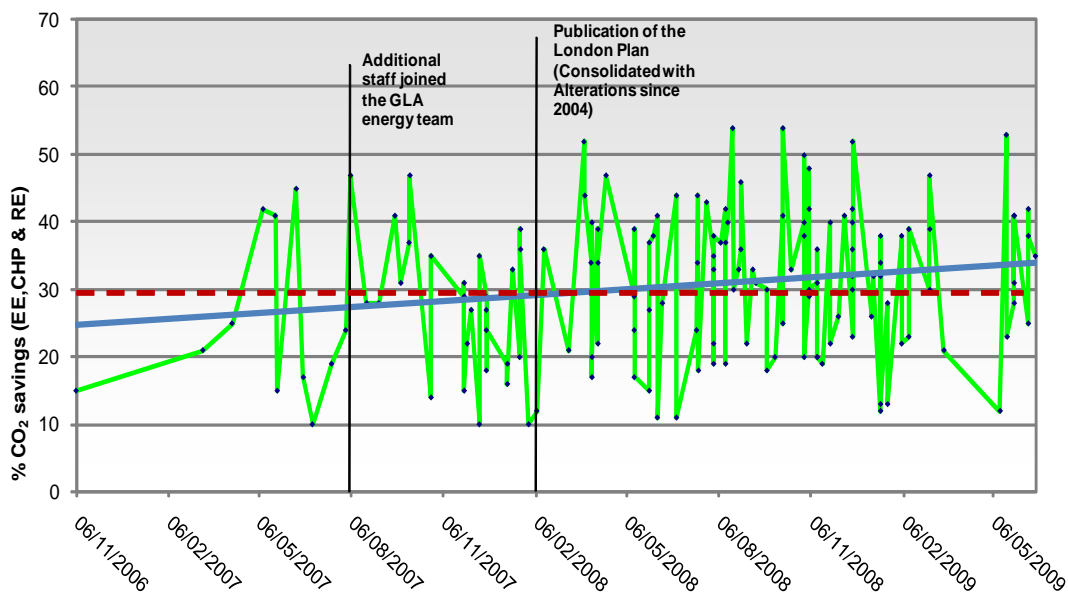
<sup>17</sup> Percentage over the baseline

<sup>18</sup> The dates used here refer to the Stage II report dates at which time the applications were formally approved by the Mayor. The Stage II reports are available from: [http://www.london.gov.uk/mayor/planning\\_decisions/](http://www.london.gov.uk/mayor/planning_decisions/)



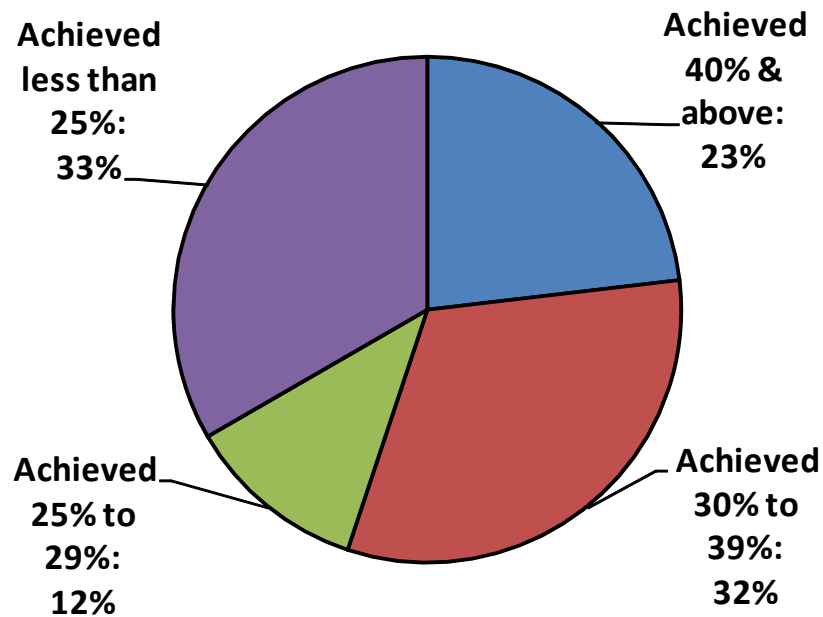
**Figure 6 Average percentage savings from combined EE, CHP and RE over progressive 12-monthly periods (across 147 developments)**

Figure 7 shows the total percentage savings from a combination of EE, CHP and RE against the Mayor’s report Stage II approval dates. While the trend line tells a similar story to Figure 6, this graph particularly illustrates the spread of percentage savings over time. More developments tend to achieve 30% CO<sub>2</sub> savings and beyond following the publication of the London Plan (Consolidated with Alterations since 2004) in February 2008, with about a quarter having met or exceeded 40% CO<sub>2</sub> savings.



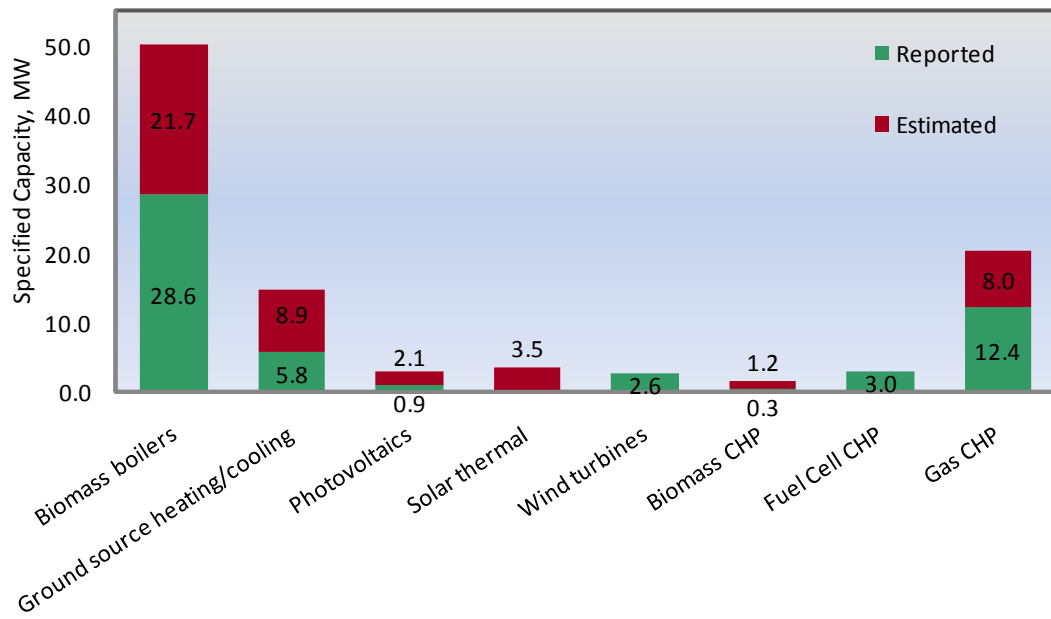
**Figure 7 Percentage savings from combined EE, CHP and RE over time (across 147 developments)**

Developments can be grouped into four broad categories of total percentage CO<sub>2</sub> savings (through a combination of EE, CHP and RE) as shown in Figure 8. While 23% of the developments achieved 40% savings and above, 32% achieved between 30% and 40% savings, 12% achieved between 25% and 30% savings, and 33% achieved less than 25% savings.



**Figure 8 Grouping developments by percentage savings of combined EE, CHP and RE (across 147 developments)**

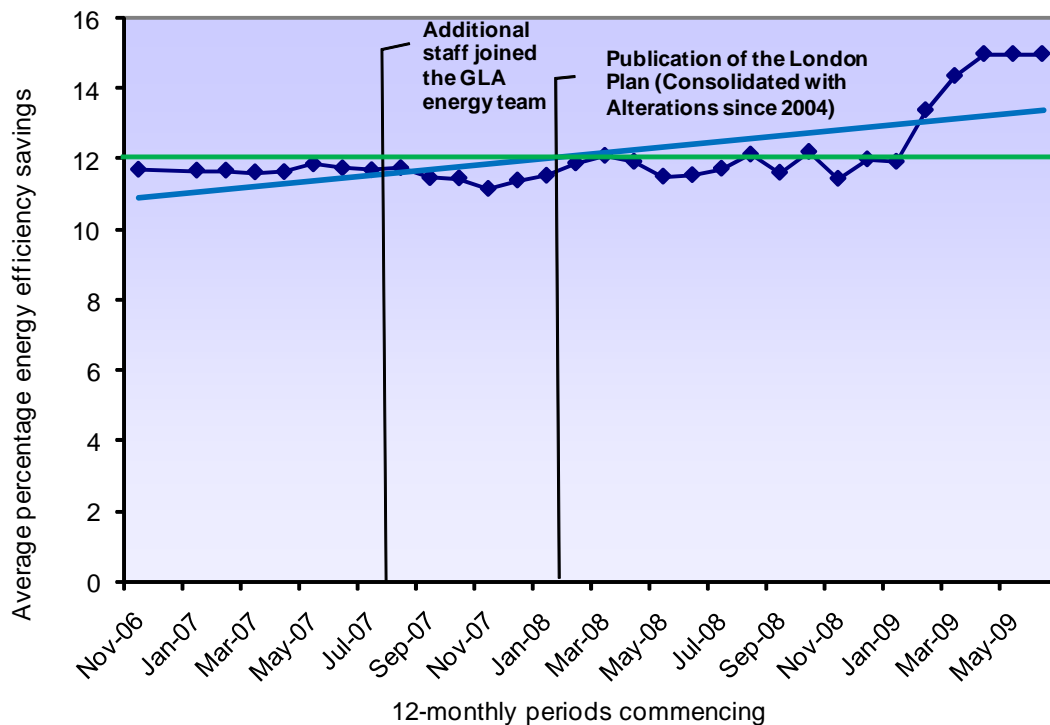
It has also been possible to gather information about the specified technology generation capacity on a number of developments as reported in the energy statements. However, this information was not provided in all cases. As a result, methodologies for each technology, based on a back-calculation from CO<sub>2</sub> savings and assuming standard parameters were derived to infer the capacities (see Appendix 2 – Calculating technology capacities). Figure 9 shows the reported (bottom series) and estimated (top series) capacities in MW thermal and electric as appropriate, aggregated for different renewable energy and CHP technologies.



**Figure 9 Specified capacity in MW for major RE and CHP technologies (across 147 developments)**

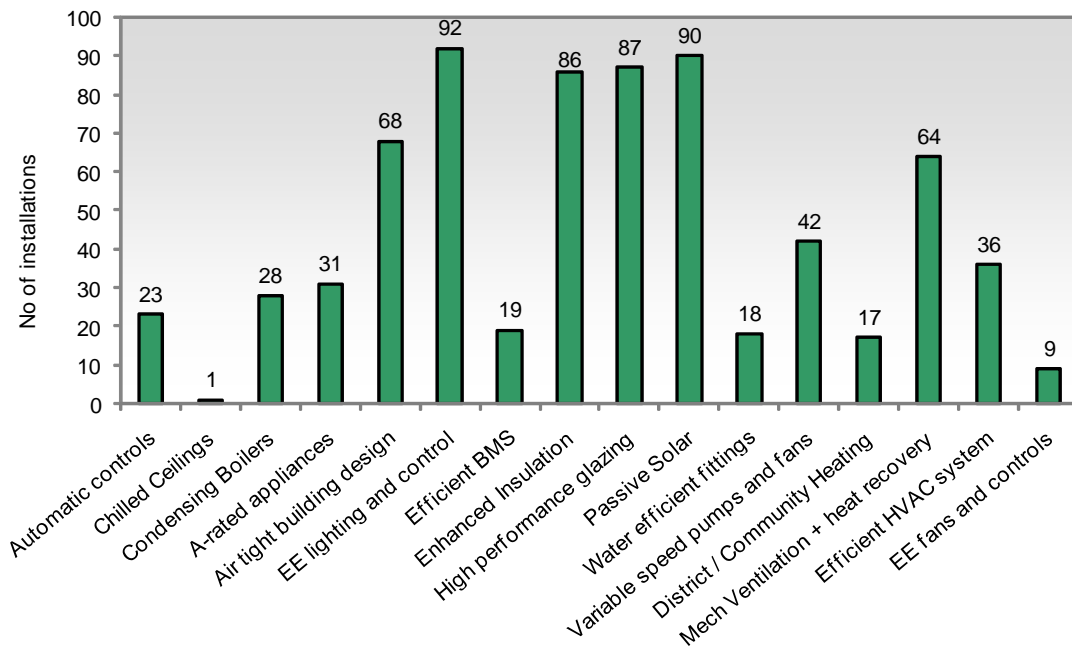
### 2.3. Analysis of Energy Efficiency contributions

Figure 10 shows the trend of average energy efficiency percentage savings beyond the baseline over progressive 12-monthly periods. These percentage savings are over and above the regulated 2006 Building regulations Part L minimum standard. They have been calculated over baseline emissions, which include emissions from both regulated and non-regulated energy uses (i.e. “whole” energy). Savings rose from about 12% up to 15%. The blue line represents an upward trend in savings while the green line indicates average savings across the entire period (12%) from November 2006 to June 2009.



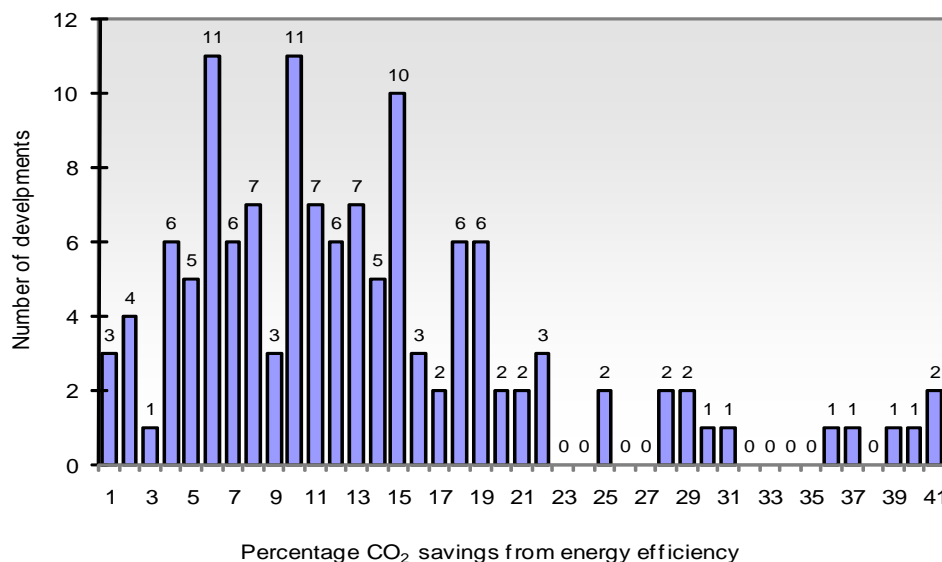
**Figure 10 Average percentage savings from EE over progressive 12-monthly periods (across 147 developments)**

While it has been difficult to quantify the savings beyond Part L 2006 minimum standard from individual energy efficiency technologies utilised, it has been possible to quantify the number of installations per measure as presented in Figure 11. There are over 700 installations of energy efficiency measures across the 147 new developments. It should be noted that the building type (for example residential housing or flats, commercial or office space) significantly influences the level of energy efficiency savings possible in schemes. Passive solar design and the installation of energy efficient lighting with lighting controls are the most common measures used by developers to reduce demand



**Figure 11 Number of installations of energy efficiency measures (across 147 developments)**

Figure 12 shows the frequency of percentage CO<sub>2</sub> savings from energy efficiency beyond the baseline. CO<sub>2</sub> savings of 6% and 10% are most common, each met by 11 developments. This is followed closely by 15% which has been met by 10 developments. However, some developments have achieved up to 40% CO<sub>2</sub> savings. The higher levels of savings achieved are typically driven by the developer or client from the initial design/architectural stages.

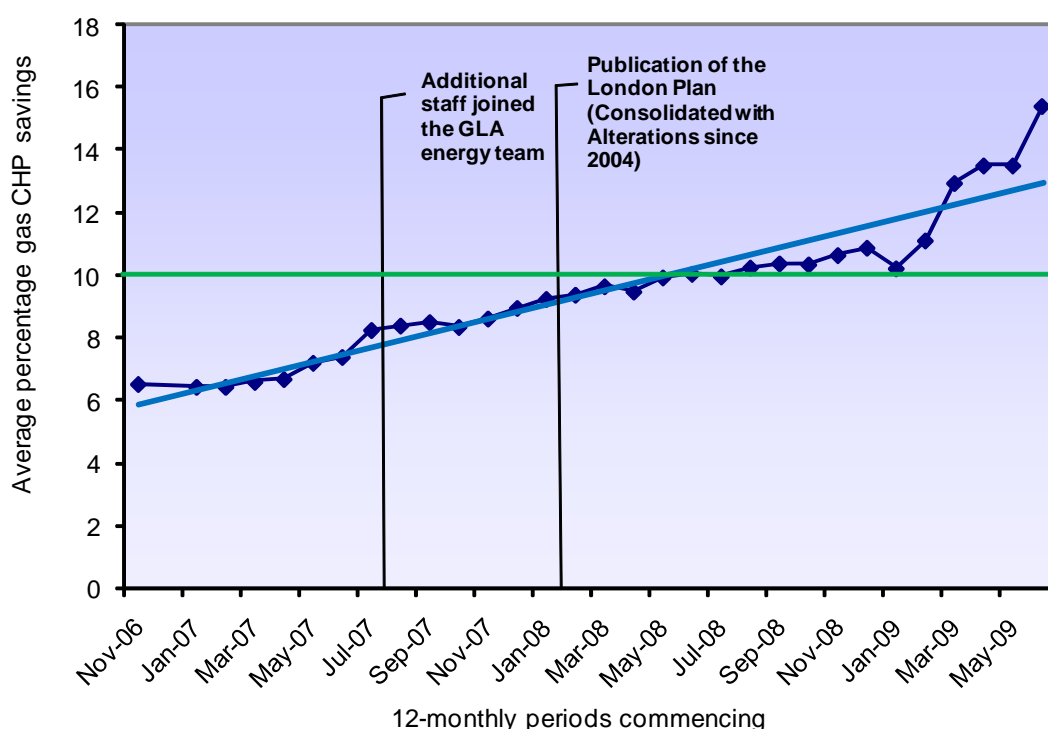


**Figure 12 Frequency of percentage savings from energy efficiency (across 130 developments)<sup>19</sup>**

<sup>19</sup> The number of developments given here is less than the total because it excludes developments which made no more reduction through energy efficiency beyond the baseline

#### 2.4. Analysis of contributions from CHP with communal heating

This section details the savings from combined heat and power (CHP) with communal heating. Percentage savings from gas-fired and fuel cell CHP are calculated over the development's emissions after energy efficiency savings have been incorporated. Figure 13 represents the trend in average savings by gas-fired CHP over progressive 12-monthly periods. An upward trend (marked by the blue line) is clearly observed as savings rose from about 6% (in November 2006) to about 15% (in May 2009). Across the entire period, the average savings was 10% (indicated by the horizontal green line) and developments started to regularly meet this average after May 2008. However, 49 developments did not include CHP due to the small nature of the developments and/or absence of sufficient heat load to support the plant. If these were excluded from the 147 developments, average CO<sub>2</sub> savings would be 13% of those using CHP.



**Figure 13 Average percentage savings from gas-fired CHP over progressive 12-monthly periods (across 147 developments)**

Figure 14 shows the frequency of percentage CO<sub>2</sub> savings from gas-fired CHP. CO<sub>2</sub> savings of 11% is most common, met by 9 developments. This is followed closely by 10% which has been met by 8 developments and 9% met by 7 developments, while some developments have achieved up to 40% CO<sub>2</sub> savings. The higher levels of savings are influenced by several factors such as the plant size and running hours.

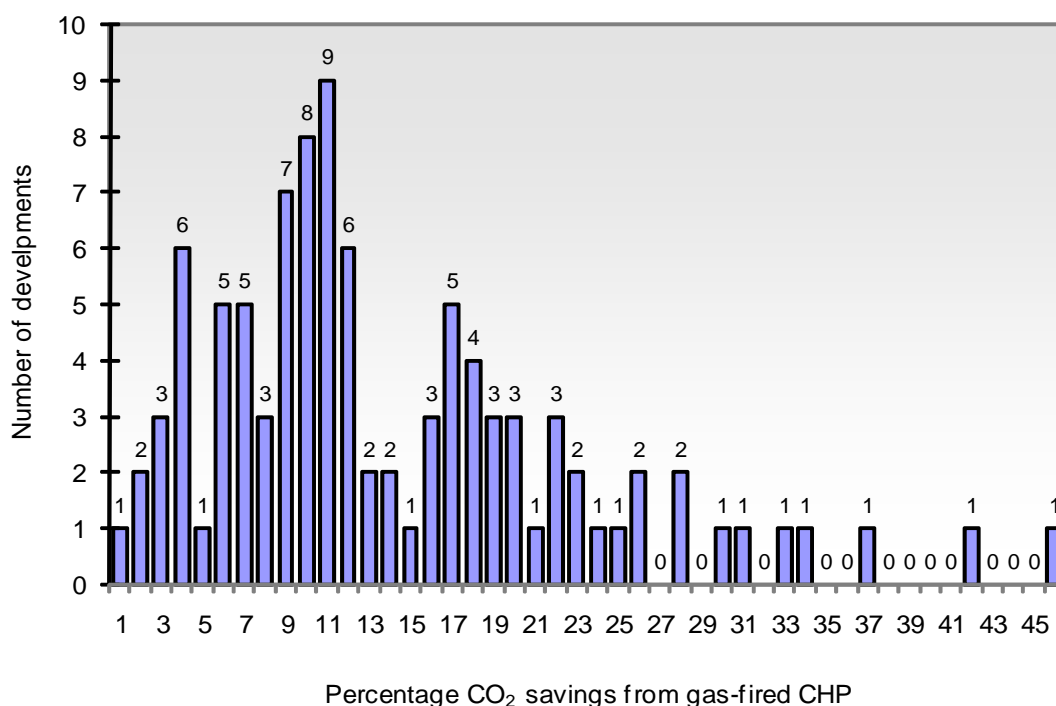


Figure 14 Frequency of percentage savings from gas-fired CHP (across 98 developments)<sup>20</sup>

#### 2.4.1. Contribution by CHP type

Table 3 summarises the contribution by different CHP technologies. These are categorised in terms of fuel type: natural gas, fuel cell and biomass<sup>21</sup>. Gas-fired CHP makes by far the largest contribution to CO<sub>2</sub> savings across all technologies (energy efficiency and renewables) and has the highest number of installations. Biomass and fuel cell CHP schemes give comparatively higher tonnes CO<sub>2</sub> saved per megawatt (MW) and per installation. However, it should be noted that these are relatively novel applications and whilst supported in the London Plan, there are still uncertainties surrounding their installation and operation compared to the more conventional gas-fired option. Hence, in planning terms the use of such novel systems are approved on the condition that if they do not prove operationally viable, the conventional gas-fired option should be adopted. It is an aim of Part Two of this study to investigate some installations in order to provide a better indication of what is practically achievable.

In terms of specified capacity, out of 94 installations of gas-fired CHP, 50 cases reported the plant capacity while the other 44 were estimated by back-calculating from the CO<sub>2</sub> savings (see Appendix 2 – Calculating technology capacities). For biomass CHP, one of the cases reported the plant capacity while the other five cases were back-calculated.

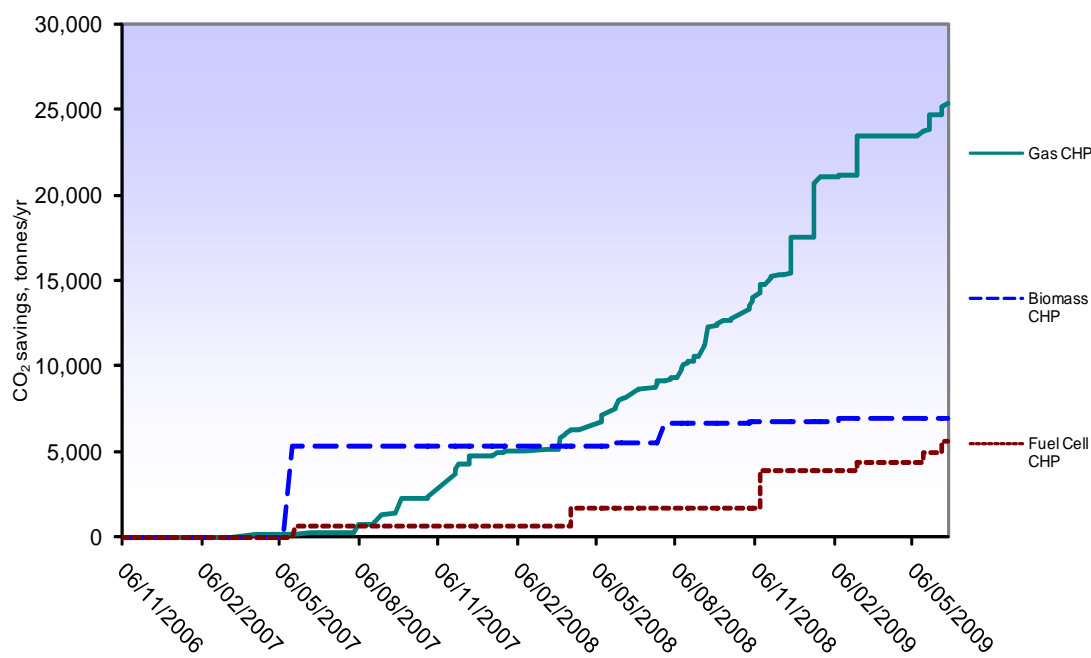
<sup>20</sup> The number of developments given here is less than the total because it excludes developments which did not include CHP as they were considered to be unsuitable for the application of CHP due to the small nature of such schemes and/or absence of sufficient heat load to support the plant

<sup>21</sup> Biomass CHP savings are cited in this section simply for comparison with other CHP types. However, the use of this technology forms part of the third step in the energy hierarchy – renewable energy technologies.

**Table 3 Contribution by CHP technology type (across 147 developments)**

|   | Gas-fired CHP | Fuel cell CHP | Biomass CHP <sup>22</sup> |
|---|---------------|---------------|---------------------------|
| number of installations                       | 94            | 6             | 6                         |
| tonnes CO <sub>2</sub> saved                  | 25,331        | 5,575         | 6,946                     |
| MW (reported)                                 | 12.4          | 3.0           | 0.3                       |
| MW (estimated)                                | 8.0           | 0             | 1.2                       |
| MW TOTAL (reported and estimated)             | 20.4          | 3.0           | 1.5                       |
| tonnes CO <sub>2</sub> saved per MW (total)   | 1,239         | 1,834         | 4,567                     |
| tonnes CO <sub>2</sub> saved per installation | 269           | 929           | 1,158                     |

Figure 15 shows the cumulative growth in savings from CHP over time<sup>23</sup>. The step changes indicate when large CHP installations were proposed.

**Figure 15 Cumulative CO<sub>2</sub> savings from CHP technology type (across 147 developments)**

<sup>22</sup> Biomass CHP savings are cited in this section simply for comparison with other CHP types. However, the use of this technology forms part of the third step in the energy hierarchy – renewable energy technologies.

<sup>23</sup> The dates used here refer to the Stage II report dates at which time the applications were formally approved by the Mayor. The Stage II reports are available from: [http://www.london.gov.uk/mayor/planning\\_decisions/](http://www.london.gov.uk/mayor/planning_decisions/)

## 2.5. Analysis of Renewable Energy contributions

In September 2006, the draft Further Alterations to the London Plan was published proposing a number of changes, including the establishment of a 20% CO<sub>2</sub> emissions reduction target through the use of renewables, an advance on the previous practice of a 10% reduction target. This reduction target is calculated over the emissions from the development after energy efficiency and CHP savings have been incorporated as pictorially illustrated in Figure 1. The Mayor's energy hierarchy (originally outlined in the Energy Strategy 2004) was also revised and included as planning policy. As a result, greater emphasis was placed in planning work around connection to existing communal heating schemes, site wide heat networks and the use of on-site CHP. In line with the London Plan policy requirements, if a CHP system was deemed to be appropriate for a scheme, the size of the CHP needed to be optimised based on total site thermal load to maximise CO<sub>2</sub> savings delivered. This reduced the available demand to be met from renewable energy (particularly renewable heat) in certain schemes where gas-fired CHP has been proposed. Figure 16 illustrates that developments which secured high percentage CO<sub>2</sub> savings through on-site CHP, found it challenging to meet the 20% RE target. Developments that were unsuitable for the application of CHP (mainly due to the absence of sufficient heat load for on-site CHP) achieved comparatively higher RE savings.

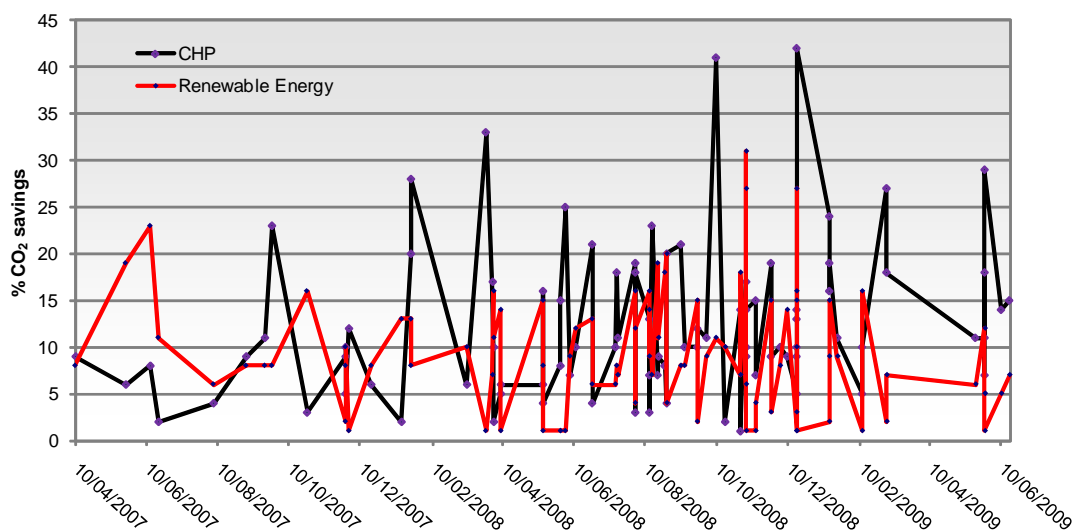


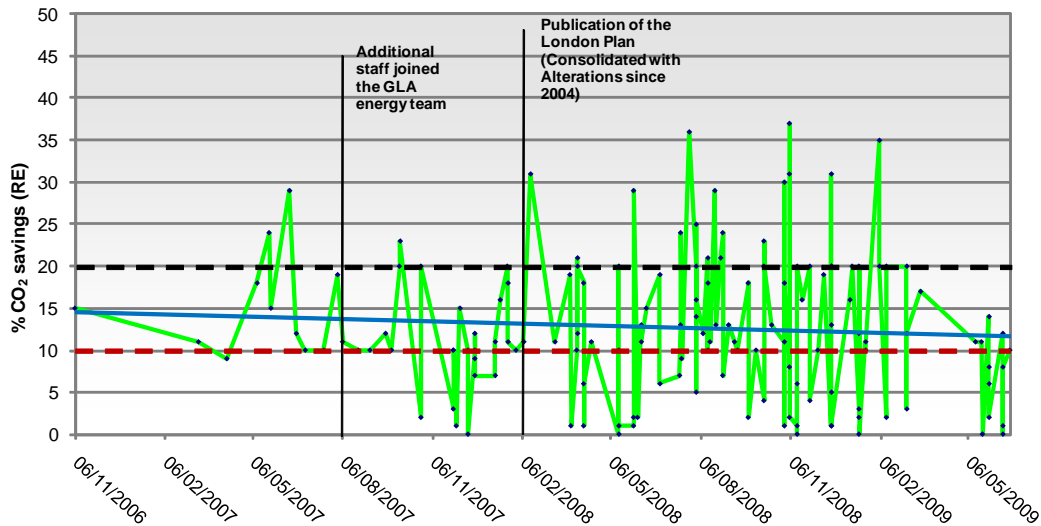
Figure 16 Effect of the revised hierarchy on percentage CO<sub>2</sub> savings (across 90 developments)<sup>24</sup>

Figure 17 shows that due to increasing levels of CO<sub>2</sub> savings from CHP, there is a small downward trend (shown by the blue line) in CO<sub>2</sub> savings from renewable energy technologies over the most recent period. However, it should be noted that there has been an overall increasing trend in CO<sub>2</sub> savings from renewables as a result of the implementation of the London Plan energy policies since the first publication in 2004 (across 260 developments)<sup>25</sup>. The red line marks the 10% renewable energy target

<sup>24</sup> The number of developments given here represents those that mutually included CHP and RE

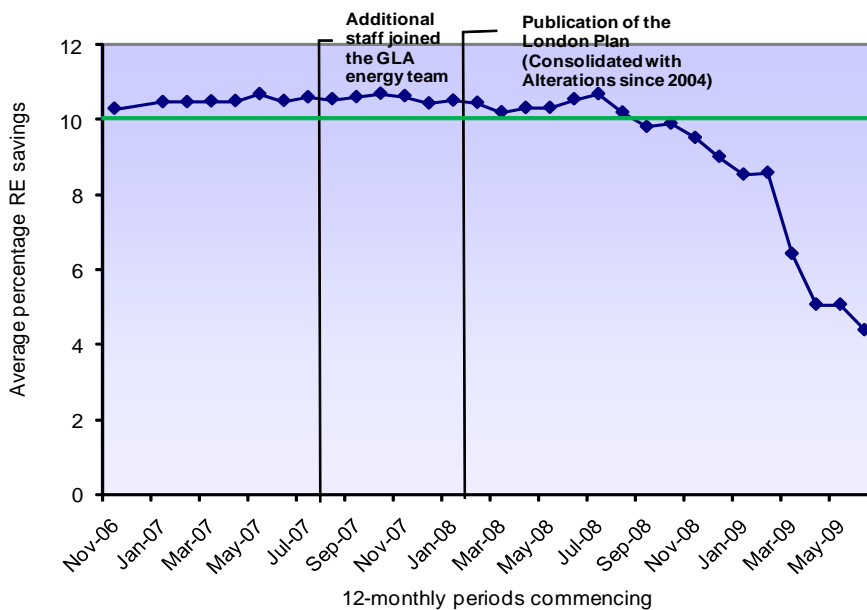
<sup>25</sup> Taking into account renewable savings from the 113 developments studied in 2007 and the 147 developments in this current study

savings while the black line marks the 20% renewable energy target through on-site renewable generation.



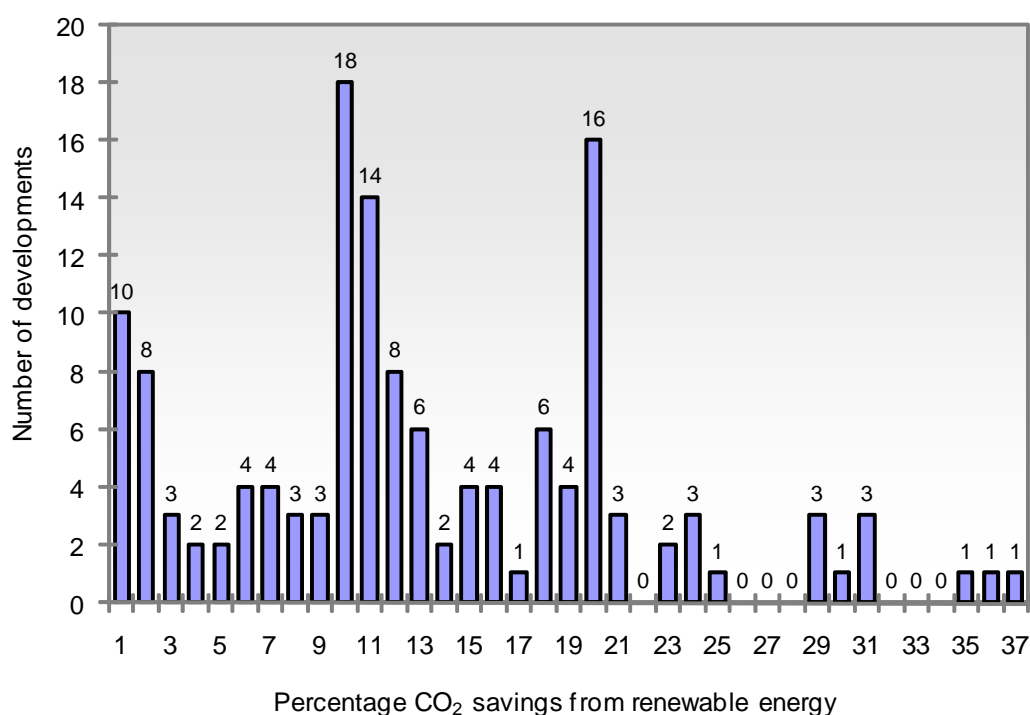
**Figure 17 Percentage CO<sub>2</sub> savings from RE over time (across 147 developments)**

Figure 18 shows the average CO<sub>2</sub> savings from renewables over progressive 12-monthly periods. It illustrates more clearly the recent downward trend in CO<sub>2</sub> savings from renewables due to increasing levels of CHP application, which has been explained above. The green horizontal line represents the average savings (10%) over the entire period (November 2006 to June 2009), although many of these developments individually achieved well above these averages.



**Figure 18 Average percentage savings from RE over progressive 12-monthly periods (across 147 developments)**

Figure 19 shows the frequency of percentage CO<sub>2</sub> savings from renewables. 10% CO<sub>2</sub> savings is most common, met by 18 developments. This is followed closely by 20% which has been met by 16 developments and 11% met by 14 developments. Some developments exceeded 20% CO<sub>2</sub> savings from renewables and at least 6 developments achieved more than 30%. The higher levels of savings are influenced by a number of factors such as the size and type of development, available demand, appropriate infrastructure both for equipment and for fuel storage (for example in cases with biomass).



**Figure 19 Frequency of percentage savings from RE (across 141 developments)<sup>26</sup>**

An alternative presentation of the same data is shown in Figure 20. Here developments have been grouped into four categories: those that had no renewable savings, those that met up to 10% CO<sub>2</sub> savings from renewables, those that achieved between 10% and 20% and lastly those that met 20% and above. It is interesting to note that 25% of the developments showed RE savings in excess of the 20% target. Whilst it would be useful to know the type of buildings in each category, this information has not been analysed in this study and should be included in future analysis.

<sup>26</sup> The number of developments given here is less than the total because it excludes developments which did not include renewable energy technologies.

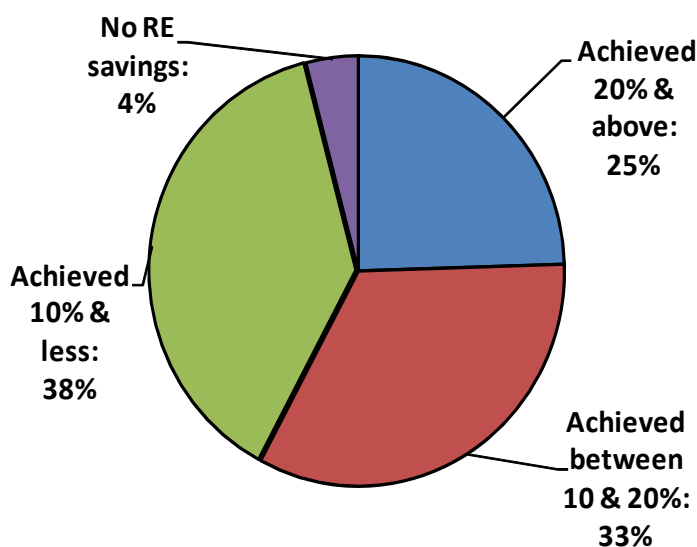


Figure 20 Grouping developments by percentage RE savings (across 147 developments)

### 2.5.1. Contribution by RE type

Table 4 summarises the contribution from the main renewable technologies. In terms of specified technology generation capacity, some developments reported plant capacity while others did not. The number of developments that reported technology generation capacities for the different technologies is given in parentheses for each technology type. For example, 42 out of 74 installations reported the biomass boiler capacities while for solar thermal none of the cases reported the technology capacity. Hence, the others have been estimated by back-calculating from the CO<sub>2</sub> savings based on assumptions (see Appendix 2 – Calculating technology capacities). There is a need to improve the quality of energy data submissions.

Table 4 Contribution by major RE technologies (across 147 developments)

|   | Biomass<br>boilers | Ground source<br>heating/cooling | Photo-<br>voltaics | Solar<br>thermal | Wind<br>turbines | Biomass<br>CHP |
|---|--------------------|----------------------------------|--------------------|------------------|------------------|----------------|
| <b>number of<br/>installations</b>                    | 74 (42)            | 31 (13)                          | 55 (10)            | 26 (0)           | 10 (7)           | 6 (1)          |
| <b>tonnes CO<sub>2</sub> saved</b>                    | 11,695             | 3,351                            | 1,718              | 560              | 2,735            | 6,946          |
| <b>MW reported</b>                                    | 28.6               | 5.8                              | 0.9                | 0                | 2.6              | 0.3            |
| <b>MW estimated</b>                                   | 21.7               | 8.9                              | 2.1                | 3.5              | 0                | 1.2            |
| <b>MW TOTAL<br/>(reported and estimated)</b>          | 50.3               | 14.7                             | 3.0                | 3.5              | 2.6              | 1.5            |
| <b>tonnes CO<sub>2</sub> saved<br/>per MW (total)</b> | 233                | 228                              | 567                | 159              | 1,047            | 4,567          |
| <b>tonnes CO<sub>2</sub> saved</b>                    | 158                | 108                              | 31                 | 22               | 274              | 1,158          |

|                  |  |  |  |  |  |  |
|------------------|--|--|--|--|--|--|
| per installation |  |  |  |  |  |  |
|------------------|--|--|--|--|--|--|

Figure 21 shows the CO<sub>2</sub> savings by renewable technologies across the entire sample of 147 developments whereas Figure 22 shows the number of installations per technology type. Biomass boilers made the most savings (11,695 tonnes CO<sub>2</sub> per year) and were the most regularly specified (74 installations). Biomass supply chain issues have always been cited as a problem for London, but this result may indicate increased confidence in this technology (as more experience has been gained) and more reliable fuel source. Also, when correctly installed and operated, biomass boilers prove to be more economically viable (£/tonne saved) than some of the other RE options. While Figure 21 shows that biomass CHP made high savings (6,946 tonnes CO<sub>2</sub> per year) considering the lower number of installations (6 installations) shown in Figure 22, these schemes are novel applications (see explanation given in Section 2.4.1).

Photovoltaics (PV) are also popular (55 individual installations) albeit their savings (1,718 tonnes CO<sub>2</sub>/year) are lower than some of the other technologies. Their popularity could perhaps be related to the increase in the use of CHP, which means that most of the heat load has been met and only electricity displacing/exporting systems can be employed. Considering the issues associated with urban wind, developers may well be driven towards the use of PV although it is an expensive technology. PV systems are also comparatively easier to specify and install. Ground source heating and cooling and solar thermal continue to be popular due to their competitive price and relative maturity.

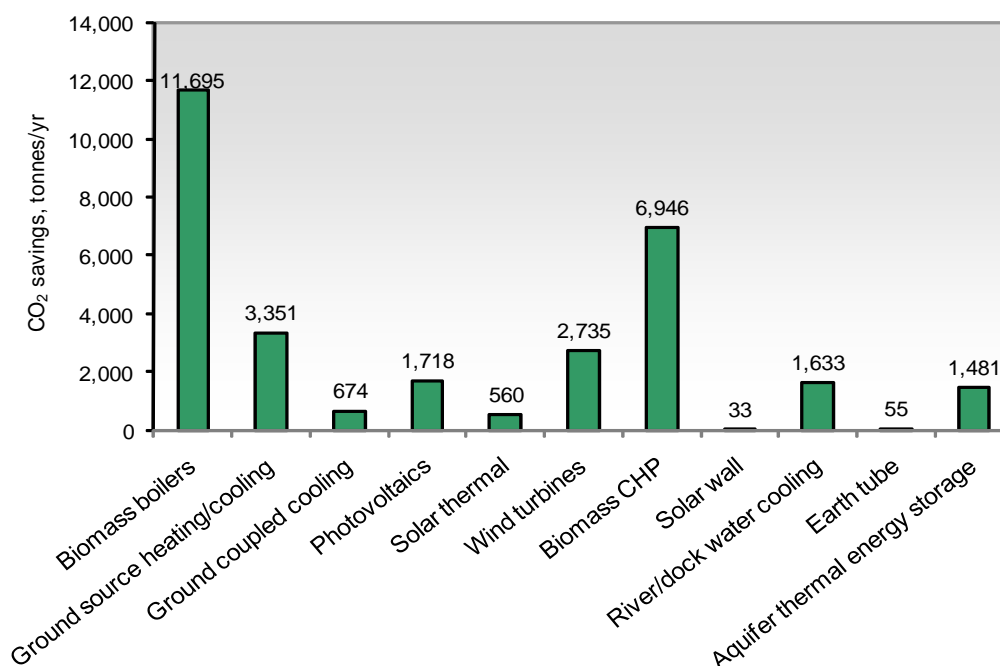
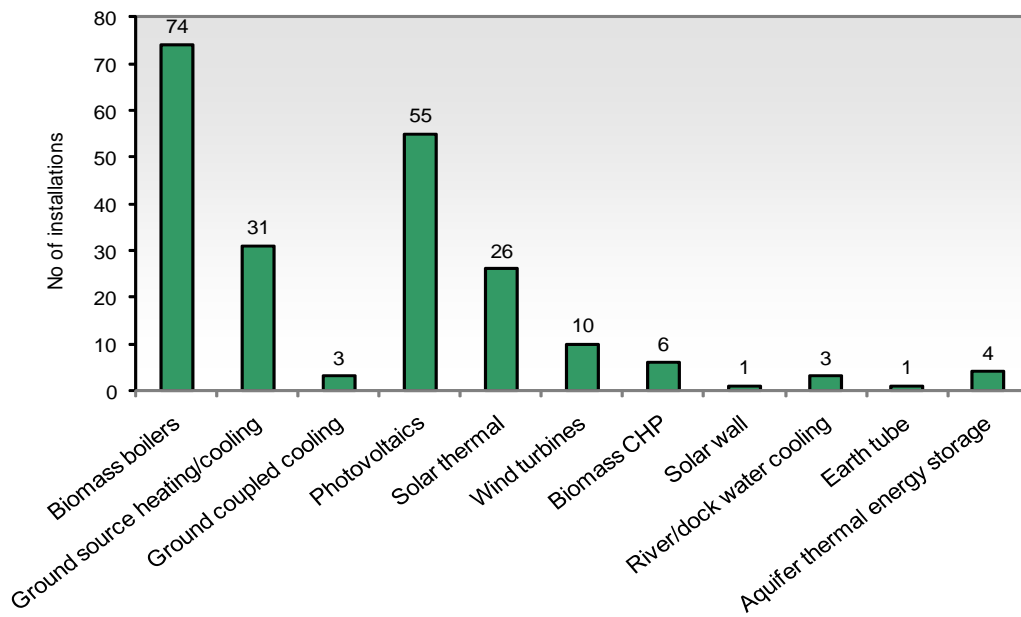
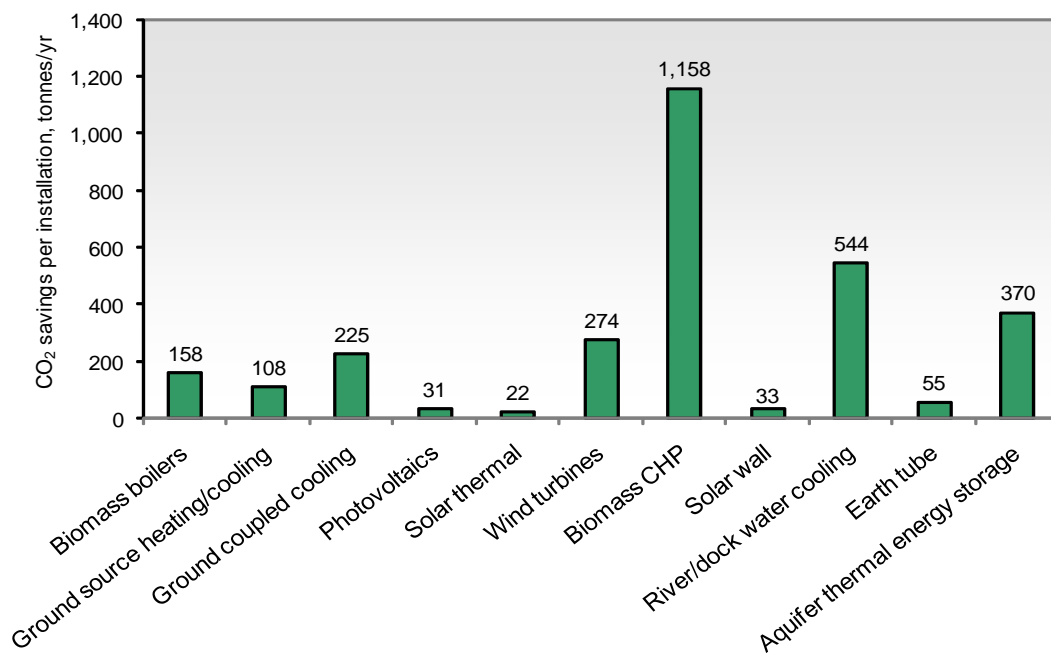


Figure 21 Overall CO<sub>2</sub> savings by RE technology type (across 147 developments)



**Figure 22 Number of installations by RE technology type (across 147 developments)**

Figure 23 indicates that the highest savings per installation were made using biomass CHP (see explanation given in Section 2.4.1). More renewable energy technologies have emerged including river/dock water cooling systems (3 installations) and Aquifer Thermal Energy Storage (ATES) or Borehole Thermal Energy Storage (BTES) systems (4 installations). These schemes also give relatively higher savings per installation compared with the other more conventional options. Whilst these novel applications are supported in the London Plan, there are still uncertainties surrounding their installation and operation.



**Figure 23 Average CO<sub>2</sub> savings per installation of RE technology type (across 147 developments)**

Figure 24 and Figure 25 show the growth in CO<sub>2</sub> savings and number of installations specified by technology respectively over time<sup>27</sup>. These show strong growth in biomass heating and steady specification of ground source heat pumps, PV and solar thermal. The others show step changes - indicating their size and relative potential contribution.

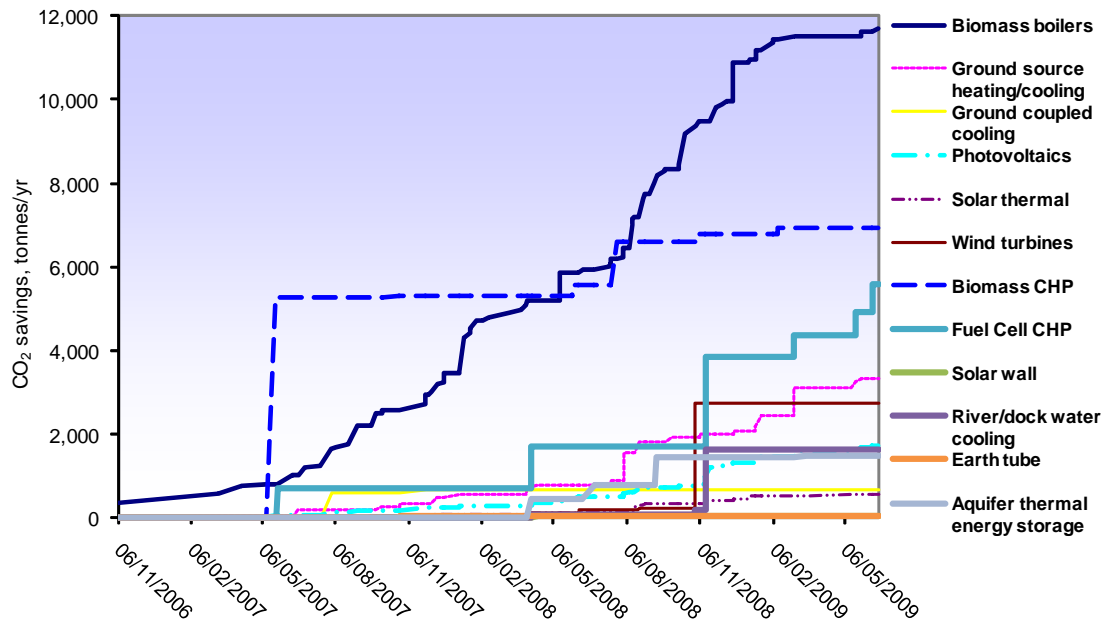


Figure 24 Cumulative CO<sub>2</sub> savings by RE technology type (across 147 developments)

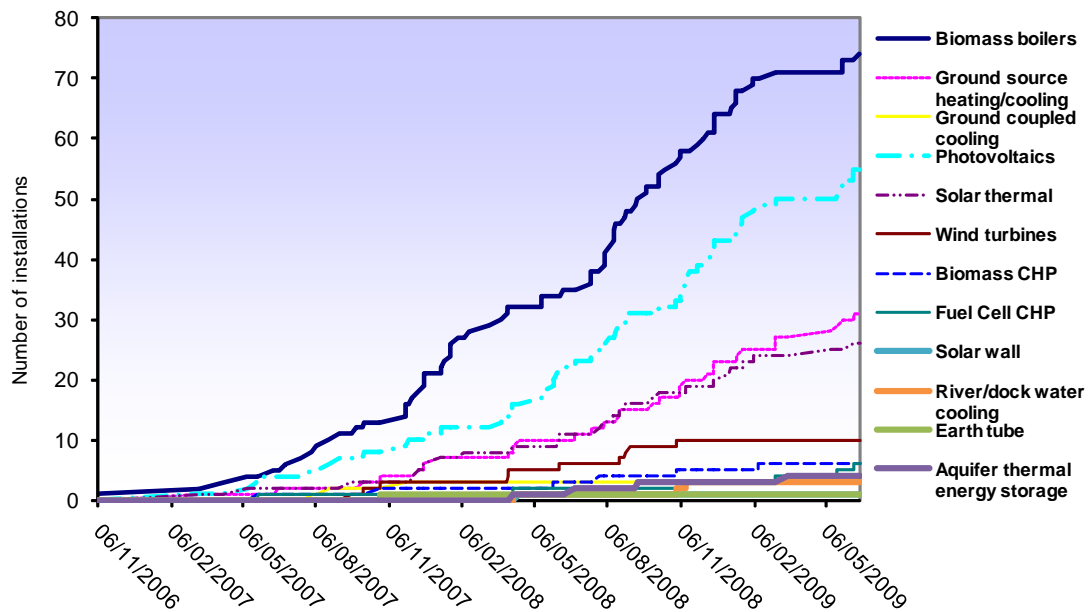


Figure 25 Cumulative number of installations by RE technology type (across 147 developments)

<sup>27</sup> The dates used here refer to the Stage II report dates at which time the applications were formally approved by the Mayor. The Stage II reports are available from: [http://www.london.gov.uk/mayor/planning\\_decisions/](http://www.london.gov.uk/mayor/planning_decisions/)

### 3. Conclusions and Recommendations

The results of the study suggest that:

- The Mayor's climate change mitigation and energy policies in the London Plan **have been successful in significantly reducing energy consumption and CO<sub>2</sub> emissions in new developments** and go well beyond the national requirements set out in 2006 Building Regulations Part L;
- Since the publication of the draft FALP in September 2006, **more than half of the planning applications analysed achieved CO<sub>2</sub> savings of at least 30%** and approximately **a quarter met or exceeded 40% CO<sub>2</sub> savings** through the use of a combination of energy efficiency, CHP and renewable energy measures;
- The CO<sub>2</sub> savings achieved demonstrate the impact that London Plan policies have had to date over and above building regulations. They also show the potential that London Plan<sup>28</sup> has to drive CO<sub>2</sub>. A number of the applications sampled through this study would meet the draft replacement Plan's tougher CO<sub>2</sub> standards for 2010-13, demonstrating that more challenging CO<sub>2</sub> targets are achievable and can drive even more efficient design solutions.
- On average, **30% reductions in CO<sub>2</sub> were achieved from the sample between November 2006 and June 2009**. These savings amount to just over 116,000 tonnes of CO<sub>2</sub> per year. The **average savings from the applications sampled has increased from 29% in 2006 to 33% in 2009**, and has consistently exceeded 30% from mid-2007 onwards;
- By 2009, the average CO<sub>2</sub> savings achieved were 33%, this is made up of 14% from energy efficiency measures beyond the baseline, 9% related to the use of gas-fired<sup>29</sup> CHP and a further 10% from renewable energy technologies. Many applications were able to go well beyond the average savings. , although many of the developments achieved well beyond these averages. The baseline reflects whole emissions i.e. both the emissions from regulated energy uses under the 2006 Building Regulations Part L minimum standard and the additional emissions from non-regulated energy uses such as cooking and equipment;
- **The number of gas-fired CHP installations has increased from 34 in the 2007 report<sup>30</sup> to 94 in the current sample**. Also, an additional 6 installations each of biomass and fuel cell CHP have recently been proposed compared to 2 installations each reported<sup>31</sup> in 2007;
- The emphasis on maximising overall CO<sub>2</sub> savings through the hierarchy, including the encouragement of district heating and on-site CHP has in some developments affected the opportunity for certain types of renewable energy technology.

<sup>28</sup> <http://www.london.gov.uk/shaping-london/london-plan/strategy/download.jsp>

<sup>29</sup> Refers to natural gas from fossil fuels

<sup>30</sup> A.R. Day, P.G. Jones and P. Ogumka (July 2007), Review of the impact of the energy policies in the London plan on applications referred to the Mayor (Phase 2), London South Bank University/Greater London Authority, Available from: <http://www.london.gov.uk/mayor/planning/docs/labu-research.pdf> Accessed 26th March 2009

<sup>31</sup> Ibid

Following changes to London Plan energy policies, greater emphasis has been placed on connecting new developments into existing district heating schemes and incorporating on-site CHP with site-wide communal heating networks where feasible. In certain schemes where gas-fired CHP has been proposed, the requirement to optimise the size of the CHP, based on total site thermal load has meant that the available demand met by from renewable energy (particularly renewable heat) became more limited. Thus, developments that achieved high CO<sub>2</sub> savings from CHP, delivered lower CO<sub>2</sub> savings from renewable energy technologies and vice versa;

- The overall CO<sub>2</sub> savings made are continuing to increase. The share of how those savings are made varies from development to development. The contribution that energy efficiency, CHP and renewable energy can make varies from development to development. For example in some applications renewable energy was able to contribute well over 30 per cent of savings, but in some cases contributed under 10 per cent. Flexibility is important to achieve the maximum overall CO<sub>2</sub> savings from developments.
- **A quarter of the sample met or exceeded 20% CO<sub>2</sub> savings from renewable energy technologies, a third of developments achieving between 10% and 20% CO<sub>2</sub> savings, and a further 38% achieving up to 10% savings;**
- Biomass boilers, photovoltaics (PV), ground source heat pumps (GSHP) and solar thermal were the most popular renewable technologies (in that order). This order of popularity differs from that observed in the 2007 study (solar thermal, biomass boilers, PV and GSHP). The sudden growth in the proposed number of biomass boilers may be an indication of growing confidence in fuel source and its CO<sub>2</sub> saving potential, while the growth in proposed PV installations may be related to its compatibility with CHP as well as its ease of specification and installation;
- The order of technologies in terms of overall savings is similar to the previous study with CHP, biomass and GSHP systems in the lead. This is greatly influenced by the large scale nature of these technologies;

## Recommendations

In view of the success of the Mayor's policies, the following are recommended:

1. The GLA should consider moving towards overall carbon emissions reduction targets for development proposals whilst maintaining an obligation for renewable energy in accordance with the current energy hierarchy. This will encourage diversity of solutions and maintain the uptake of renewables. The evidence from this study suggests that total carbon savings of at least 30% with at least 10% renewables is being routinely met on average. Therefore as a starting point a more challenging target of at least 40% total carbon savings should be proposed, whilst bearing in mind that proposed tightening of Building Regulations Part L will make these savings even more challenging in future;

2. Further work should be conducted to analyse technology savings in relation to building types and sizes. This will help provide an indication of the best technology applications for different building types. There may well be a trend in the type and size of technologies used on specific building types;
3. A standard template for energy statement submissions to the GLA should be developed. This will help improve the quality of data submitted, make the submission process simpler and more precise, and ensure monitoring of data is easier in the future. The template developed by LSBU which has been used for gathering data for this study could serve as a first draft in taking this forward. In particular, recording installation sizes and capacities should be a standard requirement in any reporting;
4. The GLA should ensure that all planning applications, in particular the required energy statements, are submitted and filed electronically, with key information held on a central database and updated on a regular basis. This would enable future analysis to be conducted rapidly and reliably.

## **5. Acknowledgements**

We would like to acknowledge the valuable assistance given by all the GLA staff, in particular Alina Lazar, Syed Ahmed, Peter Daw and David Taylor-Valiant. We thank the LSBU team that helped with this project, especially Godswill Arum. The contribution of Metropolis Green has been very valuable. Also, we value the input of developers, architects and energy consultants assisting us with Part Two (reviewing the 'as-built' status of renewable installations) of this on-going study.

## Appendix 1 – List of applications analysed

| S/No | GLA Case name                                  | PDU No. | Mayor's report Stage II approval date | Planning Application Number | Developer  | Architect                                    | Energy Consultant ID          | Borough        |
|------|--|---------|---------------------------------------|-----------------------------|--|--|-------------------------------|----------------|
| 1    | Eastern side of Indecon Court, 20 Millharbour  | 0176c   | 06/11/2006                            | 05/01294                    | Sir Robert Ogden                                   | Metropolitan Workshops                       | RPS                           | Tower Hamlets  |
| 2    | Ropemaker Place, 25 Ropemaker Street           | 0206a   | 12/03/2007                            | P062728                     | Dominion Corporate Trustees & British Land         | Arup Associates                              | Arup Associates               | Islington      |
| 3    | 22 Marsh Wall, Isle of Dogs                    | 1050a   | 10/04/2007                            | PA/06/01439                 | Chalegrove Properties Limited                      | Squire and Partners                          | Hoare LEA                     | Tower Hamlets  |
| 4    | Sedgehill school                               | 1608    | 11/05/2007                            | 06/64389                    | Learning 21  | Learning 21                                  | Scott Wilson                  | Lewisham       |
| 5    | Heathrow East Terminal                         | 1538    | 23/05/2007                            | 62360/APP/2006/2942         | BAA  | Fosters and Partners                         | BAA                           | Hillingdon     |
| 6    | Arrowhead Quay, Marsh Wall                     | 0018b   | 25/05/2007                            | PA/07/00347                 | Cartman Ltd  | SOM  | DSA Engineering               | Tower Hamlets  |
| 7    | London Metropolitan University, Pentonville    | 1563a   | 13/06/2007                            | P070448                     | London Metropolitan University                     | TP Bennett                                   | Cundall Genesys Environmental | Islington      |
| 8    | former Essex House, 100 George Street, Croydon | 1585    | 20/06/2007                            | 06/04991                    | Terrace Hill Croydon Ltd                           | Sheppard Robson                              | RYB Konsult                   | Croydon        |
| 9    | Creekside Village (West)                       | 0312d   | 29/06/2007                            | 06/2062                     | Creekside Ltd.                                     | Squire and Partners                          | Ove Arup & Partners Ltd       | Greenwich      |
| 10   | Crown Woods School                             | 1666    | 18/07/2007                            | 07/0899                     | Greenwich Council                                  | Nicholas Hare Architects                     | BDP                           | Greenwich      |
| 11   | Bucklersbury House, Walbrook Square            | 1207    | 01/08/2007                            | 06/00442/FUL                | Legal and General City Offices Limited Partnership | Foster and Partners and Ateliers Jean Nouvel | NDY Consulting Ltd            | City of London |
| 12   | 79-89 Uxbridge Road                            | 1431    | 06/08/2007                            | P/2007/1119                 | Standard Life Investment Funds Limited             | YRM Architects                               | Watkin Payne Partnership      | Ealing         |

|    |   |             |            |                           |   |                                   |                            |                      |
|----|---|-------------|------------|---------------------------|---|-----------------------------------|----------------------------|----------------------|
|    |   |             |            |                           |   |                                   | (WPP)                      |                      |
| 13 | West Brook Crescent, East Barnet  | 1740        | 22/08/2007 | N02587K/07                | Jewish Community Secondary School               | RHWL                              | Foreman Roberts            | Barnet               |
| 14 | Merchant Square, Paddington Basin   | 1317        | 03/09/2007 | 06/00929                  | Paddington Development Corporation Ltd          | Perkins + Will                    | NDY Consulting Engineers   | Westminster          |
| 15 | Zenith House  | 1447 & 1696 | 19/09/2007 | W01156AH/07 & W01156AJ/07 | Genesis Housing Group                           | European Urban Architecture       | RYB Konsult                | Barnet               |
| 16 | former Middlesex Hospital, Mortimer Street                                | 1561        | 25/09/2007 | PT/07/01120/FULL          | Project Abbey (Guernsey) Holdings Ltd           | Make                              | Ove Arup & Partners Ltd    | Westminster          |
| 17 | Wandsworth Business Village, Broomhill Road                               | 1334        | 03/10/2007 | 2007-2999                 | Workspace Glebe                                 | Rolfe Judd Architects             | Waterman building services | Wandsworth           |
| 18 | Uxbridge High School  | 1805 & 1806 | 04/10/2007 | 6528/APP/2007/2043 & 2074 | Uxbridge High School                            | Architects Design Partnership LLP | BDP                        | Hillingdon           |
| 19 | Sainsbury's, Stadium Way, Crayford  | 1203b       | 25/10/2007 | 06/11504/FULM             | Sainsbury's Stores Limited                      | Chetwood Associates               | Synergy                    | Bexley               |
| 20 | Highbury Grove School   | 1935        | 25/10/2007 | P071736                   | Transform Schools (on behalf of BSF)            |                                   | Transform schools and BDP  | Islington            |
| 21 | Riverside South, Canary Wharf   | 0524a       | 27/11/2007 | PA/07/00935               | Canary Wharf Ltd                                | Rogers Stirk Harbour & Partners   | Hilson Moran Ltd           | Tower Hamlets        |
| 22 | 150 High Street Stratford (Kessler Site)                                  | 1581a       | 27/11/2007 | 07/01166/LTGDC            | Seapoint Dev. Ltd & Genesis Housing Group       | Stock Woolstencroft Architects    | ESD                        | Newham               |
| 23 | Tottenham Hotspur football training facility Land at Bulls Cross, Enfield | 1330b       | 27/11/2007 | TP/07/1623                | Tottenham Hotspur Football Club,                | KSS                               | Fulcrum Consulting         | Enfield              |
| 24 | National Car Park site, Hammersmith Grove                                 | 1654        | 30/11/2007 | 07/02005/FUL              | Development Securities & London Underground Ltd | Hamiltons Architects              |                            | Hammersmith & Fulham |

|    |  |              |            |  |                                  |                                  |  |                        |
|----|--|--------------|------------|--|----------------------------------|----------------------------------|--|------------------------|
| 25 | Thomas Tallis School                     | 1667a        | 04/12/2007 | 07/2217  | Greenwich Council                | John McAslan and Partners        | BDP                                      | Greenwich              |
| 26 | Creekside Village (East)                 | 1402         | 12/12/2007 | DC/06/63352B & DC/06/63352C.<br>LBG: 06/2290/F | Ampurius NuHomes Investments Ltd | Squire and Partners              | Battle McCarthy Consulting               | Greenwich              |
| 27 | Milton Court, The Guildhall School       | 1408 & 1408a | 12/12/2007 | 06/01160/FULEIA and 06/01161/LBC               | Heron Property Corporation Ltd   | David Walker Architects          | Foreman Roberts                          | City of London         |
| 28 | 721-737 Commercial Road, E14             | 1434         | 19/12/2007 | PA/06/02081                                    | Sure Estates Limited             | Stock Woolstencroft              | Energy for Sustainable Development       | Tower Hamlets          |
| 29 | Thurston Road Industrial Estate          | 0612b        | 19/12/2007 | 07/65251                                       | Chesterhouse Properties          | Barton Willmore                  | Whitecode Design Associates              | Lewisham               |
| 30 | 160-188 High Street, Stratford           | 0584d        | 19/12/2007 | 07/01390/LTGDC                                 | McFeely Group                    | Stock Woolstencroft Architects   | Energy for Sustainable Development       | Newham                 |
| 31 | Chichester House 278 - 282 High Holborn  | 1778         | 19/12/2007 | 2007/3967/P                                    | HEDF                             | GMW                              | Faber Maunsell                           | Camden                 |
| 32 | Crown House 51 Aldwych WC1               | 1930         | 09/01/2008 | PT/07/06901/FUL                                | UKI (Kingsway) Ltd               | Sidell Gibson Architects         | Fulcrum Consulting                       | Westminster            |
| 33 | Wedge House, 32-40 Blackfriars Road, SE1 | 1989         | 09/01/2008 | 07-AP-2332                                     | Derwent Valley London Ltd        | Lifschutz Davidson               | Norman Disney Young                      | Southwark              |
| 34 | Greenwich Millennium Village             | 0519e        | 14/01/2008 | 07/2704/F                                      | Greenwich Millennium Village Ltd | Broadway Malyan                  | Hoare Lea                                | Greenwich              |
| 35 | Bedfont Trading Estate                   | 1569         | 21/01/2008 | 06/3263  | Trehaven Group                   | Nathaniel Lichfield and Partners | URS Corporation Ltd                      | Hounslow               |
| 36 | 181-183 Warwick Road                     | 0739a        | 22/01/2008 | 06/2568  | Warwick Road Developments Ltd.   | Allies & Morrison                | Centreline Building Services Consultants | Kensington and Chelsea |
| 37 | Central Square Wembley                   | 2032         | 22/01/2008 | 07/3548  | Sowcrest Ltd                     | Dexter Moren Architects          | Halcrow Yolles                           | Brent                  |
| 38 | Land Adjacent to                         | 1715         | 30/01/2008 | 07/03483/OUTM                                  | Burt Bolton Housings,            | PRC Group                        | Cudd Bentley                             | Bexley                 |

|    |  |       |            |  |  |   |                                |                  |
|----|--|-------|------------|--|--|---|--------------------------------|------------------|
|    | Nufarm Ltd,<br>Belvedere   |       |            |  | Aynho Estates, L&P Ltd                                   |   | Consulting Ltd                 |                  |
| 39 | Norwood Green<br>Road, Southall                                  | 1798  | 07/02/2008 | 2007/3165                                    | Trustees of Gurdwara Sri<br>Guru Singh Sabha<br>Southall | Architects Co-<br>Partnership                             | QuinnRoss<br>Consutants Ltd    | Ealing           |
| 40 | 160 Bromley Road   | 2000  | 14/02/2008 | DC/07/67513                                  | Access Self Storage Ltd                                  | MMA   | SRE                            | Lewisham         |
| 41 | 21 Wapping Lane  | 1040a | 10/03/2008 | PA/06/1787                                   | Eulysses Ltd (part of the<br>Ballymore grp of coy)       | PDP Architects  | HOARE LEA                      | Tower<br>Hamlets |
| 42 | Former Elizabeth<br>Garrett Anderson<br>Hospital, Euston<br>Road | 0140a | 25/03/2008 | 2007/3736/P                                  | UNISON   | Squire and<br>Partners                                    | Foreman<br>Roberts             | Camden           |
| 43 | London Park Hotel<br>Site, Elephant &<br>Castle                  | 1517  | 26/03/2008 | 07-AP-0760                                   | English Partnerships and<br>First Base                   | Richard Rogers  | First Base                     | Southwark        |
| 44 | Stonegrove and<br>Spur Road Estates                              | 1652  | 01/04/2008 | W13582E/07                                   | Barratt Homes, Barnet<br>Council & FMHA                  | Sprunt Architects   | HBS<br>Consulting<br>Engineers | Barnet           |
| 45 | 32 - 42 Bethnal<br>Green Road,<br>Shoreditch                     | 1621  | 02/04/2008 | 07/2193                                      | Telford Homes and<br>Genesis Housing Group               | Stock<br>Woolstencroft                                    | ESD                            | Tower<br>Hamlets |
| 46 | 100 George Street<br>(former Essex<br>House site)                | 1585a | 02/04/2008 | 08/00131/P                                   | Terrace Hill Croydon<br>Limited                          | Sheppard Robson   | RYB Konsult                    | Croydon          |
| 47 | Former Pirelli<br>Works, Erith                                   | 2122  | 02/04/2008 | 07/17924/FUL                                 | Bericote Properties Ltd                                  | Michael Sparks<br>Associates                              |                                | Bexley           |
| 48 | 20 Blackfriars Road  | 1024  | 08/04/2008 | 07-AP-0301                                   | Land Securities  | Wilkinson Eyre<br>Architects                              | Roger Preston<br>Environmental | Southwark        |
| 49 | Heron Quays West   | 1995  | 08/04/2008 | PA/07/03088,<br>PA/07/03089 &<br>PA/07/03090 | South Quay Properties<br>Ltd                             | Rogers, Stirk,<br>Harbour &<br>Partners & Patel<br>Taylor | Hilson Moran                   | Tower<br>Hamlets |
| 50 | Royal London<br>House, 22-25<br>Finsbury Square,<br>EC2          | 2028  | 08/04/2008 | PO60001                                      | Shieldpoint 22 Ltd                                       | Sheppard Robson   | HOARE LEE<br>Sustainability    | Islington        |

|    |   |       |            |                               |  |   |                          |                        |
|----|---|-------|------------|-------------------------------|--|---|--------------------------|------------------------|
| 51 | B & Q, 500 Purley Way                       | 1750  | 16/04/2008 | 07/02350/P                    | B & Q Properties Ltd                         | Harris Partnership                              | White Young Green        | Croydon                |
| 52 | North East Quadrant, Regents Place          | 1294  | 14/05/2008 | 2007/0823/P                   | British Land Company Plc                     | Wilkinson Eyre & Munkenbeck & Marshall Urbanism | Watkins Payne            | Camden                 |
| 53 | Woodberry Down Estate - Kick Start Site One | 1826  | 14/05/2008 | 07/1841                       | Berkeley Homes Ltd                           | Wilkinson Eyre Architects and Rolfe Judd.       | WSP Energy & Environment | Hackney                |
| 54 | Caspian Works, Strong & Hoe sites           | 1982  | 14/05/2008 | PA/07/2706                    | Berkeley Homes                               | KKM Architects                                  |                          | Tower Hamlets          |
| 55 | York House, Waterloo                        | 2120  | 14/05/2008 | 08/00629/FUL                  | York Trust for Land                          | Sheppard Robson                                 | Faber Maunsell Limited   | Lambeth                |
| 56 | 30 Old Bailey                               | 1450  | 29/05/2008 | 07/00382/FULEIA               | City of London Real Property Company Ltd     | MAKE Architects                                 | Ove Arup & Partners Ltd  | City of London         |
| 57 | Trocadero, 13 Coventry Street, W1           | 1813  | 29/05/2008 | PT/07/05504/FUL L             | London Trocadero Ltd                         | Sheppard Robson                                 | Charterhouse energy      | Westminster            |
| 58 | Gayton Road car park                        | 2030  | 29/05/2008 | P/4126/07/CFU & P/1254/08/CFU | Fairview New Homes and Mount Anvil           | Metropolis Architectural Studios                | Scott Wilson             | Harrow                 |
| 59 | Former TACentre, Warwick Road               | 1604b | 02/06/2008 | 08/00218                      | Nalex Limited                                | SOM   | Faber Maunsell           | Kensington and Chelsea |
| 60 | Ibis Hotel, Lillie Road, Fulham             | 1482a | 06/06/2008 | 07/00608/OUT                  | Goodearth Hotels Ltd                         | Halpern   | Scott Wilson             | Hammersmith & Fulham   |
| 61 | Former Sleepze Site, 61 Morden Road         | 2016  | 06/06/2008 | 07/P3812                      | Easter Properties Ltd and Norwich Union Life | Hamiltons                                       | Faber Maunsell           | Merton                 |
| 62 | Ransomel's Wharf, Battersea                 | 1759  | 11/06/2008 | 2008/0407                     | The Curatus Trust Company                    | CZWG Architects LLP                             | Fulcrum consulting       | Wandsworth             |
| 63 | East India Dock Road                        | 0181a | 25/06/2008 | PA/07/00391                   | Barret Homes Ltd., Circle Anglia Ltd., etc   | CZWG  | URS Corporation Ltd      | Tower Hamlets          |
| 64 | Wah Kwong House                             | 2033a | 25/06/2008 | 08/01136                      | G&G Properties                               | RHWL Architects                                 | Halcrow Yolles           | Lambeth                |

|    |  |              |            |                           |  |                                   |                                |                        |
|----|--|--------------|------------|---------------------------|--|-----------------------------------|--------------------------------|------------------------|
| 65 | Croydon Vocational College                   | 1345&1345a   | 15/07/2008 | 06/00845/P and 06/00855/P | Croydon College                          | Nightingale Associates            | Ove Arup & Partners Ltd        | Croydon                |
| 66 | Terminal 5 Hotel                             | 2173         | 16/07/2008 | 2008/1333                 | Arora International                      | One Architecture Ltd              | SFaber Maunsell                | Hillingdon             |
| 67 | 61-63 Great Suffolk Street, SE1              | 1969a        | 16/07/2008 | 08-AP-1034                | Q Developments Ltd                       | Conran and Partners               | Richard Hodgkinson Consultancy | Southwark              |
| 68 | Harrow College, Harrow                       | 1623         | 17/07/2008 | P/0707/08CFU              | Harrow College                           | MJP Architects                    | HOARE LEA                      | Harrow                 |
| 69 | Tesco site, High Road & Trout Road, Yiewsley | 2087         | 25/07/2008 | 60929/APP/2007/3744       | Tesco Stores Ltd                         | ColladoCollins                    | Scott Wilson                   | Hillingdon             |
| 70 | Land at Prestons Road and Yabsley Street     | 1376         | 01/08/2008 | PA/05/1866                | Baladine Properties                      | HKR Architects                    | Hilson Moran Partnership Ltd   | Tower Hamlets          |
| 71 | Trinity EC3 (Aldgate Bus Station)            | 1497         | 01/08/2008 | 06/00727/FULEIA           | Minories Estate Ltd                      | Foreign Office Architects         | Atelier Ten                    | City of London         |
| 72 | Grand Union Centre, Ladbroke Grove           | 1576 & 1576a | 01/08/2008 | 07/01345 and 07/01346     | Workspace Glebe                          | Stiff and Trevillion              | Hoare Lea                      | Kensington and Chelsea |
| 73 | 56 Bloemfontein Road                         | 1419a        | 01/08/2008 | 2007/04690                | Building Better Health Ltd               | Rogers Stirk Harbour & Partners   | Cundall Genesys Environmental  | Hammersmith & Fulham   |
| 74 | former Bishop Challoner School site          | 0961b        | 01/08/2008 | PA/08/00305               | Bellway Thames Gateway North             | Stock Woolstencroft               | URS Corporation Ltd.           | Tower Hamlets          |
| 75 | Kender Triangle NDC                          | 2165         | 08/08/2008 | DC/08/68448               | New Cross Gate New Deal for Com. & Rydon | Feilden Clegg Bradley Studios LLP | Max fordham                    | Lewisham               |
| 76 | UEL Barking Campus                           | 1292         | 13/08/2008 | 06/01284/OUT              | George Wimpey and Quadrant Housing Trust | Assael Architecture Ltd           | Fulcrum Consulting             | Barking and Dagenham   |
| 77 | Former EMI site, Hayes                       | 1502a        | 13/08/2008 | 59872/APP/2007/3060       | Hayes General Partner Limited            | Munkenbeck & Marshall             | Fulcrum Consulting             | Hillingdon             |
| 78 | Haggerston West                              | 1047         | 13/08/2008 | 2007/2889                 | London and Quadrant                      | PRP Architects                    | WATERMAN                       | Hackney                |

|    |   |                     |            |  |                                      |                          |                              |                        |
|----|---|---------------------|------------|--|--------------------------------------|--------------------------|------------------------------|------------------------|
|    | and Kingsland Estates   |                     |            |  | Housing Trust                        |                          | BUILDING SERVICES            |                        |
| 79 | land at the corner of Great Suffolk Street and Lavington Street, Bankside | 1786a               | 15/08/2008 | 08-AP-1330                               | UNITE group PLC                      | Allies and Morrison      | WATERMAN BUILDING SERVICES   | Southwark              |
| 80 | 144-152 Bermondsey Street   | 1712a               | 20/08/2008 | 08/AP/1096                               | Haysboro Limited                     | Munkenbeck & Marshall    | McBains Cooper               | Southwark              |
| 81 | Chambers Wharf, Bermondsey  | 1645                | 21/08/2008 | 07-AP-1262                               | St. Martins Property Investments Ltd | Ian Simpson Architects   | hoare Lea                    | Southwark              |
| 82 | St. Paul's School   | 1291a               | 26/08/2008 | 08/1760/OUT                              | St. Paul's School                    | Patel Taylor Architects  | ROGER PRESTON ENVIRONME NTAL | Richmond upon Thames   |
| 83 | Stonebridge Schools Site, Stonebridge Estate                              | 1988                | 28/08/2008 | 07/2932                                  | Stonebridge Housing Action Trust     | Shepherd Epstein         | Calford Seaden consultants   | Brent                  |
| 84 | Telephone Exchange, Warwick Road  | 2144                | 28/08/2008 | 08/01214                                 | Northacre                            | Squire and Partners      | Faber Maunsell Limited       | Kensington and Chelsea |
| 85 | Colonite Wharf, River Road, Barking                                       | 1675                | 03/09/2008 | 07/00224/FUL                             | Barking Riverside Ltd.               |                          | Barking Riverside Ltd.       | Barking and Dagenham   |
| 86 | Land to the western side of Central Parade, New Addington                 | 1529                | 09/09/2008 | 08/00216/P                               | Tesco Stores Limited                 | accord architecture      | Scott Wilson                 | Croydon                |
| 87 | Minoco Wharf  | 1768/1769/1776/1777 | 12/09/2008 | 07/01140, 07/01141, 07/01142, & 07/01143 | Clearstorm Ltd                       | 3D Ried                  | Hoare Lea                    | Newham                 |
| 88 | Roman Place   | 2070                | 23/09/2008 | PA/07/03277                              | Goldquest Investments Limited        | Stock Woolstencroft      | Hoare Lea                    | Tower Hamlets          |
| 89 | Stockwell Street, Greenwich   | 0346a               | 23/09/2008 | 07/0897/F                                | Capital & Counties Properties Ltd    | Sidell Gibson Architects | ARUP                         | Greenwich              |

|     |                                  |       |            |                           |  |                                      |  |                      |
|-----|----------------------------------|-------|------------|---------------------------|--|--------------------------------------|--|----------------------|
| 90  | Rayners Lane phases E to H       | 0489a | 01/10/2008 | P/0431/08COU              | Home Group RSL                                     | MEPK architects                      | RPS                                      | Harrow               |
| 91  | Turks Boatyard                   | 2089  | 09/10/2008 | 07/12536                  | UA Developments Limited                            | MAA Architects                       | SRE                                      | Kingston upon Thames |
| 92  | Apart-hotel, Olympia             | 2137  | 09/10/2008 | 2008/00547/FUL            | Sunlight Projects Ltd/Earls Court and Olympia Grou | Glenn Howells Architects             | Centreline Building Services Consultants | Hammersmith & Fulham |
| 93  | RAF Bentley Priory, Stanmore     | 2099  | 09/10/2008 | P/1452                    | VSM Estates  | Robert Adam Architects               | Halcrow Yolles                           | Harrow               |
| 94  | Elizabeth House, Waterloo        | 0935a | 17/10/2008 | 07/02628/FUL              | P & O Estates (DP World)                           | Allies and Morrison                  | Roger Preston Environmental              | Lambeth              |
| 95  | Packington Estate                | 1433  | 30/10/2008 | P062806                   | Hyde Housing Ass. & Rydon Construction Ltd         | Pollard Thomas Edwards Architects    | HOARE LEA                                | Islington            |
| 96  | Crossness Sewage Treatment Works | 2151  | 30/10/2008 | 08/03936/FULEA            | Thames Water Utilities Ltd                         | Charles Planning Associates Ltd      | Ove Arup & Partners Ltd                  | Bexley               |
| 97  | Odeon West End                   | 1580  | 30/10/2008 | 08/03016/FULL             | Leicester Square Group                             | Make architects                      | Roger Preston Environmental              | Westminster          |
| 98  | Millwall Cutting and South Dock  | 2218  | 30/10/2008 | PA/08/01359               | Aquiva (Thames Quay) Limited                       |                                      | White Young Green                        | Tower Hamlets        |
| 99  | Greenwich Peninsula (Plot N0602) | 2124  | 04/11/2008 | 08/1013/F                 | Peninsula Quays Limited                            | Patel Taylor LLP                     | HILSON MORAN PARTNERSHIP LTD             | Greenwich            |
| 100 | World of Golf                    | 2216  | 04/11/2008 | 08/02139/FULL1            | Ashtour Ltd  | Strutt Parker                        | J W Associates                           | Bromley              |
| 101 | Swiss Cottage School             | 2230  | 04/11/2008 | 2008/3662/P               | Camden Building Schools for the Future             | Seymour Harris Architecture          | RYB Konsult                              | Camden               |
| 102 | Vauxhall Sky Gardens             | 2116  | 04/11/2008 | 08/02750/FUL              | Fairbriar Projects                                 | Amin Taha Associates and Carey Jones | WSP                                      | Lambeth              |
| 103 | Newfoundland, Canary Wharf       | 2110  | 12/11/2008 | PA/08/00598               | South Quay Properties Ltd                          | Patel Taylor                         | HOARE LEA                                | Tower Hamlets        |
| 104 | Wood Wharf, Isle of Dogs         | 2208  | 12/11/2008 | PA/08/01215, PA/08/01217, | Wood Wharf (General Partner) Ltd.                  | Rogers Stirk Harbour + Partners      | Hilson Moran                             | Tower Hamlets        |

|     |  |       |            |                             |  |   |   |               |
|-----|--|-------|------------|-----------------------------|--|---|---|---------------|
|     |  |       |            | PA/08/01218                 |  |   |   |               |
| 105 | Crossrail Station, Isle of Dogs        | 2184a | 12/11/2008 | PA/08/01651                 | Cross London Rail Links Ltd & Canary Wharf Group | Tony Meadows Associates & Foster + Partners | ARUP                                    | Tower Hamlets |
| 106 | Cumberland Avenue and Rainsford Road   | 2261  | 12/11/2008 | 08/2380                     | Standard Life and Canmoor Ltd                    | Michael Sparks                              | DSA ENGINEERING                         | Brent         |
| 107 | former Catford Greyhound Stadium       | 1723  | 17/11/2008 | DC/07/67276                 | Countryside Prop, Eng Part. & Hyde Housing Ass   | Hunter and Partners Ltd                     | Faber Maunsell                          | Lewisham      |
| 108 | St. Andrew's Hospital site             | 684   | 25/11/2008 | PA/08/01161 and PA/08/01162 | London Development Agency and Barratt Homes      | Allies and Morrison Architects              |   | Tower Hamlets |
| 109 | land at Downtown Road                  | 2215  | 25/11/2008 | 08-AP-1563                  | Barratt Homes Ltd                                | Proctor and Matthews                        | Bespoke Builder Services Ltd            | Southwark     |
| 110 | Wards Corner, Seven Sisters            | 1973  | 03/12/2008 | HGY/2008/0303               | Grainger (Seven Sisters) Ltd                     | Pollard Thomas Edwards                      | Fulcrum Consulting                      | Haringey      |
| 111 | GE Lighting Site, Great Cambridge Road | 2080  | 09/12/2008 | TP/08/1077                  | Frontier Key (Enfield) Ltd                       | Powell Dobson.                              | RPS Planning & Development              | Enfield       |
| 112 | Hartfield Road Car Park                | 1457a | 17/12/2008 | 07/P3813                    | Wimbledon Phoenix Limited                        | Woods Hardwick                              | Faber Maunsell/Aecom                    | Merton        |
| 113 | Crystal Palace Park, Bromley           | 1295a | 17/12/2008 | DC/07/03897/OUT             | London Development Agency                        | Latz and partners                           | Latz + Partner / Waterman Environmental | Bromley       |
| 114 | Safestore Storage Compound             | 2233  | 17/12/2008 | HGY/2008/1431               | London Borough of Haringey                       | TP Bennett Architects                       | RYBKonsult                              | Haringey      |
| 115 | Seager Distillery Site, Deptford       | 0098c | 17/12/2008 | DC/08/69448                 | Galliard Homes                                   | BUJ Architects                              | HOARE LEA                               | Lewisham      |
| 116 | Area 3, Canning Town                   | 2168  | 17/12/2008 | 08/01599/FUL                | Countryside Properties                           | Maccreeanor Lavington and Mouchel           | Faber Maunsell Limited                  | Newham        |
| 117 | Malcolm House                          | 2273  | 17/12/2008 | 08/2633                     | Summit Hotels Ltd                                | Ica Architects                              | RPS                                     | Brent         |
| 118 | Castle Industrial                      | 1795  | 17/12/2008 | 08-AP-2403                  | Eadon Limited                                    | Tate Hindle                                 | McBain Cooper                           | Southwark     |

|     |   |                     |            |                                   |   |                                  |                              |                |
|-----|---|---------------------|------------|-----------------------------------|---|----------------------------------|------------------------------|----------------|
|     | Estate, Elephant & Castle                       |                     |            |                                   |   |                                  |                              |                |
| 119 | 95-111 Brighton Road & 1 Old Lodge Lane, Purley | 2333                | 05/01/2009 | 08/03343/P                        | Crest Nicholson (South East) Ltd                  | Hamiltons                        | RHB Partnership LLP          | Croydon        |
| 120 | Beavers Lane                                    | 2250                | 07/01/2009 | 00092/J/P1                        | Hounslow Homes                                    | Stanford, Eatwell and Associates | PRP                          | Hounslow       |
| 121 | Telephone Exchange                              | 1704                | 14/01/2009 | 07/00092/FULL                     | Telereal Services Ltd and British Tel plc         | HKR Architects                   | Hilson Moran                 | City of London |
| 122 | The former Ram Brewery site                     | 1519                | 14/01/2009 | 2008/0955                         | Minerva (Wandsworth) Ltd                          | EPR Architects Ltd               | Hoare Lea                    | Wandsworth     |
| 123 | Cockpen House, 20-30 Buckhold Road              | 1743a               | 14/01/2009 | 2008/0960                         | Minerva plc                                       | ERM Architects                   | Hoare Lea                    | Wandsworth     |
| 124 | Orchard Hill Hospital, Carshalton               | 1269; 1269a & 1269b | 14/01/2009 | C2008/59828/OUT & C2008/59820/FUL | Sutton and Merton PCT                             | HP and Haverstock Associates     | Faber Maunsell               | Sutton         |
| 125 | Telehouse West                                  | 2192                | 14/01/2009 | PA/08/01799                       | Telehouse Europe                                  | YRM architects                   | TELEHOUSE WEST DOCKLANDS     | Tower Hamlets  |
| 126 | Arcadia redevelopment, Ealing                   | 1668                | 21/01/2009 | P/2007/4246-ST                    | Glenkerrin (UK) LTD                               | HKR and Foster & Partners        | RYB:KONSULT                  | Ealing         |
| 127 | 1 North Road, Brentford                         | 2195                | 21/01/2009 | 00816/A/P11                       | Betterline Enterprise LTD                         | Squire and Partners              | Mecserve Sustainability      | Hounslow       |
| 128 | Lascar works, Staines Road                      | 1996a               | 04/02/2009 | 01054/AB/P10                      | Beldam Lascar Seals Ltd & Howard Teesland Ltd     | Hamilton Associates.             | ION Consulting Engineers Ltd | Hounslow       |
| 129 | 6 Paris Garden & 20-21 Hatfields                | 1815b               | 04/02/2009 | 08-AP-2809                        | JG Paris Gardens LLP and Central School of Ballet | Allies and Morrison              | URS                          | Southwark      |
| 130 | 153 - 157 Tower Bridge Road                     | 0792a               | 11/02/2009 | 08-AP-0813                        | Sunlight Properties Ltd                           | Weston Williamson Architects     | Centreline                   | Southwark      |
| 131 | 40 Common Road, Stanmore                        | 2321                | 11/02/2009 | P/3206/08                         | Jewish Care                                       | Kenneth W. Reed & Associates     | Hoare Lea                    | Harrow         |

|     |   |       |            |                               |   |                                      |                                     |                |
|-----|---|-------|------------|-------------------------------|---|--------------------------------------|-------------------------------------|----------------|
| 132 | Middleton Road Playing Fields                         | 2205  | 04/03/2009 | 08/P1509                      | London Borough of Merton                        | Curl La Tourelle                     | Halcrow Yolles                      | Merton         |
| 133 | Arundel Great Court                                   | 2172  | 04/03/2009 | 08/08518/FULL                 | Land Securities                                 | Wilkinson Eyre and Horden Cherry Lee | Roger Preston and Partners          | Westminster    |
| 134 | Airport Bowl, Bath Road                               | 2133a | 04/03/2009 | 38807/APP/2008/3493           | Riva Bowl Limited                               | Foster and Partners.                 | PHA Consult                         | Hillingdon     |
| 135 | National Maritime Museum                              | 2138  | 18/03/2009 | 08/2920 & 08/2921 & 08/2910/F | National Maritime Museum                        | Purcell Miller Tritton               | Fulcrum consulting                  | Greenwich      |
| 136 | Bridge Road Recreation Ground                         | 1702  | 13/05/2009 | 08/2842                       | Mr John Christie                                | Studio E Architects Ltd              | Faber maunsell/aecom                | Brent          |
| 137 | ExCeL, Phase 2a                                       | 2361  | 19/05/2009 | 09/00311/OUT                  | ExCeL London Ltd                                | Jestico and Whiles                   | Hoare Lee                           | Newham         |
| 138 | 20 Fenchurch Street                                   | 0044b | 20/05/2009 | 08/01061/FULMAJ               | The City of London Real Property Company Ltd    | Rafael Viñoly Architects             | Hilson Moran                        | City of London |
| 139 | Central Middlesex Hospital                            | 0492a | 27/05/2009 | 08/1043                       | Montpelier Estates                              | HLM architects                       | Services Design Partnership         | Brent          |
| 140 | Compound D Hotel, Terminal 5                          | 2395  | 27/05/2009 | 47853/APP/2008/3326           | Arora International Hotels                      | One Architecture Ltd                 | Faber Maunsell Limited              | Hillingdon     |
| 141 | 50 – 57 High Holborn                                  | 1814b | 27/05/2009 | 2009/0675/P & 2009/0677/C     | Bedell Corporate Trustees & Atrium Trustees Ltd | Sheppard Robson                      | ARUP                                | Camden         |
| 142 | Thistle Hotel, Heathrow                               | 2343  | 27/05/2009 | 3063/APP/2009/415             | Guoman Hotels                                   | EPR                                  | ME engineers                        | Hillingdon     |
| 143 | RAF East Camp (now known as Beaufort Park), Colindale | 0522b | 10/06/2009 | W00198BT/07                   | St George (Central London) Ltd                  | Broadway Malayan                     | Hoare Lee                           | Barnet         |
| 144 | 10 East Road (New Roman House)                        | 2201  | 10/06/2009 | 2008/1991                     | East Road Investments Ltd                       | Lifschutz Davidson and Sandilands    | Capita Symonds Consulting Engineers | Hackney        |
| 145 | Aldgate Place, Aldgate                                | 1439a | 10/06/2009 | PA/08/02690                   | TST Aldgate Holdings LLC                        | Wilkinson Eyre                       | DSA Engineering                     | Tower Hamlets  |

|     |                                  |      |            |              |                                   |                                    |                    |         |
|-----|----------------------------------|------|------------|--------------|-----------------------------------|------------------------------------|--------------------|---------|
| 146 | former General Lying-In Hospital | 2430 | 10/06/2009 | 09/00841/FUL | General Lying In (York Road) Ltd  | Hamiltons                          | Capita Symonds Ltd | Lambeth |
| 147 | 18-42 Wharf Road                 | 2127 | 17/06/2009 | 2008/1753    | RREEF UK Industrial Property Fund | Munkenbeck + Marshall Urbanism Ltd | Hoare Lee          | Hackney |

## Appendix 2 – Calculating technology capacities

### ◆ Biomass/bio fuelled boiler

Calculation = CO<sub>2</sub> savings / (A \* average running hours)

Where:

$$A = [(gas\ emission\ factor / \eta_{gas\ boiler}) - (biomass\ emission\ factor / \eta_{biomass\ boiler})]$$

Gas emission factor = 0.194 kg CO<sub>2</sub>/kWh (Part L 2006)

Biomass emission factor = 0.025 kg CO<sub>2</sub>/kWh (Part L 2006)

Average running hours = 1,218 hours (estimated based on the average running hours of cases with reported capacity)

$$\eta_{gas\ boiler} = 86\%$$

$$\eta_{biomass\ boiler} = 80\%$$

### ◆ Ground source heating/cooling

Calculation = CO<sub>2</sub> savings / {C \* [A + (B \* F \* G)]}

Where:

$$A = [(gas\ emission\ factor / \eta_{gas\ boiler}) - (grid\ supplied\ electricity\ emission\ factor / GSHP\ Seasonal\ COP_{heating})]$$

$$B = [(grid\ supplied\ electricity\ emission\ factor / GSHP\ Seasonal\ COP_{cooling}) - (grid\ supplied\ electricity\ emission\ factor / GSHP\ Seasonal\ COP_{cooling})]$$

$$C = [(24 * Heating\ degree\ days\ @\ 15.5^{\circ}C) / \Delta T_{heating}]$$

$$F = (cooling\ degree\ days\ @\ 13^{\circ}C / heating\ degree\ days\ @\ 15.5^{\circ}C) * (\Delta T_{heating} / \Delta T_{cooling})$$

$$G = 0.75\ (\text{ratio of cooling to heating fuel input to heat pump})$$

Gas emission factor = 0.194 kg CO<sub>2</sub>/kWh (Part L 2006)

Grid supplied electricity emission factor = 0.422 kg CO<sub>2</sub>/kWh (Part L 2006)

Hours run = 5,520 hours

$$\eta_{gas\ boiler} = 86\%$$

$$Seasonal\ COP_{electrical\ chiller} = 2.7$$

GSHP Seasonal COP<sub>heating</sub> = 4

GSHP Seasonal COP<sub>cooling</sub> = 3

Difference in system heating design temperature, delta T = 21°C

Difference in system cooling design temperature, delta T = 6°C

Heating degree days @ 15.5°C = 1,862

(sum of heating degree days per annum for London taken from

[http://www.eci.ox.ac.uk/~rlayber/weekly\\_updated\\_data/monthly/Heathrow\\_monthly\\_hdd.csv](http://www.eci.ox.ac.uk/~rlayber/weekly_updated_data/monthly/Heathrow_monthly_hdd.csv))

Cooling degree days @ 13°C = 579

(sum of cooling degree days per annum for London taken from

[http://www.eci.ox.ac.uk/~rlayber/weekly\\_updated\\_data/monthly\\_cooling/Heathrow\\_monthly\\_cdd.csv](http://www.eci.ox.ac.uk/~rlayber/weekly_updated_data/monthly_cooling/Heathrow_monthly_cdd.csv))

#### ◆ **Photovoltaics (PV)**

Calculation = {[CO<sub>2</sub> savings\*module rated output]/ [annual power output\* grid displaced electricity emission factor]}

Where:

Annual peak irradiance = 1,022 kWh/m<sup>2</sup> (London Renewables Toolkit)

Efficiency factor (Module conversion efficiency\*positioning factor\*inverter efficiency\*system losses factor\*packing density factor) = 12% (London Renewables Toolkit)

Annual power output = 123 kWh/m<sup>2</sup>

Module rated output = 0.11 kWp/m<sup>2</sup>

Grid displaced electricity emission factor = 0.568 kg CO<sub>2</sub>/kWh (Part L 2006)

#### ◆ **Solar water collectors**

Calculation = {[CO<sub>2</sub> savings\*module rated output]/ [annual heat output\* gas emission factor]}

Where:

Annual peak irradiance = 1,022 kWh/m<sup>2</sup> (London Renewables Toolkit)

Efficiency factor (Module conversion efficiency\*positioning factor\*utilisation factor) = 40%

Annual heat output = 409 kWh/ m<sup>2</sup>

Module rated output = 0.5 kWp/m<sup>2</sup>

Gas emission factor = 0.194 kgCO<sub>2</sub>/kWh (Part L 2006)

◆ **Small wind turbines**

Calculation = {[CO<sub>2</sub> savings/ grid displaced electricity emission factor]/ [load factor\*number of hours]}

Where:

Grid displaced electricity emission factor = 0.568 kg CO<sub>2</sub>/kWh (Part L 2006)

Load factor = 20%

Number of hours = 8,760 hours

◆ **Gas fired CHP**

Calculation = [CO<sub>2</sub> savings / (A – B + C)]

Where:

A = [(Heat ratio\*hours run\*gas emission factor)/ η<sub>gas boiler</sub>]

B = {[ (Heat ratio + Power ratio)\*hours run\*gas emission factor]/η<sub>CHP</sub>}

C = (hours run\*grid displaced electricity emission factor)

Heat ratio = 1.65

Power ratio = 1

Gas emission factor = 0.194 kg CO<sub>2</sub>/kWh (Part L 2006)

Grid displaced electricity emission factor = 0.568 kg CO<sub>2</sub>/kWh (Part L 2006)

Hours run = 5,520 hours

η<sub>gas boiler</sub> = 86%

η<sub>gas CHP</sub> = 78%

◆ **Biomass/bio fuelled CHP**

Calculation = [CO<sub>2</sub> savings / (A – B + C)]

Where:

$$A = [(Heat\ ratio * hours\ run * gas\ emission\ factor) / \eta_{gas\ boiler}]$$

$$B = \{[(Heat\ ratio + Power\ ratio) * hours\ run * gas\ emission\ factor] / \eta_{CHP}\}$$

$$C = (hours\ run * grid\ displaced\ electricity\ emission\ factor)$$

$$Heat\ ratio = 1.80$$

$$Power\ ratio = 1$$

$$Gas\ emission\ factor = 0.194\ kg\ CO_2/kWh\ (Part\ L\ 2006)$$

$$Biomass\ emission\ factor = 0.025\ kg\ CO_2/kWh\ (Part\ L\ 2006)$$

$$Grid\ displaced\ electricity\ emission\ factor = 0.568\ kg\ CO_2/kWh\ (Part\ L\ 2006)$$

$$Hours\ run = 5,520\ hours$$

$$\eta_{gas\ boiler} = 86\%$$

$$\eta_{biomass\ CHP} = 90\%$$

#### ◆ Fuel Cell CHP

$$Calculation = [CO_2\ savings / (A - B + C)]$$

Where:

$$A = [(Heat\ ratio * hours\ run * gas\ emission\ factor) / \eta_{gas\ boiler}]$$

$$B = \{[(Heat\ ratio + Power\ ratio) * hours\ run * gas\ emission\ factor] / \eta_{CHP}\}$$

$$C = (hours\ run * grid\ displaced\ electricity\ emission\ factor)$$

$$Heat\ ratio = 1$$

$$Power\ ratio = 1$$

$$Gas\ emission\ factor = 0.194\ kg\ CO_2/kWh\ (Part\ L\ 2006)$$

$$Fuel\ emission\ factor = 0.025\ kg\ CO_2/kWh\ (Part\ L\ 2006)$$

$$Grid\ displaced\ electricity\ emission\ factor = 0.568\ kg\ CO_2/kWh\ (Part\ L\ 2006)$$

$$Hours\ run = 5,520\ hours$$

$$\eta_{gas\ boiler} = 86\%$$

$$\eta_{fuel\ cell\ CHP} = 90\%$$