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Towards a net zero carbon London: Energy Monitoring Report 2019

OCTOBER 2020

Contents

This report

This report summarises the expected energy performance of all referable (*Ref.1*) developments that gained planning approval from the Mayor in calendar year 2019, against the current London Plan climate mitigation policies.

In 2019, a total of 108 referable planning applications were granted provisional approval by their local planning authority and were subsequently approved by the Mayor.

Table 1 presents the type of developments which gained approval.

Developments approved by the Mayor			
Type of development	**Number of developments**	**Number of dwellings**	**Non-residential floor area (million m^2)**
Mixed-use	62	28,262	0.77
Residential	7	2,027	N/A
Non-residential	39	N/A	0.64
Total	**108**	**30,289**	**1.41**

Table 1: Total number and type of referable developments approved by the Mayor in 2019

Key findings

2019 Energy monitoring report key findings

- **Total carbon savings: A total carbon reduction of 40.6 per cent** more than required by the 2013 Building Regulations secured on average for the 108 developments approved in 2019 (the London Plan asks for at least 35 per cent on-site savings). This amounts to a total carbon saving of 33,436 tonnes CO_2. This is an improvement on the 2018 result of a 36.9 per cent carbon reduction.

- **Zero carbon target: The Mayor's net zero carbon homes standard is driving greater on-site carbon reductions in the residential sector for the third year running.** On average, the developments subject to the net zero carbon homes target achieved a **40.1 per cent** carbon reduction against Building Regulations, notably exceeding the **35.6 per cent** average achieved by residential developments to which the net zero carbon target did not apply.

- **Carbon offsetting:** An estimated **£30.6 million potentially available for collection by boroughs**. This is an approximate figure and not based on agreements between local authorities and developers.

- **Energy efficiency savings:** Savings from energy efficiency measures resulted in a **16.7 per cent** reduction in CO_2 emissions; the highest reduction we have seen since we started reporting in 2011. Residential developments achieved on average a **7.4 per cent** reduction in carbon emissions (the target is 10 per cent) whereas non-residential elements achieved **13.8 per cent** (target is 15 per cent). The residential energy efficiency savings are estimated to reduce energy costs by approximately £485,000, which would otherwise be paid by residents.

- **District heating connections and CHP: London's approach to emission factors is creating the necessary shift away from gas-based heating solutions**. The number of gas-engine CHP units declined by 22 per cent compared to 2018. A total of 6,571 dwellings in 14 developments are expected to connect to an existing District Heating Network (DHN), an increase compared to last year (2,900 dwellings in 2018) showing that **DHN connection opportunities are being actively pursued.** This is estimated to lead to circa £66 million investment in heat network infrastructure.

- **Solar PV: New solar PV capacity continues to increase with an encouraging 6.7 MWp proposed**, compared to 5.5 MWp in 2018. This represents a total proposed PV area of 39,599m², and an investment of nearly £7.7 million, reflecting an improvement in the efficiency of panels being selected by applicants.

- **Heat pumps: The London Plan and the introduction of the SAP 10.0 carbon emission factors are driving more residential heat pump installations** compared to last year with 11 out of the 43 heat pump installations in total serving dwellings; the same figure last year was only four applications. This represents circa 2,200 residential units and 186,000m² of non-residential space being supplied by a heat pump.

Photo credit PRP Architects LLP

Overview

The role of the planning system in the climate emergency

The Mayor of London has declared a climate emergency and has stated his ambition for London to be net zero carbon city by 2030.

His 1.5°C Climate Action Plan looks at the different scenarios London can take to reach net zero carbon. It is compatible with the highest ambition of the Paris Agreement to limit the global average temperature rise to 1.5C above pre-industrial levels.

The planning system has an important role to play in our response to the climate emergency and improving air quality by ensuring that all new development is net zero carbon. If we don’t do this, then we are only adding to the number of buildings that will need to be retrofitted later on at greater cost and disruption.

The Mayor’s London Plan already includes a net zero carbon target for major residential development which has been in place since 2016. The new London Plan will extend the net zero target to all major non-residential developments, along with a higher carbon offset price to incentivise higher on-site carbon reductions.

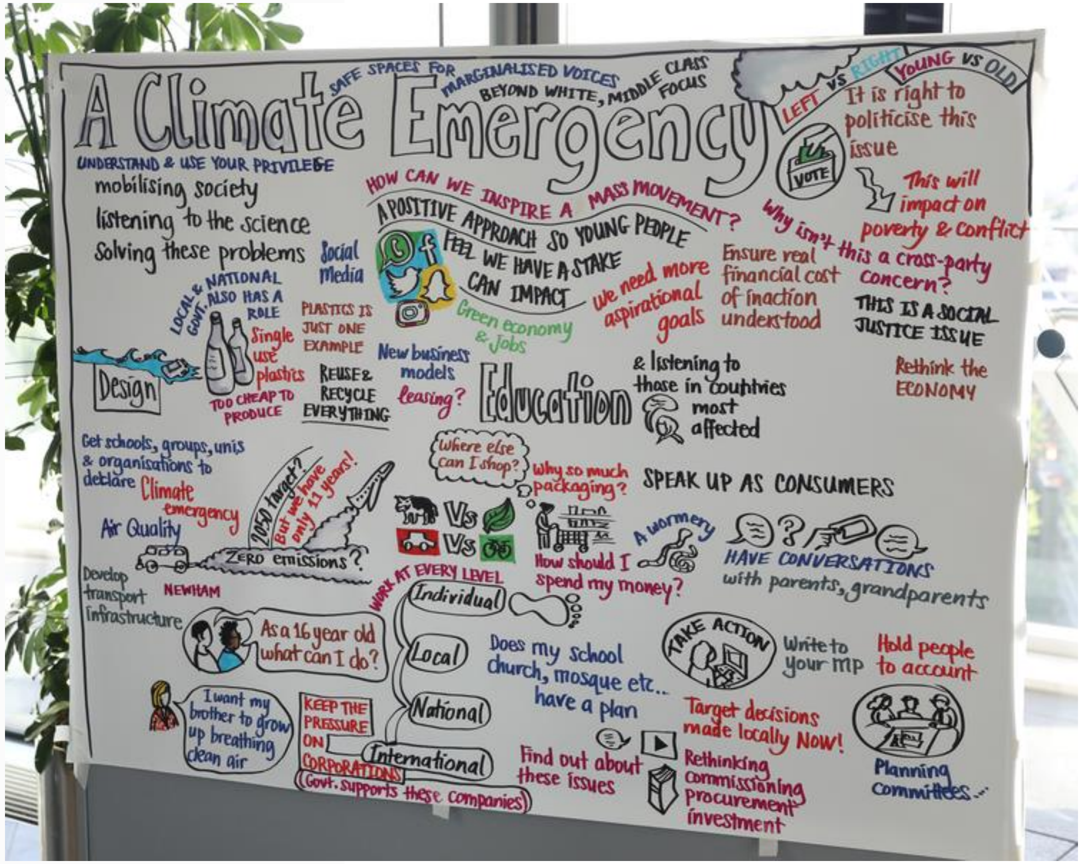

Figure 1: London Climate Action Week – London Sustainable Development Commission event “Listening to the Future” - a youth response to London’s climate challenge

Energy hierarchy

The London Plan requires all major developments to achieve a minimum of a 35 per cent on-site carbon improvement on national Building Regulations, using a Part L 2013 baseline and the appropriate carbon emission factors (see overleaf for details on London's approach to carbon emission factors). Major residential developments are required to go further and meet the Mayor's net zero carbon target.

To achieve these targets, planning applicants are expected to follow the energy hierarchy:

- **'be lean'** use less energy
- **'be clean'** supply energy efficiently
- **'be green'** use renewable energy

Figure 2 presents the latest energy hierarchy and the associated targets in line with the new London Plan, which introduces energy efficiency targets and the 'be seen' energy monitoring requirement. Follow this link for information on the status of the new London Plan: https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/what-new-london-plan

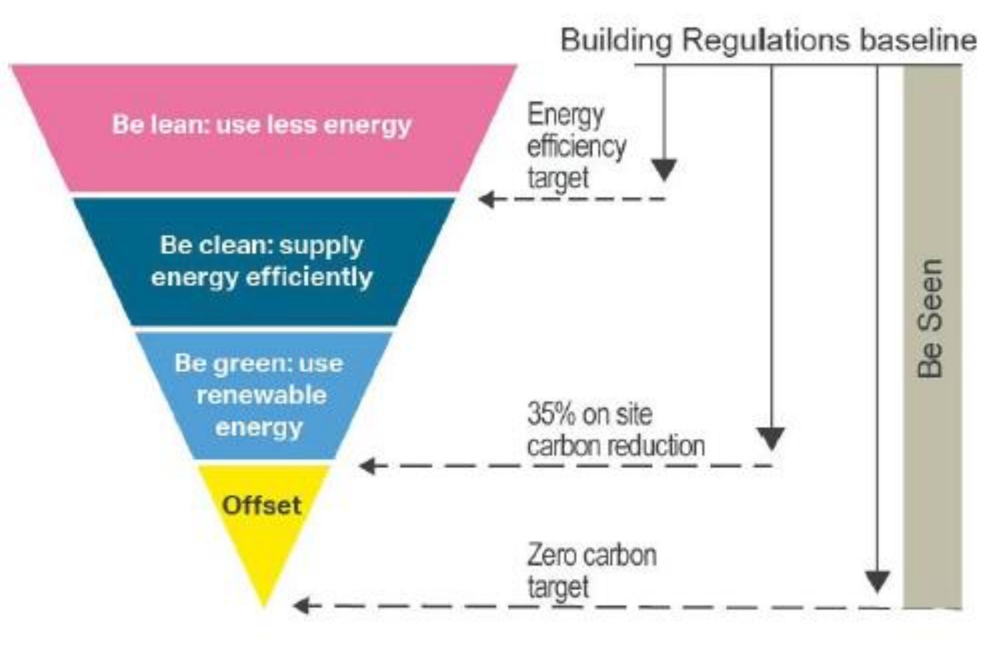

Figure 2: GLA's energy hierarchy and associated targets

London's approach to carbon emission factors

Using updated carbon emission factors

National Building Regulations are out of date and are encouraging the installation of high-carbon systems in new developments. To address this the Mayor has, since January 2019, encouraged applicants submitting referable planning applications to use the updated SAP 10.0 carbon emission factors in areas where there are no opportunities to connect to district heating networks.

This approach better reflects the decarbonisation of the electricity grid and therefore encourages the installation of electrically-based low carbon heating solutions, such as heat pumps, instead of gas-based solutions, such as gas-engine CHP, to meet the carbon targets. It also supports the transition to the new London Plan climate mitigation policies.

Referable developments with potential to connect to a heat network may continue to use the SAP 2012 carbon emission factors, provided that the heat network operator has submitted a decarbonisation strategy to the Mayor. This exception is in place to support the Mayor's London Plan policy to encourage the expansion of heat networks.

See the latest Energy Assessment Guidance for further background on the approach.

What does this mean for the developments approved in 2019?

The majority of the referable planning applications approved in 2019 were submitted before this approach took effect and were approved using the SAP 2012 emission factors (in line with national Building Regulations).

Twelve of the developments approved in 2019 used the SAP 10.0 carbon emission factors. This covers a total of 1,773 dwellings and circa 70,000m^2 of non-residential space. The results presented in this report incorporate all 108 developments, taking into account the different carbon emission factors used for different applications.

In certain places, the SAP 10.0 developments are presented separately. This is clearly noted where this is the case. These results indicate that as more applicants use SAP 10.0 we can expect to see more low carbon solutions such as heat pumps being proposed, instead of gas-based systems, higher energy efficiency savings and higher on-site carbon savings overall.

Updated Building Regulations

As and when Government updates Building Regulations with more accurate carbon emission factors, we will review this approach and confirm our stance in the Energy Assessment Guidance.

Overall results

Total on-site carbon savings

A total carbon reduction of **40.6 per cent** more than required by the 2013 Building Regulations was secured on average for the 108 developments approved in 2019. This amounts to a total carbon saving of 33,436 tonnes CO_2. Residential proposals' savings amounted to 14,335 tonnes CO_2 (40.7 per cent savings) whereas non-residential developments achieved 19,100 tonnes CO_2 savings (equating to 40.5 per cent).

The total percentage carbon reduction achieved comfortably exceeds the Mayor's 35 per cent target, improving on the 2018 result of a 36.9 per cent carbon reduction. **Year on year we have seen that the Mayor's policies are continuing to drive significant carbon reductions.**

The increase in savings is mostly attributed to the higher 'be lean' savings achieved due to the push towards the new London Plan energy efficiency targets. The introduction of SAP 10.0 also helped demonstrate higher savings under the 'be green' scenario.

The twelve developments approved in 2019 using SAP 10.0 achieved an average carbon reduction of 44.8 per cent due to the higher savings that were achieved from 'be green'.

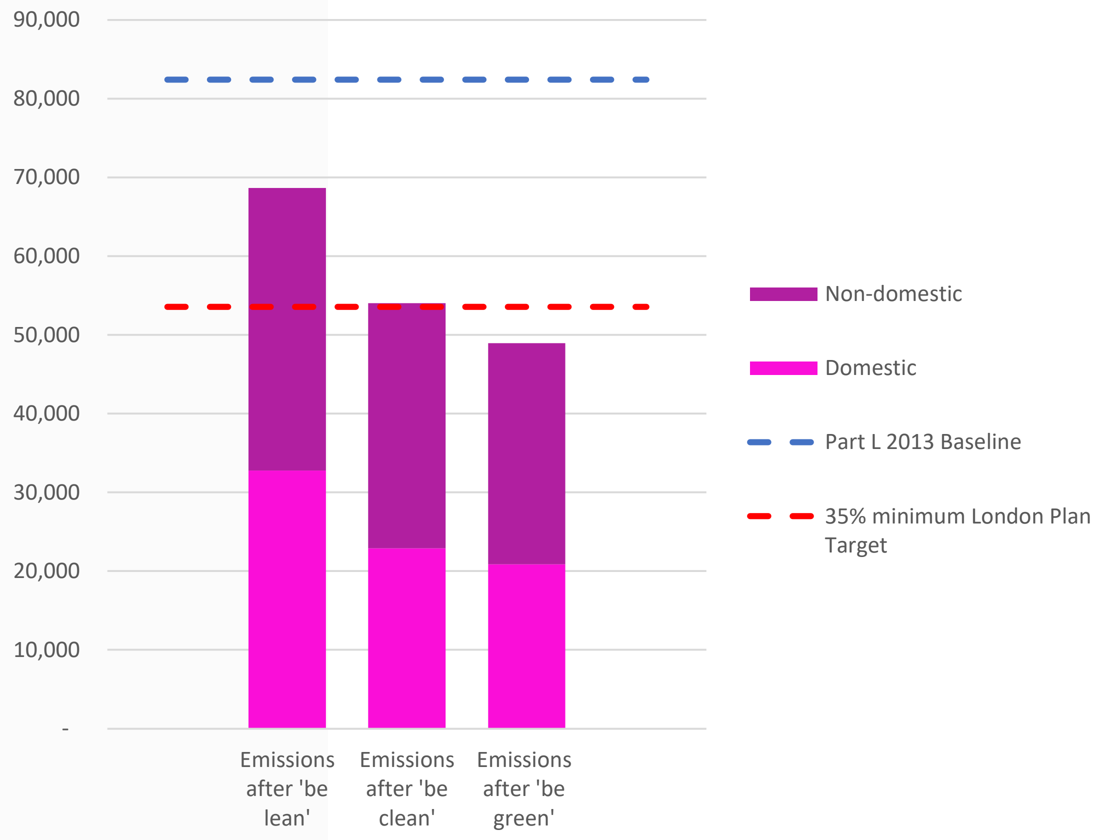

Figure 3: Total carbon emissions (tonnes CO_2) after each stage of the energy hierarchy

Carbon savings of 40.6 per cent more than Building Regulations

Carbon savings breakdown

In 2019, applicants achieved the following savings:

- **'Be lean'** energy efficiency measures resulted in a **16.7 per cent** reduction in CO_2 emissions; the highest reduction we have seen since 2011 and contributing a similar share of overall savings as the 'be clean' stage. The residential energy efficiency savings are estimated to reduce energy costs by approximately £485,000 which would otherwise be paid by residents. (See *Ref. 2* for an explanation of how this figure has been calculated). See the 'be lean' section for further analysis.

- **'Be clean'** a **17.7 per cent** CO_2 emissions reduction resulting from an estimated £66 million investment in heat network infrastructure and £6.5 million in approximately 9.3 MWe of CHP capacity (down from 18.8 MWe in 2018). For the third year in a row we have seen a drop in the contribution of this stage of the hierarchy to overall savings (Figure 4). See the 'be clean' section for further analysis.

- **'Be green'** a **6.2 per cent** CO_2 emissions reduction leading to nearly £7.7 million invested in 6.7 MWp of new solar photovoltaic (PV) capacity, with additional investment in heat pumps through the 43 heat pump applications that came forward. The savings are proportionately similar to 2018. All but one of the SAP 10.0 developments proposed heat pumps, with carbon savings from 'be green' making up an average of 72 per cent of the total savings, compared to 13 per cent for the SAP 2012 developments. See the 'be green' section for further analysis.

Table 2 overleaf sets out the total CO_2 emissions and savings achieved against each stage of the energy hierarchy.

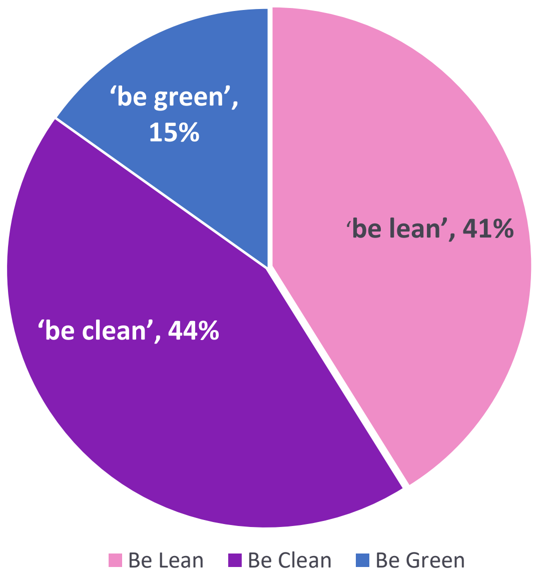

Figure 4: Percentage breakdown (per cent) of total carbon savings by each stage of the energy hierarchy for all referable developments

Carbon savings secured

Cumulative CO_2 emissions and savings			
Stages of the energy hierarchy	**Regulated emissions**	**Cumulative regulated emissions reductions relative to Part L 2013 Building Regulations**	
	(tCO_2/year)	**(tCO_2/year)**	**(per cent)**
Building Regulations 2013 Baseline	82,394	-	-
After ‘be lean’	68,646	13,748	16.7
After ‘be clean’	54,026	28,368	34.4
After ‘be green’	48,958	33,436	**40.6**

Table 2: Total cumulative carbon emissions and savings after each stage of the energy hierarchy

Distribution of carbon savings

The vast majority of developments achieved CO_2 savings in the range of 35 – 40 per cent beyond Building Regulations, as shown in Figure 5. This is similar to 2018. In summary:

- 73 per cent (79) of developments met/exceeded the 35 per cent target
- 27 per cent (29) developments missed the target

Developments that significantly exceeded the target were largely able to meet the minimum 35 per cent target from 'be clean' and 'be lean' savings. In line with GLA guidance these developments continued to identify savings from 'be green' to go beyond the target and maximise opportunities on-site for large-scale renewable energy generation.

Developments that missed the target (a seven per cent increase compared to 2018) mostly did so narrowly. In the majority of cases these sites were either unsuitable for CHP or a DHN connection and therefore could not achieve 'be clean' savings, or did not have sufficient space to install renewable technologies to achieve 'be green' savings. To account for these site limitations, many applicants focussed on achieving higher than usual reductions from other stages. In these cases, boroughs are encouraged to collect offset payments to make up the shortfall.

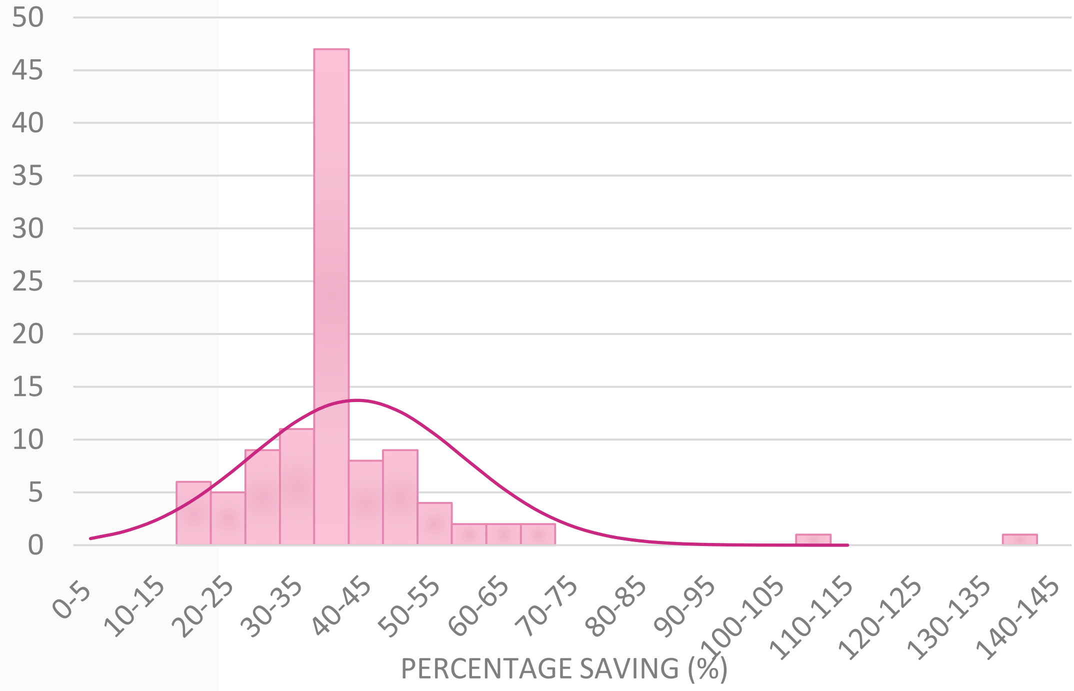

Figure 5: Histogram showing the range, frequency and distribution of the percentage (%) carbon savings achieved in 2019 (y axis represents the number of referable developments)

Net zero carbon homes

Since 2016 major residential developments have been required to meet the net zero carbon homes target. These developments are required to achieve a minimum 35 per cent reduction in carbon emissions on-site and offset any shortfall to zero by making a cash-in-lieu contribution to the respective borough's carbon offset fund.

In 2019, 62 developments were required to achieve the net zero carbon homes target, as the associated applications were submitted after the target came into effect. Seven developments had submitted applications prior to this and so were required to meet the minimum 35 per cent on-site target only.

On average the developments subject to the net zero carbon homes target achieved a **40.1 per cent** carbon reduction**,** notably exceeding the **35.6 per cent** average achieved by the seven residential developments to which the net zero carbon target did not apply.

This trend has occurred for the third year running, indicating that **the net zero carbon target is continuing to drive greater on-site carbon savings**. As shown in Figure 6, the additional savings are primarily due to applicants finding higher savings from fabric improvements ('be lean') and renewable energy installations ('be green').

The net zero carbon homes target continues to drive greater on-site carbon savings

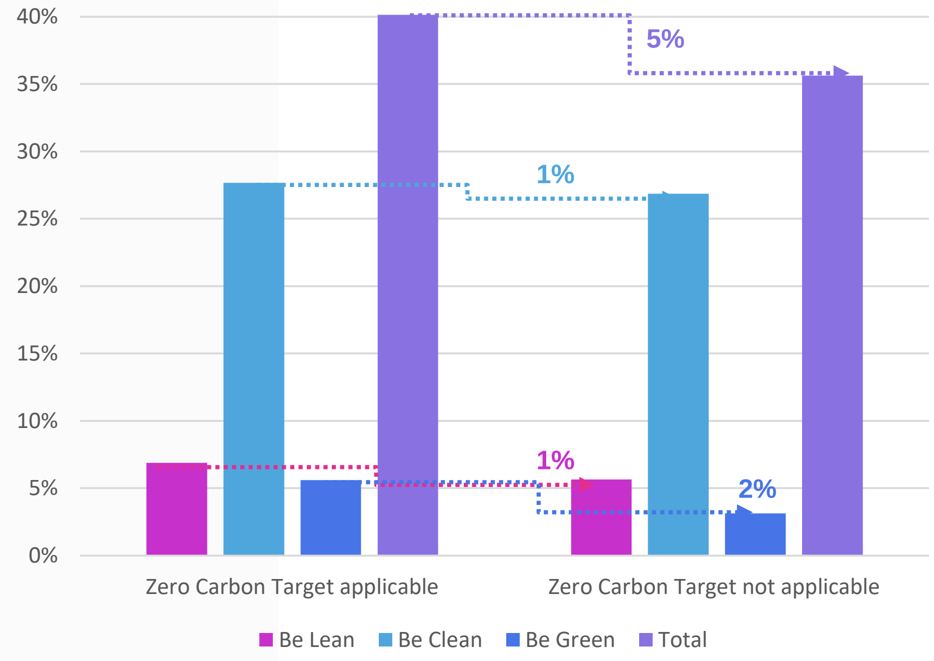

Figure 6: Carbon savings (per cent) achieved by developments where the residential net zero carbon target was and was not applicable

Carbon offsetting

Carbon offsetting is a last resort measure that is only utilised when on-site carbon savings have been maximized.

However, until approaches and technologies improve to allow further on-site reductions, carbon offset funds provide flexibility to meet the London Plan targets. They provide a source of funding for carbon reduction projects across London and have a role in funding emission reductions from existing buildings where achieving carbon savings can be more challenging compared to new build. The Mayor has set a recommended carbon offset price of £60/tonne/CO_2, which will increase to £95/tonne under the the new London Plan. Alternatively, boroughs can apply their own locally-set cost of carbon.

We have estimated that £30.6 million could have been collected by boroughs from referable developments between January to December 2019. This is made up of payments arising from the net zero carbon target, along with the payments made by developers to reach the 35 per cent target where it was not possible on-site. See Table 3.

These figures are estimates only. Boroughs are responsible for calculating and collecting offset payments. The Mayor undertakes monitoring of the value of carbon offset funds and how they are being spent. These reports are published separately and are available on the GLA website.

Carbon offsetting is a last resort measure but gives flexibility in meeting London Plan targets

Type of offset payment	Estimated total (£ million)
To achieve net zero carbon homes target	£25.6 million
To achieve minimum 35 per cent target	£5.1 million
Total	**£30.6 million**

Table 3: Estimated carbon offset contributions to achieve London Plan targets from January to December 2019

Borough highlights

Tower Hamlets, Sutton, Ealing and the London Legacy Development Corporation (LLDC) have all secured some impressive results in 2019 going far beyond the London-wide average for total carbon reductions and for specific stages of the energy hierarchy. Some particular highlights are presented here.

Opportunities for carbon savings will vary between the boroughs, depending on various factors such as their density, availability of DHN connections and waste heat sources as well as how the borough is using the planning system to respond to the climate emergency.

For example, Tower Hamlets has an established 45 per cent on-site carbon reduction target which helps explain its high performance. Whereas the London Legacy Development Corporation (LLDC) has been able to secure DHN connections for all 3 referable developments due to the existing Queen Elizabeth Olympic Park DHN.

Tower Hamlets

10 referable developments approved in 2019 which are expected to achieve a:

- **54 per cent** total carbon reduction on average
- **37 per cent** carbon savings from energy efficiency ('be lean)

Ealing

9 referable developments approved in 2019 which are expected to achieve a:

- **37 per cent** total carbon reduction on average
- **22 per cent** savings from DHN connections and CHP ('be clean')
- **8 per cent** carbon savings from renewable energy generation ('be green')

Sutton

2 referable developments approved in 2019 which are expected to achieve a:

- **66 per cent** total carbon reduction on average
- **32 per cent** carbon savings from energy efficiency
- **34 per cent** carbon savings from renewable energy generation ('be green')

London Legacy Development Corporation (LLDC)

3 referable developments approved in 2019 which are expected to achieve a:

- **47 per cent** total carbon reduction on average
- **28 per cent** carbon savings from renewable energy generation ('be green')

‘Be lean’

‘Be lean’: Residential

The London Plan is driving residential ‘be lean’ savings

Residential developments achieved on average a **7.4 per cent** reduction in carbon emissions from energy efficiency measures alone, an important improvement in performance compared to 2018 when 4.9 per cent was achieved.

40 per cent of residential proposals achieved savings between 5 and 10 per cent (see Figure 7), compared to only 23 per cent in 2018. A greater proportion of residential developments assessed under SAP 10.0 were also able to comply with the 10 per cent energy efficiency savings target; the average exactly meeting the forthcoming new target.

This is encouraging progress towards the Mayor’s new London Plan energy efficiency target of a 10 per cent improvement on Building Regulation, which is expected to be adopted later this year.

26 per cent of residential developments in 2019 were able to put in place measures to achieve the new target, with some able to go above and beyond it. Examples of effective measures that delivered savings include highly insulated walls, minimising thermal bridging and high efficiency mechanical ventilation systems with heat recovery.

This demonstrates that the Mayor’s ambitious target is already beginning to affect applicants’ design decisions. Over time, we expect this figure to increase as planning applicants identify further passive design solutions to meet the target.

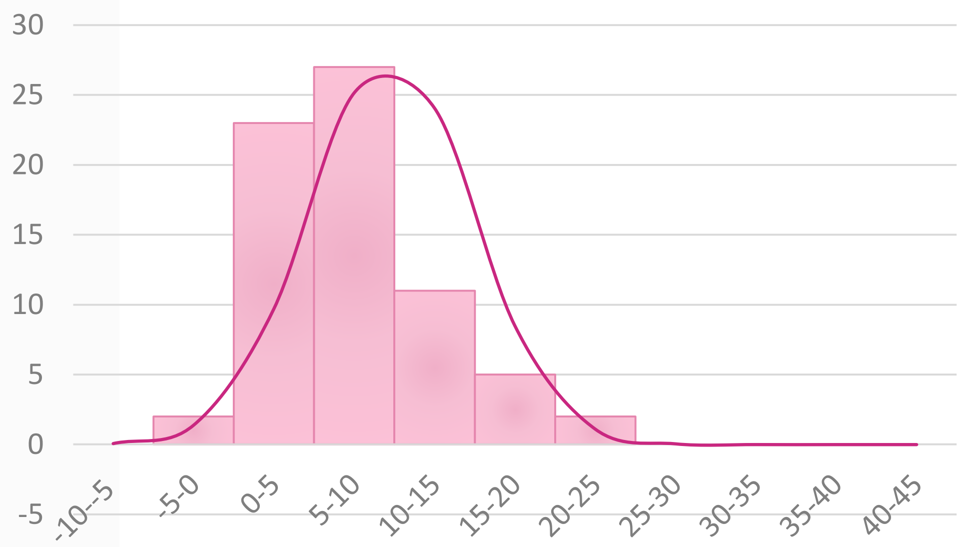

Figure 7: Carbon savings (per cent) achieved from ‘be lean’ measures for residential developments (y axis represents the number of referable developments)

‘Be lean’: Non-residential

Non-residential developments secured on average a **13.8 per cent** carbon reduction from energy efficiency measures alone. This is a notable drop in performance compared to last year when 20.2 per cent was achieved. It is also lower than the Mayor’s new London Plan non-residential energy efficiency target of a 15 per cent improvement on Building Regulations which will be adopted later this year.

The non-residential category covers a wide range of typologies and therefore there will be variation year on year on the savings that can be achieved. In 2019, non-residential developments were predominantly made up of offices and retail with some hotels and student accommodation.

47 per cent of non-residential developments were able to comfortably achieve or significantly surpass the Mayor’s new target. This group comprises buildings such as offices primarily, which are able to achieve higher savings compared to other typologies. See the former Stewart Plastics site case study on page 20.

The remaining developments, which make up the majority, were principally comprised of hotels, student accommodation and educational buildings. These buildings, which all have a high hot water demand, were able to achieve more modest savings, with a small number unable to make any savings at all. This explains the drop in performance in 2019.

A very small number of buildings failed to meet the Building Regulations target baseline under the ‘be lean' scenario; however all these cases went on to achieve the 35 per cent on-site target once ‘be clean' and ‘be green' measures were included.

Passive design principles should be considered early on in design to allow for optimal orientation and massing that enables a reduced energy demand, as well as efficient hot water generation. This applies to all developments and particularly to schemes, such as hotels and student accommodation.

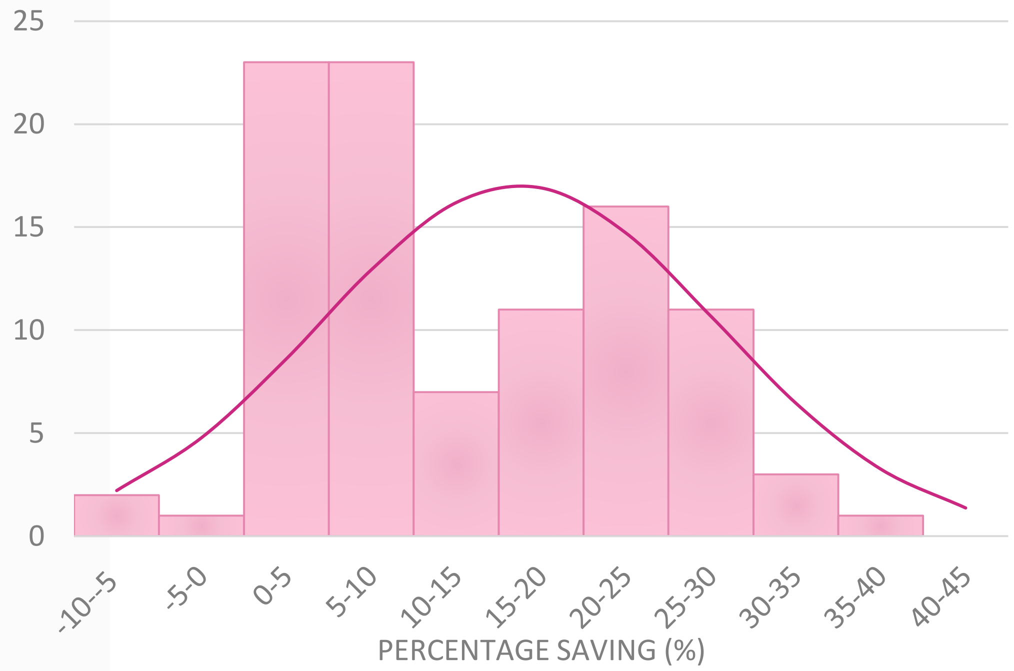

Figure 8: Carbon savings (per cent) achieved from ‘be lean’ measures for non-residential developments (y axis represents the number of referable developments)

Overheating

The Mayor's cooling hierarchy requires applicants to mitigate potential overheating risks through the use of passive measures. Measures such as external shading are strongly encouraged, particularly in developments with noise or air quality limitations. Other common measures for mitigating overheating risk within a residential development include the use of solar control glazing, which has the ability to reduce solar heat gains while offering high levels of natural light for a comfortable internal environment.

If an applicant has applied the cooling hierarchy and the risk of overheating still exists, only then should active cooling measures be considered, such as air conditioning. However, active cooling in residential developments is generally discouraged.

For the developments approved in 2019 an average g-value (a measure of how much solar heat is allowed in through a window) of 0.46 was proposed. It is common to see ranges in g-values proposed (in 2019 we saw 0.35 to 0.63) depending on orientation. **London Plan policy promotes more efficient glazing specifications compared to the default Building Regulations figure of 0.63, which can cause major overheating risk.**

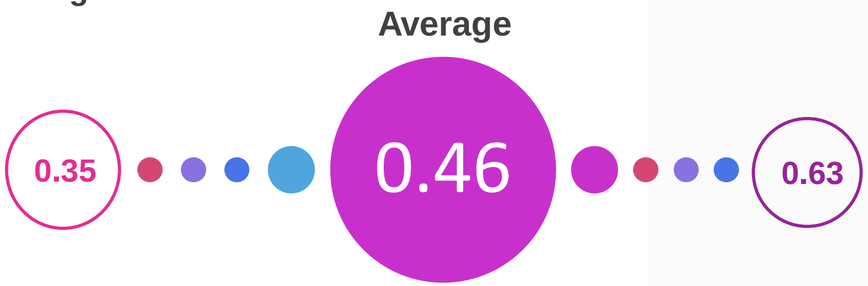

Figure 9: Minimum, average and maximum g-values proposed for residential applications

Tools for assessing overheating risk

To demonstrate that the overheating risk has been mitigated, applicants are required to undertake a CIBSE Technical Memorandum (TM)59 compliant dynamic overheating assessment for residential proposals. Non-residential developments that are proposed to be naturally ventilated are assessed against the TM52 assessment methodology.

Of the 108 developments, 68 (60 residential and 8 non-residential) submitted a TM59 or TM52 dynamic overheating assessment report demonstrating how the design proposals will mitigate overheating risk.

42 developments (62 per cent) demonstrated compliance with the TM49 Design Summer Year (DSY) 1 weather file, which represents summer conditions occurring every other year. The remainder were either non-residential developments with active cooling or residential proposals with acoustic and air quality issues that prevented windows from being openable; particularly for these schemes external shading, albeit not a typical solution in London, could lead to huge benefits and should be considered.

Preparing for higher temperatures in the future

It is becoming increasingly important for applicants to mitigate the overheating risk as climate change leads to rising temperatures. To respond to this, the latest Energy Assessment Guidance introduces a requirement for more rigorous analysis under the future weather files (DSY 2 and DSY 3). This will help applicants determine and mitigate the risk of overheating during more prolonged warm spells or higher temperature peaks.

Cooling proposals

A total of 60 developments (56 per cent) proposed active cooling (Figure 10). At 8.28 GWh per annum, the total cooling consumption reported for 2019 is a pro rata reduction of 28.5 per cent compared with 2018. There may be multiple reasons for this including design improvements or typologies of referable applications. By following our cooling hierarchy, the cooling demand should be kept to a minimum.

Non-residential

The 21 purely non-residential developments (57 per cent of the total number of non-residential developments) proposing cooling predominantly comprised offices and retail units, a very similar proportion to 2018. Those not proposing cooling were typically schools, sports facilities and storage warehouses.

For non-residential developments proposing active cooling it is expected that the National Calculation Methodology (NCM) cooling demand is lower than the notional estimate. The cooling data provided showed an average cooling demand of approximately 10 kWh/m²/yr.

Residential

Seven mixed-use developments (out of a total of 70 mixed-use development) proposed active cooling in the dwellings. This represents 7.1 per cent of residential developments proposing active cooling, a marginal increase on 2018 where 6.6 per cent of residential cases proposed active cooling. The average cooling demand was approximately 1 kWh/m²/yr (Figure 11). While active cooling is generally discouraged in residential developments, it may be needed where site constraints prevent passive measures from reducing overheating risk sufficiently.

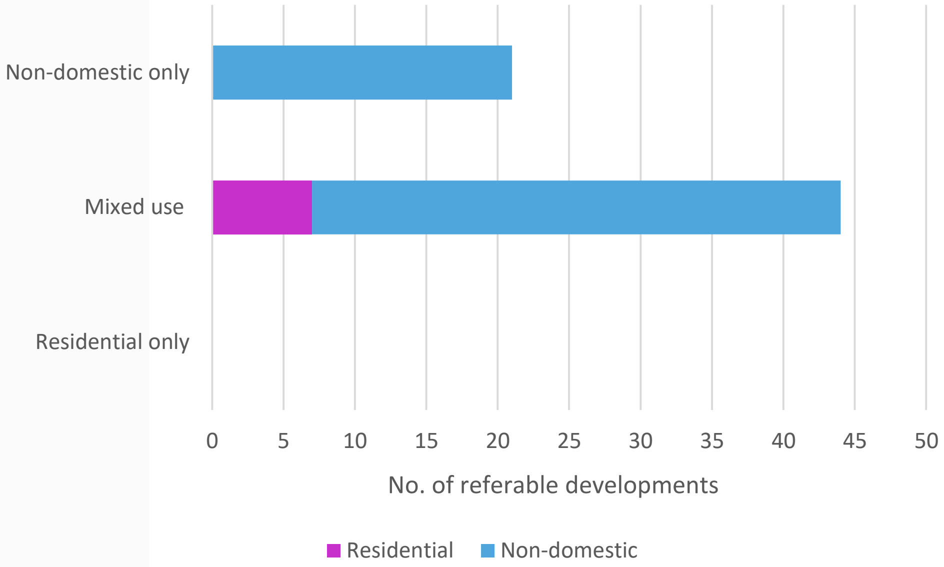

Figure 10: Number of cooling proposals by development type

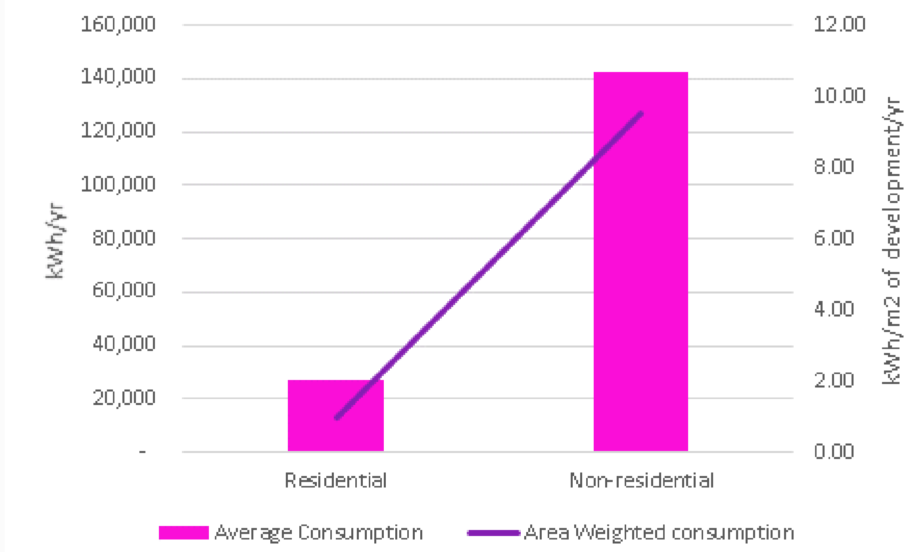

Figure 11: Average annual cooling demand (kWh and kWh/m²) by development type

Case study: Former Stewart Plastics site

The former Stewart Plastics site lies to the west of the London Borough of Croydon's Metropolitan Centre. Its redevelopment will provide around 8,000 m^2 of industrial processes space, warehouse space and office accommodation.

Highlights

- **37 per cent total carbon savings** achieved on-site.
- **'Be lean':** the applicant was able to achieve very high energy efficiency savings of 19 per cent through a mixture of a high fabric specification (wall U-value: $0.15W/m^2K$), photocell daylight control which allow the detection of light, and LED lighting in the warehouse areas.
- **Managing heat risk:** high ceilings, exposed thermal mass, low g-value windows and rooflights as well as its approach to minimising hot water pipe runs all contribute to the mitigation of overheating.
- **'Be clean':** the site's low density and modest energy requirements, as well as the lack of a district heating system in the vicinity to connect to, means that savings from 'be clean' were not applicable to this site.
- **'Be green':** the nature of the site with its low-rise buildings and large roof area meant it was well-suited to the integration of solar PV panels and a high contribution of carbon savings (18 per cent) came from 'be green'.

Very high 'be lean' carbon savings: 19 per cent

Very high 'be green' carbon savings: 18 per cent

$572m^2$ of solar PV on-site


Photo credit Paul Raftery

‘Be clean’

District heating network (DHN) connections

District heat networks (DHNs) play an important role in London's plans to decarbonise its buildings and become a net zero carbon city. DHNs offer an efficient and competitive solution for heating buildings in urban areas with high heat density and provide the added benefit of enabling the use of secondary energy and waste heat sources.

Across London there are several examples of existing and proposed DHNs. Applicants are required to refer to the London Heat Map to identify if their site is in the vicinity of such a network. If a network exists then the applicant is expected to prioritise connection, either immediately or when the network expands to the site boundary. If a network is planned and not yet in existence, applicants are expected to design an on-site solution which is future-proofed for connection later on. In this way, heat networks can serve a growing number of buildings with low or zero carbon heat.

In 2019, a total of 6,571 dwellings in 14 developments are expected to connect to an existing DHN (Table 4). This is an increase compared to last year (2,900 dwellings in 2018) which shows that **DHN connection opportunities are being actively pursued**. In total 12,777 dwellings are expected to connect to DHNs, including those which are future-proofed for connection later on.

Connection type	No. of developments	No. of dwellings	Name of DHN
Connecting to an existing DHN	14	6,571	Fulham Gasworks, Blackhorse Lane, Queen Elizabeth Olympic Park, SELCHP, Gascoigne Estate, Renaissance, Green Man Estate
Connecting to existing DHN in the future	9	3,938	Queen Elizabeth Olympic Park, Citigen, SELCHP, Shoreditch, Barkantine, Excel, Royal London Hospital, Bexley
Future connection to proposed DHN	9	2,268	City 2, Southall Gateway, Hammersmith and Fulham, Colindale, OPDC

Table 4: Number of developments and dwellings connecting to existing and proposed DHNs

Communal heat networks

Developments in Heat Network Priority Areas (HNPAs) are expected to have a communal heat network to enable connection to a district heat network, either now or in the future. A communal heat network connects individual dwellings to a centralised heating system, delivering efficiencies through management of energy demand.

In 2019, a total of 26,344 dwellings are expected to connect to a site-wide communal heat network or an area-wide DHN (87 per cent of all dwellings). This is a drop compared to 2018 (96 per cent) which could be down to the location and typology of applications coming forward. However, **we see developments consistently proposing communal networks as a means of future proofing for connection to area wide DHNs**. Figure 12 shows the development of communal heat networks in London over the years.

Most of these dwellings will be supplied by CHP, either on-site or via the energy centre of an area-wide heat network. With wider spread adoption of updated carbon emission factors and new London Plan policy, low emission CHP will become limited to units that can facilitate the delivery of an area wide strategic heat network (see following page for more detail). Applicants will need to investigate alternative low carbon, renewable, and waste heat sources.

The London Plan is driving heat network development

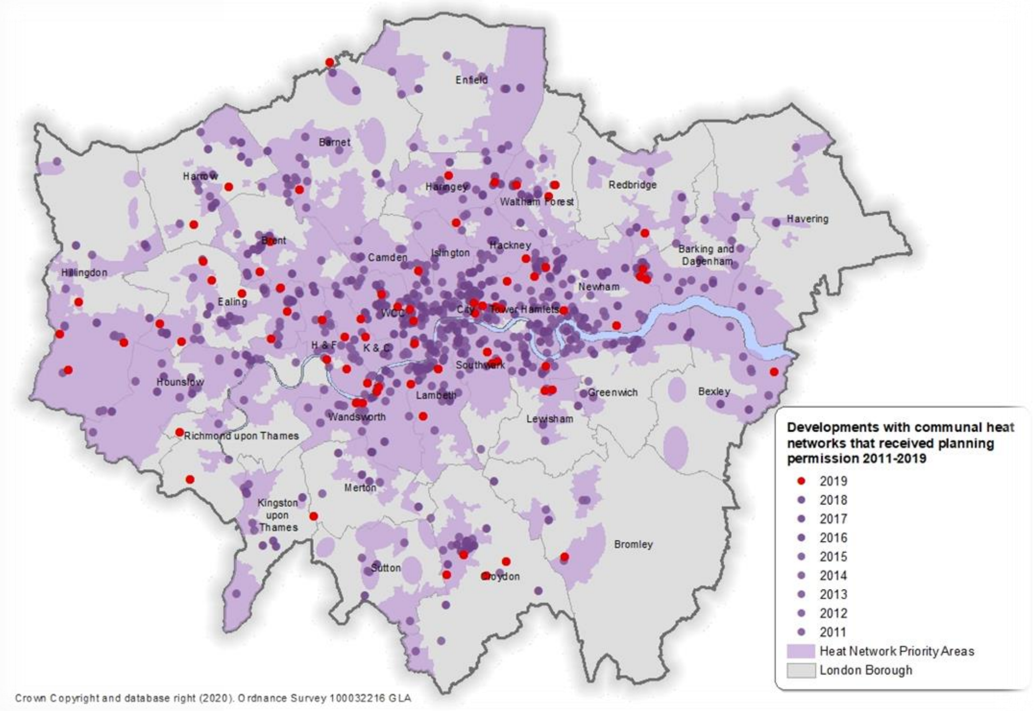

Figure 12: Distribution of developments committed to providing site-wide heat networks

On-site CHP

In 2019, 39 developments (36 per cent) proposed to install on-site CHP with a total capacity of just over 9.3 MW. Compared to 2018 this represents a significant 22 per cent decline in the proportion of developments installing this technology, and approximately a halving of total electrical CHP capacity and investment. This reduction is due to a combination of transitioning to the new London Plan policies and the fact that the typologies proposed in 2019 were less suitable for on-site CHP e.g. small/medium developments.

Since January 2019, the GLA has discouraged CHP on small-medium sites due to their adverse air quality impacts and because such schemes do not typically have the potential to offer high electrical efficiencies and therefore high carbon savings. **We are beginning to see the effects of this shift in the role of CHP as seen by the smaller proportion of developments proposing it in 2019.** This will be further strengthened by the new London Plan heating hierarchy which limits the role of low emission CHP to where it can enable the delivery of an area-wide heat network.

Table 5 sets out the number of CHP installations proposed, their scale and the total electrical capacity. There has been a marginal drop in the proportion of smaller scale CHP units up to 100kWe from 51 per cent last year to 49 per cent. As time progresses, we would expect this to continue to decline with small CHP units being replaced by lower carbon solutions such as heat pumps utilising low grade waste or environmental heat sources.

Table 5 also shows that there were four larger developments proposing CHP installations >500kWe, making up over half of the total electrical capacity. Larger developments, especially those with a mix of building types with complementary heat demand profiles, can form the nucleus for area-wide DHNs. See the Clapham Park Estate case study on page 26, which will help facilitate the development of a new district heat network.

CHP engine (kWe)	Number of installations	Total electrical capacity (kW_e)
Up to 100kWe	19	907
100 – 500kWe	16	3,417
Above 500kWe	4	5,004
Total	**39**	**9,328**

Table 5: Number of CHP installations and total electrical capacity proposed by CHP size

Photo credit PRP Architects LLP

Case study: Clapham Park Estate

Clapham Park Estate is a residential-led regeneration site in the London Borough of Lambeth which will include 2,535 new dwellings and 2,716m² of commercial and community floorspace.

Highlights

- **36 per cent total carbon savings** achieved on site
- **'Be lean':** 16 per cent reduction for the residential element achieved through energy efficiency measures such as high performance fabric, low air permeability, and whole-house mechanical ventilation heat recovery (MVHR) system
- **'Be clean':** 18.5 per cent carbon savings from the 2MW CHP unit, alongside 68,000 litre thermal store operating on a low return temperature heat network
- **CHP is an acceptable strategy as it is intended to facilitate a new area-wide heat network** (see image) which will provide heating and hot water to the entire estate. This is a high density development in an area already identified for its district heating potential. Engagement with the wider community has begun to explore potential connections beyond the estate, including with schools and nurseries.

High residential 'be lean' carbon savings:

16 per cent

239kWp of solar PV, saving 73 tonnes CO_2 per annum

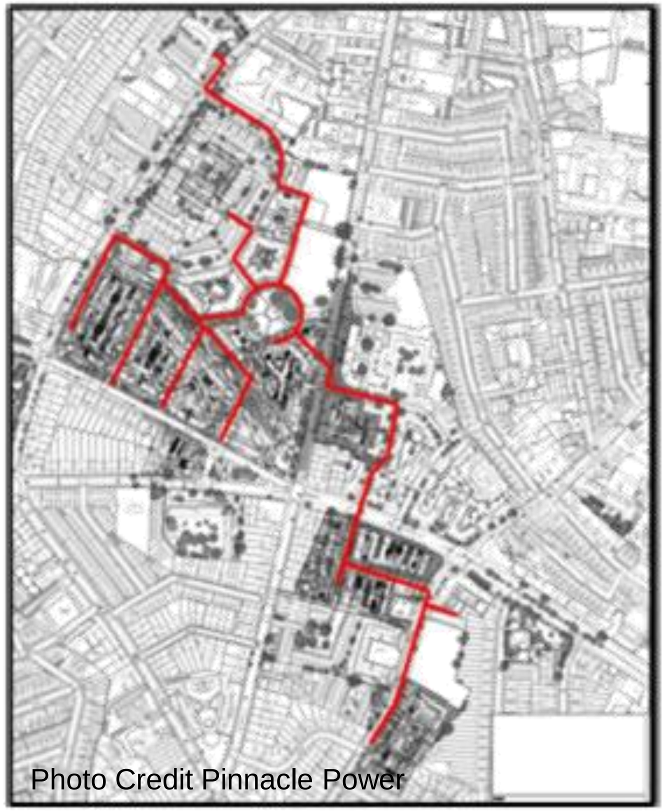

Photo Credit Pinnacle Power

‘Be green’

Solar energy

In 2019, a total of 84 developments proposed to install PV with an average installation area of 364m². This is comparable with last year, however, there has been an encouraging increase in the total PV capacity from 5.5 MWp in 2018 to 6.7 MWp (See Figure 13). This is despite a drop in the total proposed PV area from 55,027m² in 2018 to 39,599m². **This reflects a very encouraging improvement in the efficiency of panels being selected by applicants.**

We estimate this equates to an investment of nearly £7.7 million, with 78 per cent of applicants proposing solar PV this year.

The total area of PV per 1,000m² of floor area is slightly smaller than that of 2018. This is due to a number of very large PV arrays in 2018 proposed which would have affected the average installation size. In addition there were slightly more installations proposed in inner London boroughs where space is more limited than in 2018. Inner London planning authorities like LLDC, Lambeth and Camden installed a relatively high area of PV with Bexley, Bromley and Sutton being the highest of the outer boroughs.

Larger PV installations are predominantly found on low-rise buildings. The Former Stewarts Plastics site is just such an example, see the case study on page 23.

39,599m² total PV area
6.7 MWp total capacity

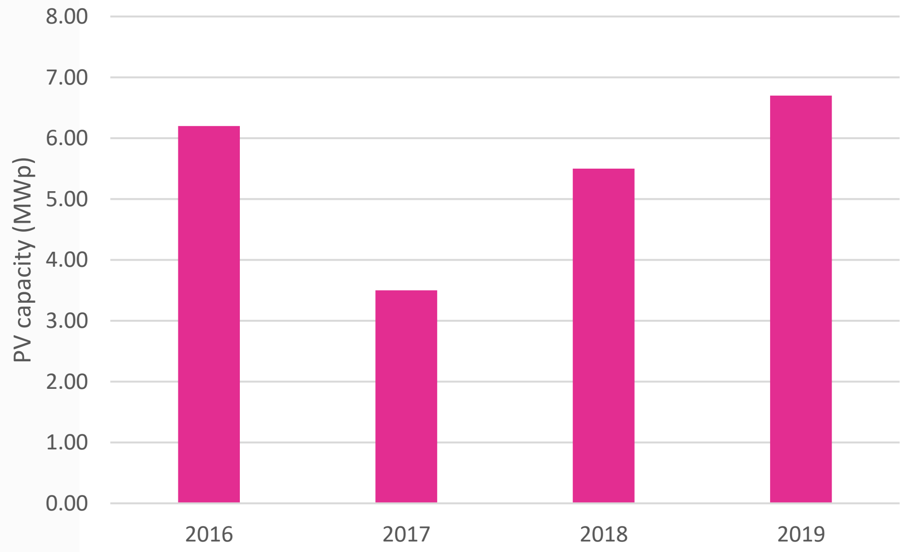

Figure 13: Total PV capacity (MWp) proposed per annum

Heat pumps

In 2019, 43 developments committed to installing a heat pump and these were typically proposed for non-residential led development. The proposals are made up of 35 Air Source Heat Pumps (ASHPs), two Ground Source Heat Pumps (GSHPs) and a Water Source Heat Pump (WSHP). The remaining five were hybrid applications, comprising ASHP and gas boilers for peak generation, which were proposed exclusively on residential/accommodation-led development. This is a similar split of heat pump type compared to last year with ASHPs making up the majority of the heat pump proposals.

The number of heat pumps proposed is relatively stable with 40 per cent of applications proposing heat pumps compared to 44 per cent in 2018. This can be explained by the decrease in smaller heat pump installations, used to serve individual retail or office units, and their likely replacement by communal heat networks using centralised heat pumps.

Eleven heat pumps served residential units either through mixed-use or residential-only developments, an increase compared to 2018 when only four heat pump applications were put forward for residential heat supply. The remaining 32 served non-residential developments. Figure 14 shows the capacity split by typology with mixed-use developments making up over half of heat pump capacity.

Thirteen of the heat pump applications (five ASHPs, the GSHPs, the WSHP and the hybrid installations) are all large scale (>25kW) and intended to primarily serve mixed-use developments from a centralised energy centre. **It is encouraging to see centralised heat pumps of this scale serving residential units, which in the past would have been served by a CHP-led network. This is further driven by the introduction of the SAP 10.0 carbon emission factors.**

With the number of applications approved using SAP 10.0 emission factors anticipated to increase, we expect to see a larger number of heat pump proposals in the coming years, particularly with centralised heat pump applications supplying residential or mixed-use schemes.

The London Plan is driving more residential heat pump installations

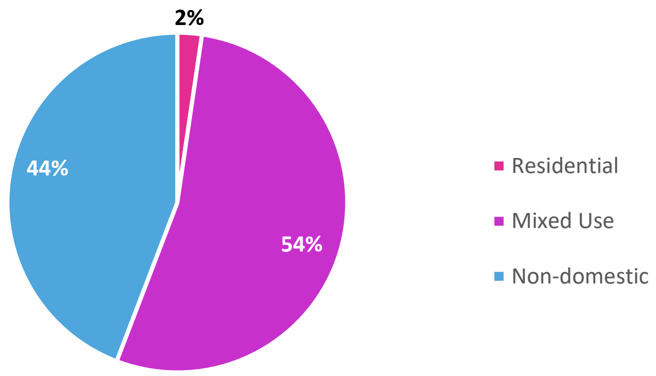

Figure 14: Percentage of centralised heat pump capacity (kW) by development type

Case study: Pentavia Retail Park

Situated in Mill Hill in the London Borough of Barnet, the Pentavia Retail Park is a mixed-use development of 844 homes and just over 1,000m² of non-residential uses.

Highlights

- **53 per cent total carbon savings** achieved on site, far beyond the 35 per cent minimum target.
- **Managing heat risk:** to reduce overheating a high albedo facade has been proposed coupled with high thermal mass and passive ventilation, while inclusion of balconies and he overall massing of the blocks promotes self-shading.
- The initial energy strategy involved installing a site-wide CHP unit. Through discussions with officers it was pointed out to the applicant that this strategy would not be policy compliant, as it involved a CHP treating only the development and not enabling an area wide heat network. CHP raises serious air quality concerns which means that it is only supported in instances where it facilitates an area wide district heating network and with appropriate abatement technology. As a result**, the applicant amended the proposals to include centralised heat pumps instead.**

High 'be lean' carbon savings:

13 per cent

Optimised internal layout and glazing-to-wall ratios

Revised CHP strategy to a heat pump-led strategy

ASHPs and 246kWp of PV

Photo credit Arney Fender Katsalidis

Conclusions

Conclusions

- **New developments in London are achieving far higher carbon savings than required by national policy.** In 2019, developments achieved on average a 40.6 per cent carbon reduction improvement on national Building Regulations, comfortably surpassing the London Plan minimum carbon reduction target of a 35 per cent improvement.

- **The Mayor's net zero carbon homes standard is driving greater on-site carbon reductions in the residential sector for the third year running.** A similar trend is expected in the non-residential sector when the new London Plan introduces a net zero target for non-residential development.

- **Carbon offsetting continues to play a role in achieving the London Plan net zero carbon target**, with an estimated £30.6 million potentially available for collection by boroughs.

- **The new London Plan energy efficiency targets are already driving carbon savings** through building fabric improvements to reduce energy demand in both residential and non-residential developments. Developments in 2019 achieved a 16.7 per cent reduction on average from energy efficiency measures; the highest ever. This is expected to save residents approximately £485,000 in energy bills.

- **London's approach to emission factors is creating the necessary shift away from gas-based heating solutions** in support of the Mayor's zero carbon and air quality ambitions. The number of gas-engine CHP units declined by 22 per cent compared to 2018 and a halving in investment.

- **The London Plan is driving heat network development with a significant increase in the number of dwellings which are expected to connect to existing DHNs** (6,571 compared to 2,900 in 2018). Investment in heat network infrastructure has however declined overall from £94 million in 2018 to £66 million due to a drop in the total number of dwellings connecting to a site-wide communal heat network or an area-wide DHN (26,344 compared to 37,555). These figures will vary year to year as they are largely dependent on whether the sites coming forward are in areas of heat network potential.

- **New solar PV capacity continues to increase with an encouraging 6.7 MWp proposed**, compared to 5.5 MWp in 2018. This represents an investment of nearly £7.7 million with 78 per cent of applicants proposing solar PV this year.

- **The London Plan is driving the heat pump market in London**, including supplying the heat demand of homes. This is further enabled by the use of the SAP 10.0 carbon emission factors which will have more of an impact as more applications adopt the new approach.

- **London is leading the way on low carbon new build development.** The twelve developments approved using SAP 10.0 emission factors are achieving higher overall carbon savings, higher energy efficiency savings as well as supporting London's heat pump roll-out. These impacts will increase over time as more applicants use the updated factors.

Appendix A

References

References

- **Ref. 1 – Referable developments:** A planning application is referable to the Mayor if it meets the criteria set out in the Mayor of London Order (2008). The criteria include: development of 150 residential units or more, development over 30 metres in height (outside the City of London), development on Green Belt or Metropolitan Open Land. Please see the Order for the full criteria.

- **Ref. 2 –** This has been calculated using SAP 2012 modelling and BEIS cost data. A sample of archetypes (small flats, large flats and terrace houses) were modelled using SAP 2012 methodology to determine the annual fuel demands for a number of fabric and ventilation specifications. The results for each archetype's gas and electricity consumptions were plotted dependent on the percentage saving achieved relative to the Part L 2013 notional baseline carbon emissions. The fuel consumptions associated with dwelling emission reduction of seven per cent (proportional to the 7.3 per cent average achieved by the 2019 residential development proposal) was identified using interpolation.

  The 'Valuation of Energy Use and Greenhouse Gas Emission Appraisal' supporting tables 4-5 were used to source the residential electricity and gas prices for 2019. The 2019 average prices were multiplied with the fuel consumption calculated for the seven per cent reduction architype cases and the equivalent Part L 2013 notional cases. The difference between the five per cent reduction case and the notional case was defined as the annual saving for each architype. The three archetypes were assumed to occur equally across the proposed residential development for 2019.

  The total number of dwelling proposed have been combined with the average annual saving per dwelling saving of seven per cent at the 'be lean' stage of the energy hierarchy to provide the total annual reduction to residential bills. The figure for a five per cent reduction in carbon emissions from energy efficiency measures is estimated to be £485,000 per annum. The same approach was applied to calculate what the potential annual residential bill reduction arising from a 10 per cent reduction on the target baseline, as required by draft London Plan policy. This figure is estimated to be £674,000 per annum for the 2019 residential development proposal.