

Energy Assessment Guidance

Greater London Authority guidance on preparing energy assessments as part of planning applications (October 2018)

COPYRIGHT

**Greater London Authority
October 2018**

Published by
Greater London Authority
City Hall
The Queen's Walk
More London
London SE1 2AA

www.london.gov.uk

enquiries 020 7983 4100

ISBN

Photographs ©

Copies of this report are available
from www.london.gov.uk

CONTENTS

Summary of guidance update	5
Purpose of energy assessments	7
1. Introduction	7
2. Planning applications	9
3. Integration with supporting documents for planning applications	11
Structure and content of energy assessments	13
4. Executive summary of the energy assessment	13
5. Carbon emission factors	15
6. Establishing CO ₂ emissions	16
7. Calculating regulated CO ₂ emissions for refurbishments	21
8. Demand reduction (Be Lean)	23
9. Cooling and overheating	26
10. Heating infrastructure (Be Clean)	33
11. Renewable energy (Be Green)	41
12. Carbon offsetting	42
13. Monitoring	43
Glossary	44
References	46
Appendix 1	47
Required approach to whole life costing	47
Appendix 2	48
Ensuring waste to energy plants are heat network ready	48
Appendix 3	50
Guidance on different types of technologies	50
Details required in relation to liquid biofuel applications	55
Details required in relation to wind energy applications	55
Appendix 4	57
Offsetting	57
Appendix 5	58
Domestic overheating checklist	58

Appendix 6	61
NO_x and PM₁₀ emissions limits for heating plant	61

Summary of guidance update

The following updates have been made to the Energy Assessment Guidance:

- Re-titled from 'Energy Planning' guidance to 'Energy Assessment Guidance' to better reflect what the document is
- The introduction contains a new section on carbon emission factors and sets out the GLA's new approach to encourage SAP 10 carbon emission factors from January 2019
- Further explanation in the introduction setting out what is required for different types of planning application
- Section 4: a new requirement for developers to confirm which carbon emission factors they will use from January 2019
- Section 5: a new section containing information on carbon emission factors
- Section 7: a revised section on the requirements for refurbishments
- Section 8: refers to the draft London Plan energy efficiency targets and a new 'energy demand reporting' section has been included.
- Section 9:
 - a) the 'cooling and overheating' section has been moved to the 'be lean' section
 - b) the cooling and overheating requirements have been restructured, with the requirements provided separately for domestic and non-domestic developments at various stages of the planning process
 - c) includes reference to the CIBSE TM59 overheating guidance which should now be used for all residential planning applications
- Section 10:
 - a) for clarity, a hierarchy for selecting an energy system has been included
 - b) developers should consider how their development will be future-proofed to achieve zero carbon emissions on-site by 2050, with proposals
 - c) requirement for developers to provide information to update the Heat Map
 - d) further clarity provided on heat network scenarios and when a site-wide heat network is required.
 - e) information required where a site-wide heat network is applicable has been grouped into one section
 - f) new section on phased developments
 - g) new section drawing together existing guidance on designing heat network infrastructure
 - h) new section to improve the assessment of air quality impacts
 - i) CHP section moved to appendices as it is one of several technologies that may be used
- Section 11: reference to the GLA's new guidance on Carbon Offset Funds
- Section 12: minor updates to monitoring requirements
- Appendix 3: updated information requirements for heat pumps and CHP, including clarification on when CHP is appropriate

- Appendix 6: a new appendix which includes emission limits for heating and energy plant has been added

Purpose of energy assessments

1. Introduction

- 1.1. This guidance document explains how to prepare an energy assessment to accompany strategic planning applications referred to the Mayor¹ as set out in London Plan Policy 5.2. It is for anyone involved in, or with an interest in developing energy assessments including developers, energy consultants and local government officials. The purpose of an energy assessment is to demonstrate that the proposed climate change mitigation measures comply with London Plan energy policies, including the energy hierarchy. It also ensures energy remains an integral part of the development's design and evolution.
- 1.2. Although primarily aimed at strategic planning applications, London boroughs are encouraged to apply the same structure for energy assessments related to non-referable applications and adapt it for relevant scales of development.
- 1.3. The energy assessment must fully comply with Policies 5.2 to 5.9 inclusive and, recognising the integrated nature of London Plan policies, take account of relevant design, spatial, air quality, transport and climate change adaptation policies in the Plan. Further guidance on implementing these policies is set out in the Mayor's Sustainable Design and Construction Supplementary Planning Guidance (SPG)². The SPG provides detailed guidance on site layout and design, and energy and CO₂ emissions. All applicants must refer to and comply with London Plan policies and the SPG when preparing an energy assessment.
- 1.4. The energy assessment must clearly outline the applicant's commitments in terms of CO₂ savings and measures proposed to reduce energy demand. It is also important to consider and mitigate any potential air quality impacts arising as a result of the technologies proposed. Part 2 of this document provides guidance on details required within an energy assessment.
- 1.5. Each application is considered on its merits, taking into account the individual characteristics of the development. Case-specific energy comments for each development are provided at Stage 1 and 2 of the GLA planning process by GLA

¹ An application is referable to the Mayor if it meets the criteria set out in the Mayor of London Order (2008), which include development of 150 residential units or more, development over 30 metres in height (outside the City of London) or development on Green Belt or Metropolitan Open Land.

² <https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/supplementary-planning-guidance/sustainable-design-and>

energy officers to ensure applications comply with London Plan policy. However, for the avoidance of doubt, energy assessments must:

- be submitted at the planning application stage, not submitted post planning in response to a condition
- commit to reducing regulated CO₂ emissions below those of a development compliant with Part L 2013 of the Building Regulations through energy efficiency measures alone
- demonstrate how the zero carbon target³ for residential developments will be met, with at least a 35% on-site reduction beyond Part L 2013 and proposals for making up the shortfall to achieve zero carbon, where required
- demonstrate at least a 35% on-site reduction beyond Part L 2013 for non-residential development⁴. Developments comprised of both domestic and non-domestic uses must demonstrate this target has been achieved for domestic and non-domestic uses separately
- include information demonstrating that the risk of overheating has been mitigated through the incorporation of passive design measures
- demonstrate that connection to existing or planned district heating networks has been prioritised and provide correspondence to support this
- commit to a site-wide heat network to allow connection to existing or planned district heating networks identified in the area
- commit to a single energy centre to supply the site-wide heat network
- investigate suitable low carbon and/or renewable heating plant for installation within the energy centre if connection can't be made to an area wide network
- investigate and commit to maximising the installation of renewable technologies (including the potential for storage) on site
- include information on how the building's actual energy performance will be monitored post-construction
- align with related documents and assessments that are submitted as part of the planning application, e.g. Air Quality Assessments, Sustainability Statements.

Carbon emission factors

1.6. Grid electricity has significantly decarbonised since the last update of Part L in April 2014 and in July 2018 the Government published updated carbon emission factors (SAP 10) demonstrating this. These new emission factors will however not be incorporated into Part L of the Building Regulations until the Government has consulted on new Building Regulations. The impact of these new emission factors is significant in that technologies generating on-site electricity (such as gas-engine CHP and solar PV) will not achieve the carbon savings they have to date. It is therefore anticipated that developments will need to utilise alternative or additional

³ The zero carbon target applies to all major housing developments, i.e. those with 10 or more units, not just those referred to the Mayor.

⁴ The Mayor intends to introduce the zero carbon target for non-residential development when the new London Plan is published, expected in 2019.

technologies to meet the 35 per cent on-site carbon reduction target, including using zero emission or local secondary heat sources.

- 1.7. The GLA has decided that from January 2019 and until central Government updates Part L with the latest carbon emission factors, planning applicants are encouraged to use the SAP 10 emission factors for referable applications when estimating CO₂ emission performance against London Plan policies. This will ensure that the assessment of new developments better reflects the actual carbon emissions associated with their expected operation. This approach will remain in place until Government adopts new Building Regulations with updated emission factors. The timeline for this has not been confirmed but Part L is expected to be consulted on by early 2019. See section 5 for further details.

2. Planning applications

- 2.1. When submitting a planning application, the applicant must clearly identify whether the proposal relates to an outline, full or hybrid planning application. These are defined in Table 1.
- 2.2. The energy requirements for each type of application are explained in the following sections.

An outline planning application...	seeks to establish whether the scale and nature of a proposed development is acceptable in planning terms before a detailed 'reserved matters' application ⁵ is put forward.
A full planning application...	includes all of the detailed proposals of how a site can be developed which permission is based on.
A hybrid planning application...	seeks outline planning permission for one part of the site and full planning permission for another part of the same site.

Outline planning applications

- 2.2. All outline planning applications should be accompanied by an energy strategy which will guide the design of the development. While less detail will be expected than for a full planning application, applicants should undertake initial feasibility

⁵ Outline planning permission is granted subject to conditions requiring the subsequent approval of one or more 'reserved matters', i.e. matters which are reserved for later determination as defined in the Town and Country Planning (Development Management Procedure) (England) Order 2015.

work on each part of the energy hierarchy to illustrate how they will minimise carbon emissions from the development.

- 2.3. The applicant should also consider the CO₂ targets that are likely to be in place at the time of submission of the reserved matters application to ensure that the scheme can meet any higher planning or regulatory targets in place at the time e.g. the introduction of the zero carbon target for non-domestic developments, expected in 2019.
- 2.4. The strategy provided as part of an outline planning application must include the following:
 - estimated site-wide regulated CO₂ emissions and reductions (broken down for the domestic and non-domestic elements of the development), expressed in tonnes per annum, after each stage of the energy hierarchy
 - a clear commitment to regulated CO₂ emissions savings compared to a development compliant with Part L 2013 of the Building Regulations through energy demand reduction measures alone for non-domestic and domestic uses separately
 - clear evidence that the risk of overheating has been mitigated through passive design, particularly design measures relevant to an outline application i.e. building orientation and external context (location of buildings in relation to noise/pollution which may limit ventilation, landscaping proposals etc.)
 - completion of the overheating checklist (Appendix 5), which should be developed with the design team. While some aspects relating to building design may not be applicable at this stage it is important that factors that influence the risk of overheating are understood for the proposed development and a response provided outlining the design intent (e.g. glazing ratio) to reduce the risk of overheating
 - overheating modelling is not expected for the outline application, but a commitment to undertaking dynamic overheating modelling for the reserved matters application in line with GLA guidance should be made
 - evidence of investigation into existing or planned district heating networks that the development could be connected to, including relevant correspondence with local heat network operators
 - commitment to a site-wide heat network served by a single energy centre linking all apartments and non-domestic building uses
 - investigate suitable low carbon and/or renewable heating plant for installation within the energy centre if connection can't be made to an area wide network
 - large-scale developments (e.g. mixed use developments containing more than 1000 homes) which may be the catalyst for an area wide network, must:
 - investigate the feasibility of including additional space within the energy centre and capacity within the site-wide heat network to supply heat to nearby developments and, where applicable, existing buildings

- provide a feasibility assessment to ensure that whichever heating technology is used it is optimised to meet the domestic hot water and part of the space heating demand, thereby minimising CO₂ emissions
 - an initial feasibility test for renewable energy technologies (including the potential for storage) and a commitment to maximise onsite renewable energy generation to further reduce CO₂ emissions
 - consideration of the impact of development phasing (where relevant) to ensure the scheme can meet future, more stringent planning or regulatory targets
 - where the London Plan carbon reduction targets are not met, the developer must provide a commitment to ensure the shortfall is met off-site, or a payment is made into the relevant borough's carbon offset fund
- 2.5. Outline planning permission is granted subject to 'reserved matters', i.e. aspects of a proposed development which are 'reserved' and will require subsequent approval as part of a reserved matters application. The local planning authority should therefore secure the key energy commitments in the strategy through appropriate clauses in the section 106 agreement⁶ or through an appropriate planning condition.
- 2.6. When the reserved matters application is submitted it should be accompanied by a detailed energy assessment which should demonstrate consistency with the outline strategy. See the following section for information on what an energy assessment submitted alongside a reserved matters planning application should include.

Full (and reserved matters) planning applications

- 2.7. Full (and reserved matters) planning applications must provide a detailed energy assessment which includes the information set out in Part 2 of this Guidance.
- 2.8. Planning conditions and/or section 106 agreements should be used to secure the implementation of proposed measures. They must not be used to secure feasibility work that normally underpins a planning application as this will be too late in the process for feasibility work to influence the design of the development.

Hybrid planning applications

- 2.9. For hybrid applications, applicants should typically provide one strategy for the entire site with the design and expected CO₂ performance for the detailed and outline parts of the site presented separately, according to the requirements set out in the preceding sections.

3. Integration with supporting documents for planning applications

⁶ Planning obligations secured under Section 106 of the Town and Country Planning Act 1990 (as amended), commonly known as section 106 agreements, are a mechanism which make a development proposal acceptable in planning terms, that would not otherwise be acceptable.

3.1. All planning applications referred to the Mayor must include an energy assessment prepared in accordance with this guidance document; however, where other documents are being submitted as part of a planning application, it may be appropriate to cross-reference these documents, provided cross-referencing is clear and the documents contain sufficient information to allow an assessment of the application. Cross-referenced documents may include the following:

- Design and Access Statement
- Sustainability statement
- BREEAM pre-assessment report (or equivalent)
- Environmental Impact Assessment
- Air Quality Assessment (including an emissions/concentrations assessment)
- Energy master plan for the area (where this exists).

It will also be beneficial to reference generic guidance documents where appropriate, e.g. London Heat Network Manual.

Structure and content of energy assessments

4. Executive summary of the energy assessment

- 4.1. This must be a non-technical summary which provides a brief description of the proposed development. This must clearly state the number of each different type of residential unit (e.g. 450 flats and 70 houses), as well as the associated gross internal floor area. It should also summarise the floor area (m²) allocated for different non-domestic uses.
- 4.2. It should set out and commit to the key measures and CO₂ reductions identified for each stage of the energy hierarchy. It must clearly indicate the performance of the domestic and non-domestic elements of the development in relation to the London Plan carbon reduction targets for new buildings.
- 4.3. For referable applications, the executive summary should (from January 2019) also confirm which emission factors are being used. Applicants are encouraged to use the updated SAP 10 emission factors. Any applicants proposing to use the SAP 2012 emissions factors should provide a justification for this. If gas-engine CHP is also proposed applicants will be expected to provide sufficient information to justify its use and to minimise the carbon and air quality impact (see Appendix 3 for further details on the CHP information requirements). This approach will be in place until the Government adopts new Building Regulations with updated emission factors. See section 5 for further details on emission factors.
- 4.4. The regulated carbon dioxide emissions reduction target for major domestic development is zero carbon and for non-domestic development it is 35 per cent beyond Part L 2013 of the Building Regulations.
- 4.5. Where it has been fully evidenced that the targets cannot be met on-site, a commitment to ensure the shortfall is met off-site in agreement with the relevant borough or a payment made into the borough's carbon offset fund (see Tables 2 and 5 for calculations to determine the shortfall). Refer to the GLA's Carbon Offset Fund guidance for further information on carbon offsetting⁷.
- 4.6. The concept of applying the energy hierarchy in relation to Part L 2013 of the Building Regulations is illustrated in Figures 1 and 2 below. Where the blue bars drop below the black dotted line, this demonstrates savings in regulated CO₂ emissions compared to a development that complies with Part L 2013 of the Building Regulations. In the example provided the development exceeds Building Regulations compliance through energy efficiency alone, with further reductions

⁷ https://www.london.gov.uk/sites/default/files/carbon_offset_funds_guidance_2018.pdf

achieved through heat networks and renewable energy to comply with the London Plan target.

Figure 1: The domestic energy hierarchy

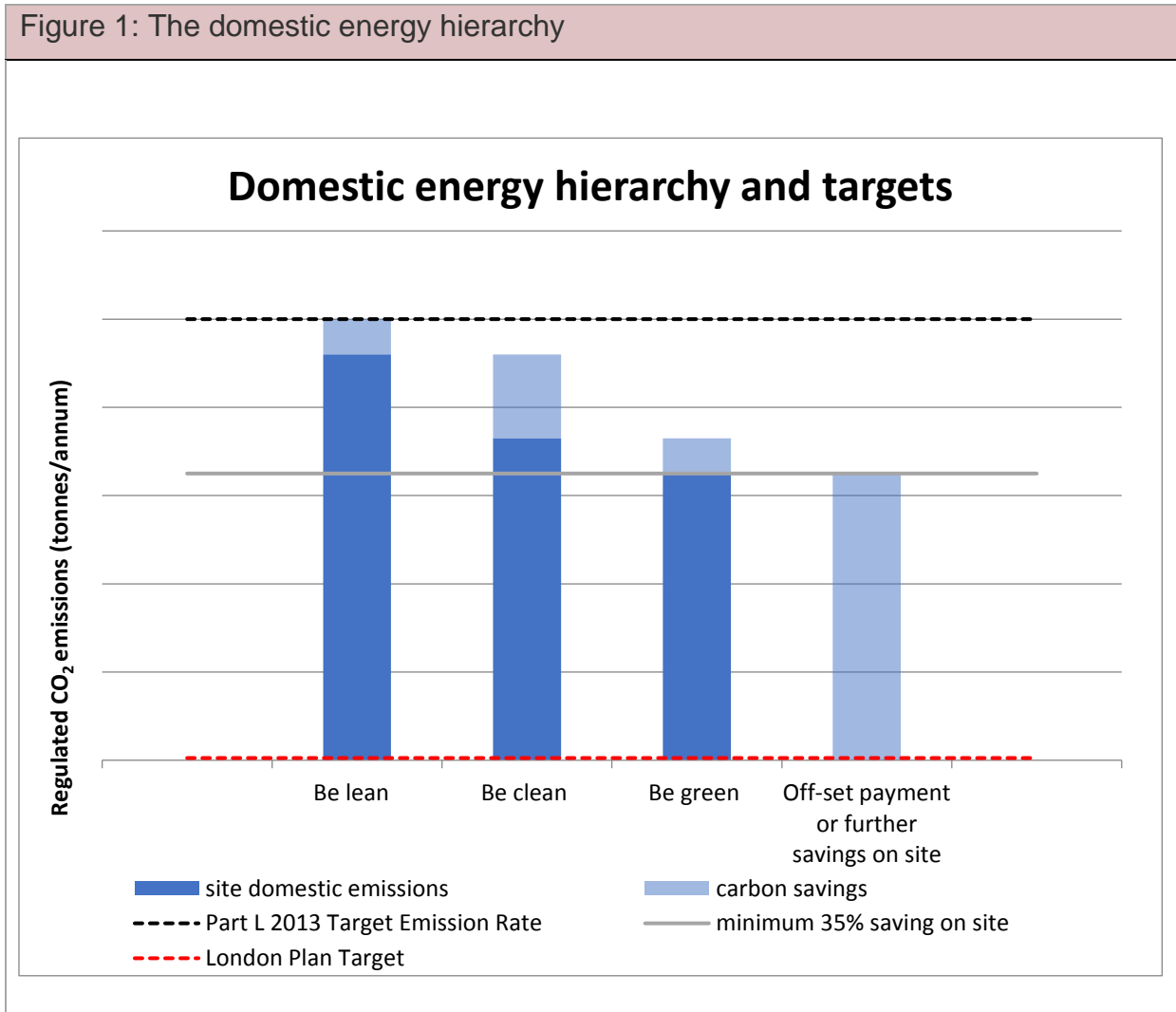
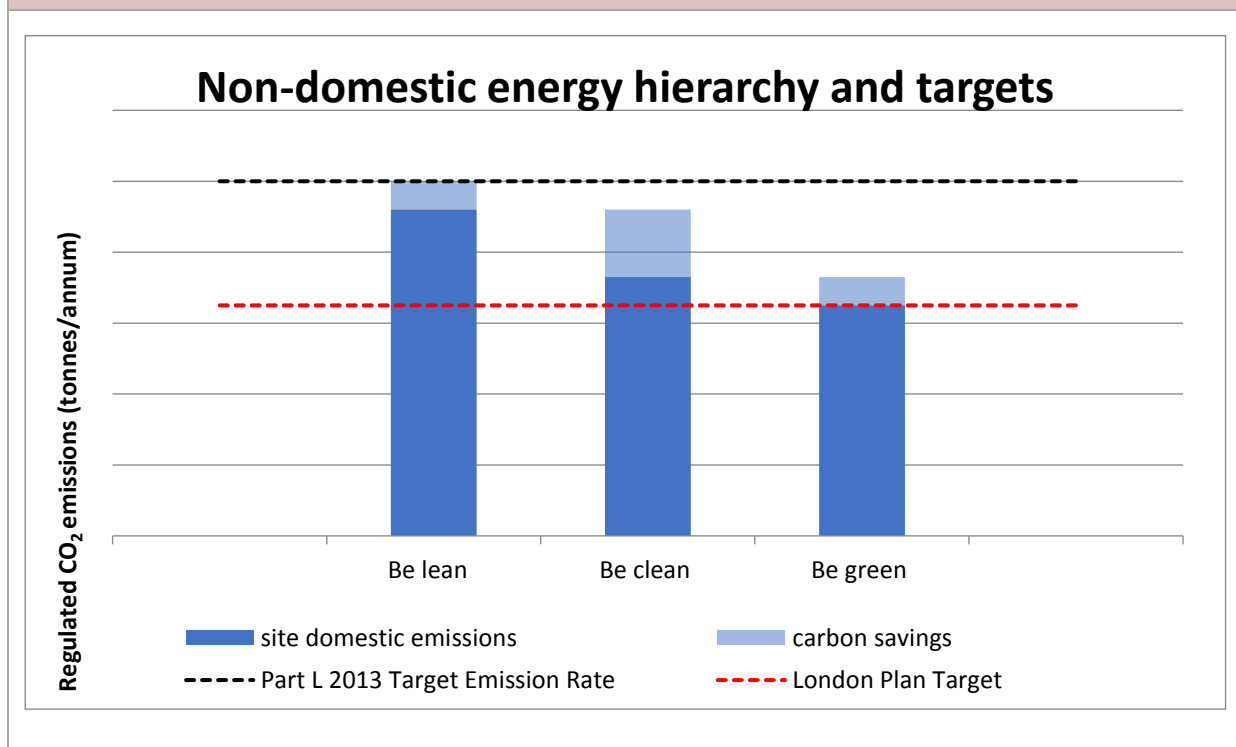


Figure 2: The non-domestic energy hierarchy



5. Carbon emission factors

- 5.1. For referable developments from January 2019, applicants are encouraged to use the updated SAP 10 emission factors. To do this applicants should continue to use the current Building Regulations methodology for estimating energy performance against Part L 2013 requirements (as outlined in Section 6), but with the outputs manually converted for the SAP 10 emission factors⁸. A spreadsheet has been developed for this purpose which applicants should provide as part of their energy assessment⁹. This spreadsheet should be used to record the estimated carbon performance of the development using SAP 10 and SAP 2012 emission factors to allow for a robust assessment of performance against the new emission factors and comparison against the old emission factors.
- 5.2. Applications should be conditioned to achieve the carbon reductions calculated using SAP 10 emission factors. This will ensure that the assessment of new developments better reflects the actual carbon emissions associated with their expected operation. It should be noted that the use of the SAP 10 emission factors in this context is for demonstrating performance against planning policy targets

⁸ At the time of publication there is no official government approved software for the SAP 10 methodology, apart from the BRE's test software which is expected to undergo further adjustments ahead of consultation on its official adoption.

⁹ <https://www.london.gov.uk/what-we-do/planning/planning-applications-and-decisions/pre-planning-application-meeting-service-0>

and, as such, is separate to Building Regulation compliance. Applications should therefore ensure that compliance with Building Regulations is maintained.

- 5.3. Applicants proposing to continue to use SAP 2012 should justify this approach. Applicants that are also proposing gas-engine CHP will be asked to provide sufficient information to justify its use, ensure that the carbon and air quality impact is minimised, for example through the selection of a lower emission unit and use of abatement technology, and undertake emissions testing to demonstrate that the installed system meets emission limits prior to occupation. See Appendix 3 for further information on the use of CHP and the information required if it is proposed.
- 5.4. Regardless of which emission factors are used, applicants will continue to be expected to meet the GLA's minimum carbon reduction targets and to maximise opportunities for carbon reductions from all stages of the energy hierarchy. All applicants should refer to Appendix 3 for guidance on the information required for the technology (or technologies) being proposed.

6. Establishing CO₂ emissions

- 6.1. The energy assessment must clearly identify the carbon footprint of the development after each stage of the energy hierarchy. Regulated emissions must be provided and, separately, those emissions associated with uses not covered by Building Regulations i.e. unregulated energy uses. The figures for the domestic elements of development should be presented separately from the non-domestic elements as domestic buildings have a different policy target to non-domestic.
- 6.2. The following tables should be completed to demonstrate compliance with the energy hierarchy and the carbon targets. Savings are to be expressed in tonnes of CO₂ per annum, not kgCO₂/m² per annum. Note: unregulated emissions are likely to be the same after the first stage of the energy hierarchy.

Domestic

Key	
A	Baseline CO ₂ emissions (Part L 2013 of the Building Regulations Compliant Development)
B	CO ₂ emissions after energy demand reduction (be lean)
C	CO ₂ emissions after energy demand reduction (be lean) AND heat network (be clean)

D	CO ₂ emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)
---	---

Table 3: Regulated carbon dioxide savings from each stage of the energy hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	A - B	$(A - B)/A * 100$
Be clean: Savings from heat network	B - C	$(B - C)/A * 100$
Be green: Savings from renewable energy	C - D	$(C - D)/A * 100$
Cumulative on site savings	A - D = E	$(A - D)/A * 100$
Carbon shortfall	A - E = F	
	(Tonnes CO ₂)	
Cumulative savings for offset payment	$F * 30 \text{ years} = G$	
Cash-in-lieu contribution	$G * \text{carbon dioxide offset price} = H$	

6.3. If the carbon savings are not achieved on site, the annual remaining carbon emissions figure is multiplied by the assumed lifetime of the development's services (e.g. 30 years) to give the cumulative shortfall. The cumulative shortfall is multiplied by the carbon dioxide offset price¹⁰ to determine the required cash-in-lieu contribution.

6.4. The Mayor's Housing Standard's Viability Assessment assumed a carbon offset price of £60 per tonne of carbon dioxide for a period of 30 years. Boroughs may use this price or set their own by undertaking a locally specific viability assessment.

¹⁰ Set by the local authority.

Where the borough applies a carbon dioxide offset price of £60 per tonne, it is not considered necessary to carry out a further viability assessment of the policy approach¹¹. The GLA will regularly review the recommended carbon offset price.

Non-domestic

Key	
A	Baseline CO ₂ emissions (Part L 2013 of the Building Regulations Compliant Development)
B	CO ₂ emissions after energy demand reduction (be lean)
C	CO ₂ emissions after heat network (be clean)
D	CO ₂ emissions after renewable energy (be green)

Table 5: Regulated carbon dioxide savings from each stage of the energy hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Be lean: Savings from energy demand reduction	A - B	$(A - B)/A * 100$
Be clean: Savings from heat network	B - C	$(B - C)/A * 100$
Be green: Savings from renewable energy	C - D	$(C - D)/A * 100$
Total cumulative savings	A - D = E	$(A - D)/A * 100$

6.5. Table 6 must also be completed if the non-domestic development fails to meet the 35 per cent target. Similarly, to the domestic offset arrangement, in this case the annual shortfall is determined by subtracting the overall regulated carbon dioxide savings from the target savings. The result is then multiplied by 30 years to give

¹¹ Boroughs should be aware that the GLA has tested a new carbon offset price of £95 per tonne as part of the new draft London Plan viability assessment, To view the progress of the new London Plan go to: <https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan>

the cumulative shortfall, which is multiplied by the carbon dioxide offset price to determine the required cash-in-lieu contribution.

	Annual Shortfall (Tonnes CO ₂)	Cumulative Shortfall (Tonnes CO ₂)
Total Target Savings	$A * 0.35 = F$	
Carbon shortfall	$F - E = G$	$G * 30 = H$
Cash-in-lieu contribution	$H * \text{carbon dioxide offset price} = I$	

Site total (domestic + non-domestic)

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ savings (Tonnes CO ₂ /year)	Percentage saving (%)
Part L 2013 baseline	A domestic + A non-domestic		
Be lean	B domestic + B non-domestic	Total A – Total B	$(\text{Total A} - \text{Total B}) / \text{Total A} * 100$
Be clean	C domestic + C non-domestic	Total B - Total C	$(\text{Total B} - \text{Total C}) / \text{Total A} * 100$
Be green	D domestic + D non-domestic	Total C – Total D	$(\text{Total C} - \text{Total D}) / \text{Total A} * 100$
		CO ₂ savings offset (Tonnes CO ₂)	
Offset		G domestic + H non-domestic	

Calculating regulated CO₂ emissions for a Part L 2013 of the Building Regulations compliant development

- 6.6. The energy assessment must first establish the regulated CO₂ emissions assuming the development complied with Part L 2013 of the Building Regulations using Building Regulations approved compliance software (see references to SAP and SBEM below). When determining this baseline, it should be assumed that the heating would be provided by gas boilers and that any active cooling would be provided by electrically powered equipment. If a communal heating system is being proposed, this should be included when determining CO₂ emissions to ensure a consistent baseline (i.e. the energy supply for a large apartment block would be provided by communal gas boilers not individual ones in each dwelling).
- 6.7. For each non-domestic building the Target Emissions Rate (TER)¹² should be multiplied by its floor area to provide the related regulated CO₂ emissions. For each representative dwelling type, the related TER is multiplied by the cumulative floor area for that dwelling type to establish the related CO₂ emissions. The CO₂ emissions for each non-domestic building and dwelling type are then summed to give the total regulated emissions for the development.
- 6.8. As shown in Tables 2 and 4, the total regulated emissions must be multiplied by the percentage target (divided by 100) to give the aggregate target reduction in the development's tonnes of regulated CO₂ emissions.

Calculating regulated CO₂ emissions at each stage of the energy hierarchy

- 6.9. Regulated emissions, which include the energy consumed in the operation of the space heating/cooling and hot-water systems, ventilation, internal lighting, must be calculated. Separately, unregulated emissions i.e. those relating to cooking and all electrical appliances and other small power, should be calculated.
- 6.10. Emissions for dwellings must establish:
- a Dwelling CO₂ Emissions Rate (DER)¹³ calculated through the Part L 2013 of the Building Regulations methodology SAP 2012. This is multiplied by the cumulative floor area for the particular dwelling type in question to give the related CO₂ emissions
 - separately, emissions associated with non Building Regulation elements (i.e. cooking and appliances) established by using BREDEM (BRE Domestic Energy Model) or similar methodology.

¹² The TER is the minimum energy performance requirement for a new dwelling/building. It is expressed in terms of kgCO₂ per m² of floor area per year.

¹³ The DER is the actual CO₂ emission rate of a dwelling expressed in terms of kgCO₂ per m² of floor area per year.

In terms of the extent of modelling work required, the applicant must provide information for a representative sample of domestic properties.

6.11. Emissions for non-domestic development must establish:

- a Building CO₂ Emissions Rate (BER)¹⁴ calculated through the Part L 2013 of the Building Regulations methodology based on the National Calculation Methodology (NCM) and implemented through Simplified Building Energy Model (SBEM) v5.2d or later or equivalent software¹⁵. For each building, the related BER is multiplied by its floor area to give the related carbon dioxide emissions
- additional emissions associated with non Building Regulation elements established by using individual end use figures (for example catering and computing) from CIBSE guide baselines (e.g. CIBSE Guide F) or evidence established through previous development work

6.12. A summary of the modelling work output (i.e. BRUKL reports, DER worksheet for dwellings) must be provided in an appendix of the energy assessment for each stage of the energy hierarchy.

6.13. The CO₂ emissions for each non-domestic building should be summed together to give total non-domestic regulated emissions. Similarly, the CO₂ emissions of all dwellings must then be summed to give the total regulated emissions for the domestic element of the development. These figures should be expressed in tonnes per annum.

6.14. After calculating the regulated emissions at each stage of the energy hierarchy, the percentage savings in regulated emissions over a Part L 2013 of the Building Regulations compliant development must be provided (as shown in the tables above) for the domestic and non-domestic elements of the development and for the site as a whole.

7. Calculating regulated CO₂ emissions for refurbishments

7.1. Where an existing building or group of buildings is refurbished and the development qualifies as a major refurbishment¹⁶, developers are required to provide an energy assessment demonstrating how the individual elements of the energy hierarchy have been implemented and how reductions in regulated CO₂ emissions have been achieved.

¹⁴ The BER is the actual CO₂ emission rate of a building (other than a dwelling) expressed in kgCO₂ per m² of floor area per year.

¹⁵ Other building regulation compliance software such as IES or TAS is also acceptable.

¹⁶ Major refurbishments are those which comprise of 10 or more units and, for other uses, those which have a floorspace of 1000m² or more.

- 7.2. The following section outlines the approach developers should take when estimating improvements in CO₂ emissions for existing buildings. For non-referable applications, applicants should liaise with the respective borough on any local requirements for existing buildings in relation to demonstrating CO₂ emission performance.

Baseline

- 7.3. Where major refurbishments are being carried out an estimate of the CO₂ savings from the refurbishment of the building will be expected. To provide this, developers are required to estimate the CO₂ emission baseline performance of the unrefurbished condition of the existing building using Building Regulations approved compliance software. Where estimates of the existing performance of building elements or services have been made developers are required to outline the source of these assumptions, such as a building condition survey, Energy Performance Certificate (EPC) conventions, industry benchmarks etc.
- 7.4. The baseline for change of use applications should be estimated assuming the existing building is the same as the proposed end use. In some circumstances, most frequently in change of use applications, it is possible that the existing building does not include certain building elements that should be included in the baseline. In this case it is expected that the estimate of the performance of the building element would meet the recommended performance standards outlined in Approved Documents L1B and L2B, or the Government's Building Services Compliance Guidance for the purposes of estimating baseline CO₂ emission performance.

CO₂ emission improvements

- 7.5. Once the baseline has been established the BER/DER of the refurbished building should be determined following improvements at each stage of the energy hierarchy using Building Regulations compliance software. These figures should then be used to report the CO₂ savings at each stage of the energy hierarchy in the format of Tables 5 and 6 above.
- 7.6. The developer should outline the performance values used to calculate the CO₂ emission improvements. The developer should confirm the source of the assumptions for the improvements in building elements or services, such as a U-value calculations, manufacturer's datasheet etc.
- 7.7. The developer is required to report how the proposed improvement measures compare with the energy performance standards included within the Building Regulation Approved Documents L1B and L2B, which provide guidance on how to comply with the Part L requirements for existing building, and the Government Building Services Compliance Guides. To meet the GLA's carbon reduction target it is expected that applicants exceed these recommended standards. It is

acknowledged that the Approved Documents allow for flexibility in meeting the recommended standards due to potential restrictions to building work upgrades, for instance listed building status. Therefore, any limitations in meeting these recommended standards should be stated.

Extensions

- 7.8. For developments consisting of a refurbishment with a new build extension the CO₂ savings for the new and refurbished elements should be presented separately within the energy strategy, making clear how the new build element is performing against current standards.
- 7.9. The new build elements should be assessed in line with the methodology for new build development and will be expected to comply with London Plan energy policy. With regards to the refurbished elements, it is acknowledged that the nature and level of carbon savings that can be achieved can vary considerably, however every effort should be made to improve the energy performance of the building and to follow the energy hierarchy

8. Demand reduction (Be Lean)

- 8.1. All applications referred to the Mayor are expected to exceed Building Regulations requirements (Part L 2013) through demand reduction measures alone (see Figures 1 and 2). This should be achieved for domestic and non-domestic uses. Energy assessments must therefore set out the demand reduction measures specific to the development and demonstrate the extent to which they meet and then exceed Building Regulations. Measures typically include both architectural and building fabric measures (passive design) and energy efficient services (active design), as described in the SPG. Introducing demand reduction features is encouraged at the earliest design stage of a development. Applicants should note that the Mayor has set new efficiency targets in the new draft London Plan:
 1. Domestic developments should achieve at least a 10 per cent improvement on Building Regulations from energy efficiency
 2. Non-domestic developments should achieve at least a 15 per. cent improvement on Building Regulations from energy efficiency.
- 8.2. Research conducted as part of the new London Plan evidence, and the Energy Monitoring Report 2017, shows that these targets are achievable for most development types. Applicants are therefore expected to adopt measures which will increase the reductions achieved from Be Lean.
- 8.3. As well as setting out the demand reduction measures, applicants should report the development's total energy demand (in MWh/year) for each building use and

include this within the energy assessment. For residential developments, the total Part L Fabric Energy Efficiency Standard (FEES)¹⁷ for the development as a whole should be provided. While there are currently no specific targets for energy demand, this data will be used to build an evidence base on energy demand in London's new developments. Further information is provided in paragraphs 8.11 and 8.12.

Demonstrating CO₂ savings from demand reduction measures

- 8.4. Passive design measures, including optimising orientation and site layout, natural ventilation and lighting, thermal mass and solar shading, should be set out in the Design and Access Statement and cross-referenced in this document. Active design measures, including high efficiency lighting and efficient mechanical ventilation with heat recovery, must be set out in the energy assessment.
- 8.5. The applicant must provide details in the energy assessment of the demand reduction measures specific to the development, for example enhanced U-value numbers (W/m²K), air tightness improvement, efficient services and lighting. Information should also be provided on the development's approach to limiting thermal bridges. Where a particular energy efficiency standard is to be met, this must be clearly stated. The glazing percentage of the buildings, expressed as the glazed area¹⁸ divided by the façade area (multiplied by 100), should be clearly stated within the energy assessment.
- 8.6. The applicant must clearly identify the extent to which Part L 2013 of the Building Regulations is exceeded through the use of these demand reduction measures alone, i.e. the percentage improvement of the BER/DER over the Target CO₂ Emissions Rate (TER)¹⁹ before the inclusion of a heat network connection and use of on-site renewables.
- 8.7. The appendix of the energy assessment must include a summary output sheet from the modelling work (i.e. a print out such as a full BRUKL report) only taking into account energy efficiency measures, i.e. excluding the proposed heating system and renewable energy. The 'be lean' case should assume that the heating is provided by gas boilers and that any active cooling would be provided by electrically powered equipment.
- 8.8. If the final heating proposal is to be low carbon or renewable energy, gas boilers must still be assumed for the purposes of the 'be lean' element of the hierarchy. In this case the gas boiler performance must be assumed to be equal with Part L notional values for boiler efficiency and controls in order to only show the

¹⁷ The FEES is the maximum energy demand for the dwelling.

¹⁸ From the inside looking out.

¹⁹ The Target CO₂ Emissions Rate is the minimum energy performance requirement for a new dwelling/building. It is expressed in terms of kgCO₂ per m² of floor area per year.

performance of the energy efficiency measures that will be installed. Higher efficiencies should only be used if gas boilers will be part of the final strategy (i.e. after the 'be clean' and 'be green' tiers of the hierarchy have also been addressed), in which case the gross efficiency of the gas boiler model to be specified can be used.

- 8.9. For applications that include residential units, a clear explanation of the different dwelling types modelled should be provided. For each dwelling type the full DER worksheet, including the effect of energy efficiency measures alone (i.e. excluding any contribution from the proposed heating system and renewable energy), should be provided, together with the full TER worksheet. It is essential that the worksheets containing the DER and TER and the modelling inputs are provided to enable the savings from energy efficiency to be validated (i.e. SAP worksheets or Part L compliance checklists alone are not sufficient as they do not include all the relevant information).
- 8.10. The assessment should also set out the plans for demand side response, including installation of smart meters, to allow the running of some equipment at a lower capacity during times of peak demand. The assessment should also investigate the incorporation of energy storage, smarter controls to optimise heating and power systems, and the feasibility of smart grids and local micro grids.

Energy demand reporting

- 8.11. Following the energy efficiency measures, the total energy demand (in MWh/year) for each building use should be reported using the template in Table 8 and included within the energy assessment. Note that the figures reported should not be energy consumption (i.e. energy consumed by plant), for instance the 'energy consumption by end use' reported in the BRUKL document is energy consumption and should not be used. The figures reported should be the delivered energy requirement at the point of use.

Building use	Energy demand following energy efficiency measures (MWh/year)						
	Space Heating	Hot Water	Lighting	Auxiliary	Cooling	Unregulated electricity	Unregulated gas
e.g. residential total							
e.g. non-residential total							

8.12. For residential developments, the total Part L Fabric Energy Efficiency Standard (FEES) for the development as a whole should be provided. The template in Table 9 should be completed and included within the energy assessment.

	Target Fabric Energy Efficiency (MWh/year)	Design Fabric Energy Efficiency (MWh/year)	Improvement (%)
Development total			

9. Cooling and overheating

The cooling hierarchy

9.1. Applicants should apply the cooling hierarchy in Policy 5.9 of the London Plan to the development. Measures that are proposed to reduce the demand for cooling should be set out under the following categories:

1. Minimising internal heat generation through energy efficient design: For example, heat distribution infrastructure within buildings should be designed to minimise pipe lengths, particularly lateral pipework in corridors of apartment blocks, and adopting pipe configurations which minimise heat loss e.g. twin pipes.

2. Reducing the amount of heat entering the building in summer: For example, through use of carefully designed shading measures, including balconies, louvres, internal or external blinds, shutters, trees and vegetation.
3. Use of thermal mass and high ceilings to manage the heat within the building: Increasing the amount of exposed thermal mass can help to absorb excess heat within the building.
4. Passive ventilation: For example, through the use of openable windows, shallow floorplates, dual aspect units, designing in the 'stack effect'
5. Mechanical ventilation: Mechanical ventilation can be used to make use of 'free cooling' where the outside air temperature is below that in the building during summer months. This will require a by-pass on the heat recovery system for summer mode operation.

Overheating risk analysis

- 9.2. All developments are required to undertake an analysis of the risk of overheating. Building regulations requirements are set out in Table 10, and these should be carried out at Stage 1.

Table 10: Overheating requirements as per Building Regulations	
Domestic developments	Non-domestic developments
At Stage 1	
Criterion 3 of Part L 1A of the Building Regulations as set out in Appendix P of SAP 2012 must be met. This relates to limiting the effects of heat gains in summer.	Criterion 3 of the Part L 2A of the Building Regulations as summarised in the BRUKL output report must be met. This relates to limiting the effects of heat gains in summer.

- 9.3. However, the regulations explicitly recognise that, as the test does not cover all factors influencing overheating, there is no guarantee that buildings will not overheat and developers should carry out additional design assessments.
- 9.4. In line with the Sustainable Design and Construction SPG²⁰, the GLA requirements are set out in Table 11.

²⁰ Specifically see paragraphs 3.2.3 and 3.2.4 of the SPG.

Table 11: GLA overheating requirements	
Domestic developments	Non-domestic developments
At pre-application stage	
Complete Section 1 of the Domestic Overheating Checklist (Appendix 5) and submit it with the preliminary energy information provided to the GLA.	Outline in the preliminary energy information how the overheating risk will be minimised.
At Stage 1	
Review Section 1 and complete Section 2 of the Domestic Overheating Checklist. The full checklist should be included in the energy assessment.	Undertake dynamic overheating modelling in line with the guidance and data sets in CIBSE TM52 and TM49 respectively
Undertake dynamic overheating modelling in line with the guidance and data sets in CIBSE TM59 and TM49 respectively	Provide evidence of how the development performs against the overheating criteria along with an outline of the assumptions made (see paragraph 9.5) in the energy assessment.
Provide evidence of how the development performs against the overheating criteria along with an outline of the assumptions made (see paragraph 9.5) in the energy assessment.	
Stage 2 onwards	
Ensure that the results of the overheating analysis continue to be incorporated into the building design discussions as the design evolves.	Ensure that the results of the overheating analysis continue to be incorporated into the building design discussions as the design evolves.
N.B. See additional overheating guidelines for domestic developments in paragraph 9.6.	

9.5. The following assumptions should be clearly reported within the energy assessment:

- Dynamic overheating analysis software used
- Site location

- Site orientation
- Weather file used
- Internal gains
- Occupancy profiles
- Thermal elements performance (U-values and glazing g-values)
- Shading features (i.e. blinds, overhangs etc.)
- Thermal mass details
- Ventilation strategy
- Model images indicating the sample units modelled
- Units' internal layout

Specific provisions for domestic developments

9.6. For all domestic dynamic overheating analyses, applicants should additionally adhere to the following guidelines:

- Communal heating systems: Heat losses from pipework and heat interface units (HIUs) should be included within the model for all community heating systems.
- Communal corridors: Communal corridors should be included in the overheating analysis where community heating pipework runs through them. Paragraph 3.9 of the new CIBSE TM59 guidance describes the relevant methodology.
- Internal Blinds: Reliance on internal blinds to obtain a pass in the overheating analysis should be avoided as they can interfere with the effective opening area of windows (i.e. create a barrier for airflow) and are reliant on occupant behaviour. Where blinds are used to enable a pass, the results without blinds should also be presented as these could hinder any natural ventilation strategy. Where blinds are required to enable a pass the applicant should confirm that they will be included in the base build and demonstrate that any reduction in free area of open windows due to blinds has been taken into account in the model.
- Occupancy: CIBSE includes different levels of comfort target depending on the occupancy. Thermal comfort Category II, in line with CIBSE TM52, should be used by default for the associated acceptable temperature range. Category I should be used for instances of vulnerable residents.

Using the CIBSE guidance

Non-domestic

9.7. CIBSE guide TM52, entitled 'The Limits of Thermal Comfort: Avoiding Overheating in European Buildings', contains guidance on the limits of thermal comfort. The TM provides guidance on predicting overheating in buildings. It is intended to inform designers, developers and others responsible for defining the indoor environment

in buildings and should be considered when carrying out dynamic thermal modelling.

Residential (including care homes and student accommodation)

- 9.8. In 2017, CIBSE published the Design Methodology for the Assessment of Overheating Risk in Homes (TM59: 2017). This guide aims to provide a standardised approach to predicting overheating risk for residential building designs (new-build or major refurbishment) using dynamic thermal analysis.
- 9.9. The TM59 guidance methodology provides a baseline for all domestic overheating risk assessments. Section 3 of the methodology includes guidance on assumptions for sample sizes, openings, ventilation etc. Section 5 of the guidance document outlines the assumptions to be used for the internal gains including occupancy profiles. Whilst all homes will be occupied and operated differently, the methodology has been developed to ensure that the units tested will perform reasonably throughout the day and night. Therefore, the applicant must ensure that the assumptions for the overheating assessment follow the guidance within Section 3 & 5.

Design weather files

- 9.10. In 2014 the CIBSE, working in conjunction with the GLA, published: Design Summer Years for London (TM49: 2014)²¹. This guide aims to provide a risk-based approach to help developers and their advisers simultaneously address the challenges of developing in an urban heat island and managing an uncertain future climate. It provides guidance to help ensure that new developments are better designed for the climate they will experience over their design life.
- 9.11. Overheating modelling for both domestic and non-domestic developments should be conducted using the following design weather file:
- DSY1 (Design Summer Year) for the 2020s, high emissions, 50% percentile scenario
- 9.12. It is expected that the CIBSE compliance criteria is met for the DSY1 weather scenario.
- 9.13. Additional testing should be undertaken using the 2020 versions of the following more extreme design weather years:
- DSY2 – 2003: a year with a very intense single warm spell.
 - DSY3 – 1976: a year with a prolonged period of sustained warmth.

²¹ <http://www.cibse.org/knowledge/cibse-tm/tm49-design-summer-years-for-london-new-2014>

- 9.14. It is acknowledged that meeting the CIBSE compliance criteria is challenging for the DSY 2 & 3 weather files. Where the CIBSE compliance criteria is not met for a particular weather file the applicant must demonstrate that the risk of overheating has been reduced as far as practical and that all passive measures have been explored, including reduced glazing and increased external shading. The applicant should also outline a strategy for residents to cope in extreme weather events, e.g. use of fans.

Location weather data

- 9.15. To enable the urban heat island effect in the locality of the development to be taken into account, weather year data for three different locations are provided in the CIBSE TM49 guide - this data has been adjusted to take account of future climate effects. The most representative weather data set for the project location should be used, as presented below.
- London Weather Centre data: the Greater London Authority Central Activity Zone (CAZ) and other high density urban areas (e.g. Canary Wharf).
 - London Heathrow airport data: lower density urban and suburban areas.
 - Gatwick Airport data: rural and peri-urban areas around the edge of London.

Exceptions to the overheating requirements

- 9.16. It is expected that dynamic thermal modelling of the overheating risk will be undertaken to support the energy assessment, unless the applicant can demonstrate exceptional circumstances where opportunities for reducing cooling demands via passive measures are constrained, for example:
- Industrial buildings including warehouses used for storage purposes;
 - Supermarkets;
 - Cinemas;
 - Laboratories;
 - Railway Station Extensions;
 - Sports buildings with limited occupancy patterns;
 - Temporary structures;
 - Small retail food outlets where doors remain open to allow customer access.
- 9.17. In each of these cases applicants should demonstrate that the cooling demand has been minimised in line with the cooling hierarchy of Policy 5.9.

Active cooling

- 9.18. 'Active cooling' should not be specified in developments where it has been demonstrated that the passive or other measures proposed have successfully addressed the risk of overheating; to avoid unnecessarily increasing a development's energy demand and carbon emissions. In addition, it is not expected that 'active cooling' will be proposed for any residential developments.

- 9.19. Where design measures and the use of natural and/or mechanical ventilation are not enough to guarantee the occupant's comfort (in line with the cooling hierarchy set out in London Plan Policy 5.9), the developer should identify the cooling requirement of the different elements of the development in the energy assessment. Please note that this is the space cooling requirement, not the energy used by the equipment providing the cooling, i.e. it is not the electricity used by electric chiller plant but the cooling energy supplied by the chiller.

Non-domestic development

- 9.20. For non-domestic buildings the BRUKL output reports contain an 'HVAC Systems Performance' table comparing the cooling demand of the actual and notional buildings for different building elements. The aim should be to reduce the actual cooling demand below that of the notional for each of the non-domestic spaces in the development where an active cooling load exists. This should be demonstrated by providing in the energy assessment a table in the format provided in Table 12 giving the area weighted average actual and notional cooling demands for all non-domestic areas. If meeting the notional cooling demand is not possible, the applicant should provide a clear explanation of why it is not possible and outline the implications for building design.

	Area weighted average non-domestic cooling demand (MJ/m ²)	Total area weighted non-domestic cooling demand (MJ/year)
Actual		
Notional		

- 9.21. If an active cooling strategy is required, it should be set out in the energy assessment and include details of the active cooling plant being proposed, including efficiencies, and the ability to take advantage of free cooling and/or renewable cooling sources. Where appropriate, the cooling strategy should investigate the opportunities to improve cooling efficiencies to reduce carbon emissions through the use of locally available energy sources such as ground cooling, river/dock water cooling, etc. and efficient technologies such as heat pumps that can be used to provide cooling.

10. Heating infrastructure (Be Clean)

- 10.1. Once demand for energy has been minimised, all planning applications must demonstrate how their energy systems will supply energy efficiently and reduce CO₂ emissions. Table 13 should be used to select the appropriate scale of system.
- 10.2. Site-wide heat networks should be embedded into development proposals from the beginning of the design process to avoid significant redesign later on e.g. by allowing sufficient space for an energy centre. Development proposals that do not obviously align with the guidance set out in the following sections, should seek clarification with the GLA or the relevant borough at the earliest opportunity in order to avoid the need for significant redesign.

1. Connection to an area wide heat networks	Where proposed developments are located near to existing or planned networks, connection must be prioritised (see paragraph 10.5 onwards).
2. Communal heating system	Site-wide heat network Where proposed developments are located in areas of decentralised energy potential, but no heat networks currently exist or are planned, developers should provide a site-wide heat network served by a single energy centre to future proof the development for easy connection to a wider heat network in the future (see paragraph 10.14 onwards).
	Building-level heating system Appropriate for single building applications or low density developments with residential blocks, where no district heating networks are planned or feasible.
3. Individual heating system	Appropriate for low density individual housing, where no district heating networks are planned or feasible, and where evidence is provided that a site-wide heat network is uneconomic. Direct electric heating will not be accepted in the majority of cases as it will not provide any on-site carbon savings in line with the energy hierarchy and it is likely to result in higher

	energy bills. Direct electric systems are also not compatible with connection to district heating networks.
--	---

- 10.3. Applicants should also consider how the development will be future-proofed to achieve zero carbon emissions on-site by 2050 and provide proposals setting this out.
- 10.4. The applicant must investigate, making reference to the London Heat Map²² and by contacting the local borough and/or local heat network operators, the potential for connecting the development to an existing heat network system. In order to keep the Heat Map up to date developers are required to contact the GLA (environment@london.gov.uk) post-construction to confirm that the development has connected to a specific heat network.

Connection to area wide low carbon heat distribution networks

Existing networks

- 10.5. Where a heat network exists in the vicinity of the proposed development, the applicant must prioritise connection and provide evidence of correspondence with the network operator. This must include confirmation from the network operator of whether the network has the capacity to serve the new development, together with supporting estimates of installation cost and timescales for connection.
- 10.6. Examples of existing district heating networks in London include King's Cross, the Olympic Park and Stratford City, Citigen, the Pimlico District Heating Undertaking (PDHU), Barkantine Heat and Power, Whitehall District Heating network, SELCHP, the Bunhill energy centre and heat network and the University College London and Bloomsbury networks. This list is not exhaustive, and it may be that there are other developments in the vicinity have heat networks with spare capacity that it may be viable to connect to. Applicants should contact developments in the vicinity to enquire about such opportunities and provide evidence of correspondence with the operator, as specified above, as an appendix to the energy assessment.
- 10.7. The carbon factor associated with the heat supplied by a network should be obtained from the network operator and be provided in the energy assessment. This should be accompanied by the assumptions used to derive the carbon factor including estimated heat losses. For each heat source, the proportion of heat provided by the source, the generation plant efficiencies and the type of fuel used should all be provided.

²² www.londonheatmap.org.uk

Planned networks

- 10.8. If no existing network is present, the applicant must investigate whether such a network is planned in the area. Reference must be made to the relevant borough's heat mapping report (available to download at: <https://www.london.gov.uk/what-we-do/environment/energy/london-heat-map/resource-library>) as well as energy master plans or similar studies carried out involving the borough (e.g. Royal Docks). Enquiries should also be made to appropriate contacts within the relevant borough and evidence of correspondence should be included in the energy assessment. Examples of planned networks include Vauxhall Nine Elms Battersea and Euston Road network.
- 10.9. Where connection is proposed to a planned network the applicant should provide the information in paragraphs 10.5 - 10.7. Should there be no information on the network performance available applicants should make reasonable assumptions on what the anticipated end use will be.
- 10.10. Where a network is planned, or in areas of decentralised energy potential, developments must demonstrate that they are designed to connect to it. The London Heat Network Manual (available at: www.london.gov.uk/what-we-do/environment/energy/london-heat-map) provides further information on designing developments to allow connection to district heating networks.
- 10.11. Section 9.2 of the London Heat Network Manual contains guidance on an approach that can be adopted when a new development falls within an energy master plan area (EMP) that proposes a district heating network.
- 10.12. Where a development is within an area that could be supplied by a district heating network but the applicant is contending that providing a site-wide heat network to allow future connection will result in uneconomic costs to end users, the applicant must provide a whole life cost (WLC) analysis comparing the communal and individual systems. See Appendix 1 for further details of how this must be approached. Although WLC results will vary on a case by case basis, modelling usually shows that WLC of well-designed heat networks and individual boilers are broadly similar for high density developments. Where the WLC of the site-wide heat network is broadly similar to that of individual gas boilers the network will not be considered uneconomic. Where it can be demonstrated and evidenced that the WLC of the site-wide heat network is significantly higher than that of individual gas boilers and would undermine the development going ahead, the site-wide heat network may be deemed uneconomic. However, the WLC analysis and assumptions will be subject to intense scrutiny before such a conclusion is drawn.
- 10.13. Whilst there may appear to be no prospect of a district heating network in the vicinity, all developments will be required to provide a site-wide heat network (see below) to enable the buildings to be supplied from on-site low and zero carbon

energy sources. There may be an exception for smaller developments, where it is demonstrated that a site-wide heat network is uneconomic.

Site-wide heat networks

- 10.14. Developments should provide a site-wide heat network served by a single energy centre, which will help to facilitate later connection of a development to an area-wide district heating network as it is less costly than retrofitting the site for connection at a later date. For developments made up of a single building a building-level heat network will be required.
- 10.15. The following three scenarios provide examples of how development with different locational and other characteristics can demonstrate a policy compliant response in relation to site-wide heat networks. Information on what information is required where a site-wide heat network is applicable is provided in paragraph 10.26 and information relating to phased to developments and designing heat network infrastructure is provided in paragraph 10.32 and 10.33 respectively.

Scenario 1: Development in areas where there are established plans for district heating

- 10.16. Where a development is to be located in an area where a heat network is being delivered or there are firm plans for a heat network that are proceeding to implementation²³, the development should incorporate a site-wide heat network and install a compatible temporary heat source until the development connects to the area wide heat network. The installation of permanent low carbon heating plant (such as CHP engines or heat pumps) should be avoided in this scenario as it could impact the financial viability of connection. However, if the development itself is of a scale that it will be the catalyst for the implementation of the area-wide heat network then a low carbon generation heat source should be incorporated. See Appendix 3 for information on the circumstances in which gas-engine CHP would not be suitable.
- 10.17. Although an on-site low carbon heat technology may not form part of the energy strategy in these circumstances, the 35 per cent CO₂ reduction target will still apply to the new development. In this situation, for the purposes of demonstrating compliance with meeting the target, the developer may include the carbon dioxide emission reductions from connection to the network in the assessment. However, at the planning stage a point must be agreed by which connection must be made. This could be set as:
- A stated number of years following occupation of the development
 - A particular date
 - An agreed trigger point, e.g. occupation of the Xth dwelling.

²³ Equivalent to cases B and C in section 9.2 of the London Heat Network Manual.

- 10.18. If connection is not made by the agreed point, the developer should install an on-site low carbon generation heat source to achieve the CO₂ reductions originally envisaged from connection to the heat network. Alternatively, the developer may:
- Pay a cash-in-lieu contribution to the borough. The value of the contribution should be the product of the envisaged CO₂ reductions from connection to the heat network and the price of CO₂ applied by the Borough; or
 - A combination of the above two options.
- 10.19. The principles set out above should be agreed between the developer, the borough and the GLA prior to the granting of planning approval and clearly set out within the section 106 agreement for the development.

Scenario 2: Development in an area of decentralised energy potential but no firm plans for a heat network exist

- 10.20. Developers will be expected to provide a site-wide heat network served by a single energy centre in order to future proof the development for easy connection to a wider heat network in the future. The type of heat source to be installed in the energy centre (e.g. heat pumps, CHP, ultra-low NO_x gas boilers) will depend on the technical feasibility of different low carbon heat technologies and the carbon savings being targeted. The scale and mix of uses on site will impact on the feasibility of different technologies. Appendix 3 provides specific information on the feasibility of low carbon and renewable technologies.
- 10.21. Developments greater than 800 dwellings are typically at a scale that would interest an ESCO and applicants should consider engaging with ESCOs to discuss the potential of supporting the construction and operation of the site-wide heat network.

Exceptions under scenarios 1 and 2

- 10.22. Where a development contains small commercial/retail units, i.e. total area <500m², as is often the case on the ground floor of a residential tower block, it is not necessary to connect these to the site-wide heat network. These units are often categorised as shell and core at the planning stage and, when built out, have very small heating demands which are usually met by air source heat pumps. For these unit types connection is encouraged, but not mandated due to the small benefit in terms of carbon reduction in these circumstances. Where connection is not proposed the applicant should outline how the units will be futureproofed for connection i.e. capped connections or space for future pipes.
- 10.23. Depending on the density of development, it may not always be appropriate to connect individual houses to heat networks. This is due to the higher network heat

losses that typically occur when supplying individual houses compared to apartments. They also have a higher cost of connection.

Scenario 3: Development in areas where an area wide heat network is not proposed and which is not within an area of decentralised energy potential

- 10.24. There are geographic areas where, due to the type and/or low density of the buildings, district heating will not be implemented in the future. Examples of such areas include areas of detached/semi-detached housing or industrial estates with unheated buildings. If it can be clearly and unequivocally demonstrated that the development is not within an area that will be supplied by a district heating network in future, for example where only individual existing houses surround the development, it will not be necessary to make provision for future connection. Each case will be considered on its own merits.
- 10.25. In such areas, an on-site heat network may still be applicable to a given new development, if this is of sufficient size and density to benefit from a decentralised heating solution (e.g. a high density development located in close proximity to a waste heat source) or medium to large scale residential led, mixed use developments. Alternatively, a communal heat network within each individual building may be more appropriate. This will be considered on a case by case basis.

Information required where a site-wide heat network is applicable

- 10.26. The site-wide heat network should be supplied from a single energy centre where all energy generating equipment is located. A single energy centre will facilitate a connection (whether immediately, or at a later date) to an area wide district heating network as well as reduce maintenance and operating costs. Accordingly, the energy assessment must demonstrate that enough space has been allocated for a sufficiently large energy centre. This must be clearly shown on the plan drawings of the development and the floor area in m² should be confirmed in writing. A floor plan showing the layout of the plant in the energy centre should also be provided to demonstrate sufficient space has been allowed for the specified equipment and, where applicable, additional equipment to be installed in future.
- 10.27. Applicants are required to use the design heat loss within the energy calculations, which should be based on the pipe length of the total network (both buried and block pipework), design temperatures (including any design summer time temperature reduction) and the level of insulation proposed. Full details should be provided in the energy assessment.
- 10.28. It is important that options for reducing the distribution losses are incorporated at planning stage as it will be largely dependent on the building design, for instance optimising circulation spaces to reduce the lateral pipe length. Therefore, the heat loss calculation must be based on the length of distribution pipes rather than a percentage estimate.

- 10.29. In order to further reduce distribution losses the use of variable flow control systems to lower flow rates and lower return temperatures at part-load must be investigated and included within the heat loss calculation. At the design stage it is recommended that careful attention is paid to ensure systems operate with low return temperatures, in line with the CIBSE Heat Networks: Code of Practice for the UK²⁴.
- 10.30. Heat network solutions can benefit from the inclusion of thermal storage. This provides useful balancing for low carbon technologies, and also helps in the case of heat from renewable and secondary heat sources that may be intermittent.
- 10.31. Applicants should explain how the heat network will be future-proofed to achieve zero carbon and the timeline for achieving this.

Phased developments

- 10.32. Networks that will be implemented in phases should seek to implement one energy centre large enough for the entire site. A simple schematic of the site-wide heat network showing all apartments and non-domestic buildings/uses connected into it, as well as the location of the energy centre, must be provided as part of the energy assessment. Where the applicant can provide evidence that a single energy centre is not feasible they must seek to minimise the number of energy centres and explain how the network will evolve across the development's phasing programme, including indicative timescales. Schematics should be provided showing how the network will evolve.

Designing heat network infrastructure

- 10.33. Poorly designed heat network infrastructure within a building, e.g. a residential tower block, can contribute towards internal overheating problems and high service charges. To avoid this, developers should commit to designing and delivering communal heating systems in compliance with the CIBSE Heat Networks: Code of Practice for the UK and in partnership with energy services companies that are or are working towards being registered participants of the Heat Trust²⁵.

CIBSE Heat Networks Code of Practice

- 10.34. The Heat Networks Code of Practice has been developed to improve the quality of feasibility studies, design, construction, commissioning and operation of heat networks in the UK by setting minimum requirements and identifying best practice options. Network losses should be investigated at the earliest opportunity as they have significant implications on the efficiency of the network (both cost and CO₂) and also the thermal comfort of occupants.

²⁴ <http://www.cibse.org/knowledge/cibse-other-publications/cp1-heat-networks-code-of-practice-for-the-uk>

²⁵ <http://www.heattrust.org/index.php>

- 10.35. The Code of Practice includes recommendations on designing to minimise pipe lengths (particularly lateral pipework in corridors of apartment blocks), using low temperature systems and adopting pipe configurations selected to minimise heat loss e.g. twin pipes. The level of pipework insulation is also identified in the Code of Practice as a key issue and designers are expected to target levels of insulation significantly beyond building regulation and British Standard requirements in order to stay within the heat loss levels identified in the Code of Practice.
- 10.36. The London Heat Network Manual also provides useful guidance on the approach to be taken when specifying pipework insulation.

The Heat Trust

- 10.37. The Heat Trust was established in November 2015 from collaboration between industry, consumers and government with the aim to establish a common standard in the quality and level of protection given by heat supply contracts. The Trust is also intended to offer heat network customers an independent process for settling disputes. The Heat Trust mark is a sign that the heat supplier has agreed to abide by the standards set out in the Scheme.

Air quality

- 10.38. As well as carbon dioxide emissions, all combustion processes can emit oxides of Nitrogen (NO_x) and, solid or liquid fuelled appliances (such as those using biomass or biodiesel) can also emit Particulate Matter. These pollutants contribute to London's poor air quality and can have negative impacts on the health of local residents and occupiers of the development. It is important that these impacts are taken into account in designing the energy strategy of a development.
- 10.39. The GLA has set emission limits for boilers, gas engines, turbines and solid and liquid biomass which need to be met in all developments. These emission limits are summarised in Appendix 6.
- 10.40. However, meeting these emission limits will not always be sufficient to prevent unacceptable levels of local impact and it is strongly recommended that the development of the energy strategy is co-ordinated with the air quality impact assessment or environmental impact assessment for the development.
- 10.41. The design and location of energy centres for communal or district heating networks has a key role to play in reducing air quality impacts; simple measures such as placing the flue on the tallest element of the development can greatly aid dispersion and reduce impacts. Where connection to an existing district heating system is proposed any additional impact on air quality from an increase in capacity or usage should be considered.
- 10.42. In order to assist the assessment of air quality impacts in line with existing London Plan policy and the Sustainable Design & Construction SPG, Table 14 should be

completed and provided in an appendix to the energy assessment. To ensure that the air quality assessment is as robust as possible it is important that the figures provided account for the total input, for instance the proportion of gas consumed in generating electricity from any proposed CHP plant must be included in the table. It may also be necessary to provide additional information on the location, design and proposed technology for the energy centre to the client or their air quality consultants to further assist the air quality assessment.

Energy source	Total fuel consumption – residential	Total fuel consumption – non-residential
Grid electricity	MWh/year	MWh/year
Domestic/communal gas boilers	MWh/year	MWh/year
Gas CHP	MWh/year	MWh/year
Connection to existing DH network	MWh/year	MWh/year
Other gas use (e.g. cookers)	MWh/year	MWh/year

11. Renewable energy (Be Green)

- 11.1. Energy assessments should set out consideration of and commitment to installing renewable energy technologies in line with Policy 5.7 of the London Plan. Within the main body of the energy assessment, detailed site specific analysis should only be provided for those renewable energy technologies considered feasible. Site specific analysis for those technologies not considered feasible should be included in an appendix.
- 11.2. The GLA expects all major development proposals to maximise on-site renewable energy generation. This is regardless of whether a 35 per cent target has already

been reached through earlier stages of the energy hierarchy. In particular, solar PV should be maximised on roof spaces.

11.3. Information required on renewable energy generation:

- An assessment of what is achievable and compatible with the measures already implemented in steps one and two of the energy hierarchy should be provided.
- Applicants should provide calculations to demonstrate that their chosen renewable system or systems will reduce CO₂ emissions. The percentage CO₂ reduction from renewable energy should be expressed relative to the Part L 2013 regulated energy baseline (see Table 3).
- High efficiency systems (e.g. state of the art PV panel models) and innovative technologies should be considered in the interest of maximising on-site CO₂ reductions.
- If a number of renewable energy technologies are proposed, it will be important to demonstrate how they will work in tandem and, where applicable, how they will be integrated into a heat network (for heat generating technologies) and, again where applicable, also how they will integrate with a cooling system/strategy.

11.4. Appendix 3 provides further guidance in relation to detailed requirements for particular types of renewable energy systems. Where a particular type of renewable energy system is proposed, the relevant section should be consulted and required information provided as part of the energy assessment.

11.5. For the avoidance of doubt, heat pumps are categorised under this third and final element of the energy hierarchy (not the first element, “be lean”).

12. Carbon offsetting

12.1. Once the GLA is satisfied that the CO₂ reduction targets cannot feasibly or viably be met on-site, a commitment should be made to ensure the shortfall is met off-site, or a payment is made into the borough’s carbon offset fund. Tables 2 and 5 and the related text above provides further information on how both the annual and cumulative shortfall in tonnes of CO₂ savings should be calculated.

12.2. The applicant should explain in the energy assessment which offsetting approach will be undertaken and provide evidence of discussions with the borough’s energy officer. Boroughs may agree that the developer can directly offset any shortfall in carbon dioxide reductions from a development by installing carbon dioxide savings measures off-site, e.g. photovoltaic panels on a local school. Whichever approach is used, the guidance in the Sustainable Design and Construction SPG should be followed.

- 12.3. A cash in lieu payment should not be used as a cost comparison with delivering CO₂ savings on-site. Policy 5.2 requires carbon reductions to be achieved as far as possible on-site and a cash in lieu contribution will be considered acceptable only in instances where it has been clearly demonstrated that no further savings can be achieved on-site. In the case of the zero carbon target for homes, a minimum of 35% carbon savings are expected to be delivered on site. The remaining savings to reach zero carbon can be achieved either on site or via a cash in lieu contribution, although savings on site are preferable.
- 12.4. The GLA has published guidance for boroughs on establishing carbon offset funds²⁶ building on the guidance contained in the Sustainable Design and Construction SPG. It also includes guidance for boroughs on how to establish a carbon offsetting fund and identify suitable projects to be funded.
- 12.5. Where boroughs have not established a local price for offsetting carbon, a figure of £60/tonne for a period of 30 years should be applied as recommended in the SPG²⁷. The GLA will regularly review the recommended carbon offset price.

13. Monitoring

- 13.1. Developers are strongly encouraged to monitor energy use during the occupation of their developments and incorporate monitoring equipment to enable occupants to monitor and reduce their energy use. Displayed energy use within individual units in residential developments will allow occupants to understand the way in which they consume energy and how much it costs.
- 13.2. Further information on monitoring energy use can be found in the Sustainable Design and Construction SPG. Developers should also investigate incorporating technology that would enable demand side response.

²⁶ https://www.london.gov.uk/sites/default/files/carbon_offset_funds_guidance_2018.pdf

²⁷ Boroughs should be aware that the GLA has tested a new carbon offset price of £95 per tonne as part of the new draft London Plan viability assessment, To view the progress of the new London Plan go to: <https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan>

Glossary

Building Emissions Rate (BER) or Dwelling Emission Rate (DER) - the actual building/dwelling CO₂ emission rate. It is expressed in terms of the mass of CO₂ emitted per year per square metre of the total useful floor area of the building (kg/m²/year). In order to comply with Part L of the Building Regulations, the BER/DER must be less than the TER (see below).

Combined Heat and Power (CHP) - defined as the simultaneous generation of heat and power in a single process.

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

Energy assessment/strategy – an energy assessment/strategy is a document which explains how the London Plan targets for CO₂ reduction will be met for a particular development within the context of the energy hierarchy.

Individual gas boiler – a gas boiler is installed in a dwelling or a non-domestic building to provide the property with heat. In this case natural gas (rather than hot water) is piped to the property.

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

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

Other low carbon heat technology – in the context of this document, this is intended to be any waste heat source that could be used to serve a heat network, potentially with the use of heat pumps to increase the output. For example, waste heat recovered from the waste incineration process, or from transformers.

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

Regulated CO₂ emissions – The CO₂ emissions arising from energy used by fixed building services, as defined in Approved Document Part L of the Building Regulations. These include fixed systems for lighting, heating, hot water, air conditioning and mechanical ventilation.

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

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

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

Target CO₂ Emission Rate (TER) - the minimum energy performance requirement for a new dwelling/building. It is expressed in terms of the mass of CO₂ emitted per year per square metre of the total useful floor area of the building (kg/m²/year).

Zero carbon homes - homes forming part of major development applications (i.e. those with 10 or more units) where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site²⁸. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be offset through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere (in line with policy 5.2E).

²⁸ In line with policy 5.2B and the Sustainable Design and Construction SPG (April 2014) guidance on conversion of the policy to Part L 2013.

References

London Plan

<https://www.london.gov.uk/what-we-do/planning/london-plan>

Sustainable Design and Construction SPG

https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/Sustainable%20Design%20%26%20Construction%20SPG.pdf

London Heat Network Manual (2014)

https://www.london.gov.uk/sites/default/files/london_heat_map_manual_2014.pdf

London Heat Map

<http://www.londonheatmap.org.uk/>

Energy Monitoring Reports

<https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/energy-planning-monitoring>

Carbon Offset Funds guidance

https://www.london.gov.uk/sites/default/files/carbon_offset_funds_guidance_2018.pdf

Appendix 1

Required approach to whole life costing

This section provides information on how whole life costing (WLC) must be approached where the developer claims that adopting communal heating will result in uneconomic costs to end users. It provides broad guidance on how the WLC must be approached - individual assumptions will be subject to scrutiny.

The WLC analysis should be conducted over a 30 year period, with the heat network assumed to have a lifespan of at least this duration. The residual value of the heat network and, where applicable, the alternative individual boilers at the end of the analysis period should be taken into account.

The discount rate should reflect the sources of finance that will be used to implement the system, e.g. for social housing funded by government grant a 3.5 per cent discount rate should be assumed in line with HM Treasury Green Book guidance.

The analysis must take into account:

- Initial installed capital cost - for the heat network this would typically be expected to be around £5,500 per apartment. This excludes the costs of internals downstream of the hydraulic interface unit (HIU) which should be assumed to be the same as those for an individual boiler. Cost estimates should be obtained from established district heating installation companies.
- Replacement costs – an individual boiler will typically be replaced twice during the lifetime of a heat network.
- Annual fuel costs – due to bulk purchasing communal boilers will have a lower unit gas cost than individual gas boilers.
- Annual operation and maintenance costs.
- Annual meter reading and billing administration costs – for heat networks this would not be expected to be greater than £80 per dwelling per annum.

In determining the annual fuel costs for the heat network option reasonable assumptions must be made regarding the heat loss and efficiency of the communal boilers. Best practice design should be assumed for the heat network e.g. low temperatures, twin pipes, etc. The case specific heat loss should be estimated for the particular project in question.

Appendix 2

Ensuring waste to energy plants are heat network ready

Some developments whose purpose is to process waste will also produce fuel (e.g. bio gas) and combust the fuel to produce electricity. This will usually be via an engine or, in larger scale installations, a boiler to produce steam for a steam turbine. To achieve energy efficient operation in the future, it is essential that these facilities are designed with a heat off take facility, i.e. a design which allows useful heat produced during the electricity generation process to be recovered. In such circumstances, the primary purpose of the energy assessment is to provide details of the heat off take facility, e.g. plant description, heat output capacity, technical drawings, etc. This will vary depending on whether an engine or steam turbine is to be used:

- Engine - the facility will need to incorporate an exhaust gas heat exchanger and heat exchangers to recover heat from the engine cooling systems.
- Steam turbine - the turbine will need to allow the extraction of steam at a temperature/pressure suitable for raising the flow temperature in a district heating network to 110°C. The ratio of lost electricity output to useful heat output must be provided for the turbine (analogous to the coefficient of performance for a heat pump).

It will also be necessary to identify a route for district heating pipework to run to the perimeter of the site. The route needs to be sufficiently wide for flow and return pre-insulated steel pipes, of sufficient internal diameter to allow the export of the full heat output of the plant, to be accommodated and be designed in accordance with the London Heat Network Manual. Space should also be provided to accommodate pumps and heat exchangers.

Carbon intensity floor

In line with Policy 5.17B, facilities generating energy from waste need to perform better in CO₂ equivalent terms than the energy they are replacing to achieve a positive carbon outcome. The Mayor has developed a minimum CO₂ equivalent emissions performance for such facilities to achieve, known as a carbon intensity floor, set at 400g of CO₂ equivalent per kWh of electricity generated from waste. Generally, waste facilities operating in combined heat and power or using a high amount of biomass fuel will meet the carbon intensity floor.

Performance against the carbon intensity floor will be used to determine whether waste to energy facilities are in general conformity with Policy 5.17B. The GLA has developed a free tool that applicants can use to test a limited number of scenarios against the carbon intensity floor. The tool, along with more information on the carbon intensity floor and ways to meet it, can be found at <https://www.london.gov.uk/what-we-do/environment/waste-and-recycling/waste-policy>.

In relation to those planning applications containing proposals to generate energy from waste, the primary consideration for the energy assessment is that the electricity generation plant is designed with a heat off take facility to provide heat to an existing or future district heating network and space for heat exchangers, pumps and pipes to the edge of the site – see Appendix 2 – and has a costed strategy for how this will be done.

For those developments which process waste for onward product delivery, the energy assessment should only cover those buildings (or parts thereof) which are not exempt from the energy efficiency requirements of building regulations²⁹. For non-exempt buildings the guidance set out in this document must be followed in line with the energy hierarchy. For the purposes of the energy assessment, process loads are classified as unregulated energy uses.

Developments generating industrial waste heat

For those planning applications relating to developments which generate surplus waste heat, for example industrial applications such as the Tate and Lyle Sugar Refinery, the primary consideration for the energy assessment is again, that the development is designed to allow the supply of heat to existing or future district heating networks. The development should identify a route for pipework to run to the perimeter of the site and space should also be provided to accommodate district heating pumps and heat exchangers.

²⁹ Exempt buildings include industrial buildings where the space is not generally heated other than by process heat: See Appendix C of Approved Document L2A Conservation of Fuel and Power 2013 Edition.

Appendix 3

Guidance on different types of technologies

Details required in relation to photovoltaic applications

The following information is required where photovoltaic panels are proposed:

- Drawings showing the amount of roof that is available within the development and that could be used to install photovoltaic modules with suitable orientation and lack of shading. The shading analysis should include an assessment of the height of existing buildings and any permissions granted for buildings near the application site.
- Quantification of the amount of roof area that could be used to install photovoltaic modules.
- An estimate of the electricity that the photovoltaic modules will generate including the assumptions for the calculations.
- A calculation of the CO₂ savings that may be realised through the use of this technology.

Details required in relation to solar thermal

The following information is required where solar thermal is proposed:

- Clarification on how the solar thermal collectors will operate alongside the heating system being proposed by the applicant
- Drawings showing the amount of roof that is available within the development and that could be used to install solar thermal collectors with suitable orientation and lack of shading
- Quantification of the amount of roof area that could be used to install solar collectors
- An estimate of the heating requirements that the solar thermal collectors may provide including the assumptions for the calculations
- A calculation of the CO₂ savings that may be realised through the use of this technology.

Details required in relation to air source heat pumps

Where the use of air source heat pumps (ASHPs) is considered appropriate, a high specification of energy efficiency will be expected to ensure the system operates efficiently and to reduce peak electricity demand. The following information will also be required:

- Clarification as to how the ASHP will operate alongside any other heating/cooling technologies being specified for the development (i.e. how will the ASHP operate alongside communal heating systems, and/or combined heat and power plant, solar thermal, etc. if they are also being proposed by the applicant)

- An estimate of the heating and/or cooling energy the ASHP would provide to the development and the electricity the heat pump would require for this purpose
- Details of the Seasonal Coefficient of Performance (SCOP) and Seasonal Energy Efficiency ratio (SEER), which should be used in the energy modelling. This should be based on a dynamic calculation of the system boundaries over the course of a year i.e. incorporating variations in source temperatures and the design sink temperatures (for space heat and hot water). Details of the assumptions should be included in the energy assessment, including manufacturer datasheets showing performance under test conditions for the specific source and sink temperatures of the proposed development and assumptions for hours spent under changing source temperatures.
- Whether any additional technology is required for hot water top up and how this has been incorporated into the energy modelling assumptions.
- Evidence that the heat pump complies with the minimum performance standards as set out in the Enhanced Capital Allowances (ECA) product criteria for the relevant ASHP technology³⁰
- Evidence that the heat pump complies with other relevant issues as outlined in the Microgeneration Certification Scheme Heat Pump Product Certification Requirements document at: <http://www.microgenerationcertification.org>
- A calculation of the CO₂ savings that may be realised through the use of this technology.
- An estimate of the expected heating costs to occupants, demonstrating that the costs have been minimised through energy efficient design.
- Confirmation that end-users will be supplied with regular information to control and operate the system e.g. at point of occupancy and maintenance visits
- The expected heat source temperature and the heat distribution system temperature with an explanation of how the difference will be minimised to ensure the system runs efficiently.
- Confirmation of the approach to generating domestic hot water and the integration of thermal storage.
- A commitment to monitor the performance of the heat pump system post-construction to ensure it is achieving the expected performance approved during planning. (It is recommended that boroughs condition this).

Details required in relation to ground/water source heat pumps

Where the use of ground source heat pumps (GSHPs) is considered appropriate, a high specification of energy efficiency will be expected to ensure the system operates efficiently and to reduce peak electricity demand. The following information will also be required:

- Clarification on how the GSHP will operate alongside any other heating/cooling technologies being specified for the development and alongside communal heating systems being proposed by the applicant

³⁰ https://etl.beis.gov.uk/engetl/fox/live/ETL_PUBLIC_PRODUCT_SEARCH

- An estimate of the heating and/or cooling energy the GSHP may provide to the development and the electricity the heat pump would require for this purpose.
- The estimation of the amount of heating/cooling that the GSHP may supply should be supported with the following information:
 - For closed loop systems an indication of the land area available that would be required to install the required number of boreholes. Where possible, the ground conditions of the specific site should be taken into account for the calculations.
 - For open loop systems (including aquifer thermal storage systems) the flow rate of water that is available on-site. It should be used to estimate the amount of heating/cooling the system could provide.
- Details of the Seasonal Coefficient of Performance (SCOP) and Seasonal Energy Efficiency ratio (SEER), which should be used in the energy modelling. This should be based on a dynamic calculation of the system boundaries over the course of a year i.e. incorporating variations in source temperatures and the design sink temperatures (for space heat and hot water). Details of the assumptions should be included in the energy assessment, including manufacturer datasheets showing performance under test conditions for the specific source and sink temperatures of the proposed development and assumptions for hours spent under changing source temperatures.
- Whether any additional technology is required for hot water top up and how this has been incorporated into the energy modelling assumptions.
- A calculation of the CO₂ savings that may be realised through the use of this technology.
- Confirmation that the site geology is suitable for ground source heat pumps.
- Also evidence of the likelihood of a permit being granted by the Environment Agency, where required.
- An estimate of the expected heating costs to occupants, demonstrating that the costs have been minimised through energy efficient design.
- Confirmation that end-users will be supplied with regular information to control and operate the system e.g. at point of occupancy and maintenance visits
- The expected heat source temperature and the heat distribution system temperature with an explanation of how the difference will be minimised to ensure the system runs efficiently.
- Confirmation of the approach to generating domestic hot water and the integration of thermal storage.
- A commitment to monitor the performance of the heat pump system post-construction to ensure it is achieving the expected performance approved during planning. (It is recommended that boroughs condition this).

Guidance and details required in relation to Combined Heat and Power (CHP)

CHP is one of various technology options that could be selected to produce the heat to serve district heat networks. Gas-engine CHP has been the most commonly used

technology to serve heat networks to date. As the electricity grid decarbonises the carbon savings achieved from gas-engine CHP will decrease and with growing concerns of the impact of the technology on air quality, applicants will be expected to utilise other low carbon technologies that make use of local secondary heat sources using heat pumps. Other forms of low-emission CHP, such as fuel cell CHP, may also come forward in the future and are encouraged.

Gas-engine CHP may still be an appropriate energy solution for area-wide heat networks due to the greater electrical efficiencies achievable at a larger scale. Developments that have the potential to connect to a district heating network served by gas-engine CHP will continue to be expected to do so and to maximise carbon reductions from the 'be lean' and 'be green' elements of the energy hierarchy. Longer-term, it is expected that such systems will be replaced with lower carbon alternatives. Any applications based on gas engines technology will be expected to provide sufficient information to justify its use and ensure that the carbon and air quality impact is minimised, for example through the selection of a lower emission unit and use of abatement technology.

The following types of development will not be considered appropriate for gas-engine CHP:

- **Small-medium residential developments:** At this scale it is generally not economic to install CHP in residential led, mixed use developments (and where CHP is installed it tends to have lower electrical efficiencies and therefore higher carbon emissions). There are also growing concerns about the air quality impacts of gas-engine CHP at this scale. In addition, due to the small landlord electricity demand, CHP installed to meet the base heat load would require the export of electricity to the grid. However, the administrative burden of managing CHP electricity sales at this small scale where energy service companies (ESCOs) are generally not active, and the low unit price available for small volumes of exported CHP electricity, means it is generally uneconomic for developers to pursue. This can lead to CHP being installed but not operated.
- **Non-domestic developments with a simultaneous demand for heat and power that do not have a year round base load for optimum operation of CHP:** Examples of such developments may include offices and schools. CHP will not be applicable in these circumstances.

Information required where CHP is applicable

Where CHP is applicable, detailed information should be provided in the energy assessment including the size of the engine proposed (kWe/kWth), the provision of any thermal store and suitable monthly demand profiles for heating, cooling and electrical loads, cost benefit analysis, carbon reduction benefits, etc. The plant efficiencies used when modelling carbon savings should be the gross values rather than the net values often provided by manufacturers. The size of the CHP must be optimised based on the thermal load profile before renewable energy systems are considered for the site. CO₂

savings from the CHP must be expressed as a percentage reduction on the regulated emissions of the Part L 2013 compliant development.

Cross referencing the Air Quality Assessment, the energy assessment should confirm that the NO_x emission standards set out in the SPG on Sustainable Design and Construction will be met. It is expected that exhaust treatment systems will be needed to meet the emission standards. This is likely to have significant spatial implications so the energy assessment should include details about the exhaust treatment methods specified and how these will be accommodated on site. It is expected that CHP plant will be required to demonstrate that the installed system meets these limits by emissions testing prior to occupation. The energy assessment should include a commitment that the CHP operator will be required to monitor and provide evidence on a yearly basis, in the form of an annual maintenance report, to demonstrate continued compliance with the emission limits. (It is recommended that boroughs condition this).

Details of the commercial operation of the CHP, such as information on how any sales of power will be managed should also be provided (this is particularly important where power is being exported to the local distribution network). Where appropriate, details of communication with ESCOs must also be supplied.

Developers should explain how the heat network will be future-proofed to achieve zero carbon and the timeline for achieving this.

Supplying heat beyond the site boundary

Applicants should investigate opportunities for supplying heat outside the site boundaries, particularly if this has the potential to facilitate an area wide heat network. Applicants could look in particular for opportunities to link to existing developments to help reduce their carbon dioxide emissions and this could help developments that can't meet their carbon reduction targets on-site to meet them off-site.

Very large mixed-use developments can often be the catalyst for heat networks serving the wider area. These developments can make best use of CHP and opportunities for the export of heat should be fully explored. In these circumstances, sufficient allowance should be made in sizing the energy centre and site-wide heat network infrastructure to allow for expansion of the network to serve a wider area in the future.

Details required in relation to biomass application and biomass emissions standards

Please refer to the Mayor's Air Quality Strategy, section 7.14 of the London Plan and relevant sections of the Sustainable Design and Construction supplementary planning guidance for more detail on air quality requirements.

Development proposals should be at least 'air quality neutral', not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas (AQMAs)), and create opportunities to improve local air quality. They

should minimise exposure to existing poor air quality and make provision to address local problems of air quality (particularly within AQMAs and where development is likely to be used by large numbers of those particularly vulnerable to poor air quality)³¹.

Where the use of biomass is proposed, the biomass boiler must meet the Mayor's biomass standards as set out in the SPG on Sustainable Design and Construction.

Details required in relation to liquid biofuel applications

Where the use of biofuel is considered appropriate the following information will also be required:

- Details of the manufacturer's warranty for the use of the proposed liquid bio-fuel in the CHP unit chosen.
- Confirmation of the blend and standard of biofuel to be used (typically B100 BS EN 14214).
- Details of potential supplier(s) of the bio-fuel to be used and written confirmation that they can supply the required quantities.
- Information relating to the maintenance regime of the CHP as a consequence of biofuel use.
- Review air quality implications of bio-fuel with borough air quality officers.
- Information relating to the sustainability and carbon intensity of the bio-fuel in line with the Government's Renewable Transport Fuel Obligation (RTFO) carbon and sustainability methodology for bio-fuels.
- Details of how the fuel will be stored on site.
- The running costs of a CHP utilising biofuel will typically be higher than a conventional CHP engine using natural gas. Confirmation that this increased running cost has been acknowledged and that it will not affect the proposed operation of the CHP is required.

Details required in relation to wind energy applications

Where the use of wind energy is considered appropriate the following information will be required:

- Estimation of the wind resource on-site at turbine height. The use of the UK Wind Speed (NOABL) Database on its own is unlikely to be appropriate to estimate the wind resource for the majority of wind energy applications in London. Instead, methodologies that modify the wind resource considering the type of terrain (flat terrain, farm land, suburban, urban etc) and surrounding obstacles should be used.
- Drawings showing the wind turbine location and height in relation to the surrounding structures and including the predominant wind directions

³¹ Clearing the air. The Mayor's Air Quality Strategy, December 2010, <http://www.london.gov.uk>

- An estimate of the electricity that the wind turbine/s modules may generate calculated using the estimated wind resource and the wind turbine characteristics i.e. power curve if available or a specific turbine swept area.
- A calculation of the CO₂ savings that may be realised through the use of this technology.

Appendix 4

Offsetting

The Carbon Offset Funds guidance document provides further information for boroughs on establishing carbon offset funds and selecting projects for funding. This document builds on the guidance contained in the Sustainable Design and Construction SPG.

London Plan Policy 5.2 sets out that where the required percentage improvements beyond Part L of the Building Regulations are not met on-site, any short fall should be provided off-site or through a cash-in-lieu contribution to the relevant borough.

Boroughs may agree with a developer for the developer to directly offset any shortfall in carbon dioxide reductions from a development by installing carbon saving measures off-site, e.g. photovoltaic panels on a local school.

To maximise the reduction in carbon dioxide emissions in London, boroughs should establish a planning related carbon dioxide reduction fund and set a price at which the carbon dioxide shortfall will be calculated.

Appendix 5

Domestic overheating checklist

This checklist is intended to assist designers to identify potential overheating risk in residential accommodation early on in the design process and trigger the incorporation of passive measures within the building envelope and services design to mitigate overheating and reduce cooling demand in line with London Plan policy 5.9.

Section 1 of the checklist should be completed at the start of the design process (concept design) and should be submitted with the preliminary energy information provided to GLA at pre-app stage. Section 1 and 2 should be reviewed as the design progresses and the full checklist should be completed and included within the energy assessment submitted at stage 1 of the planning application.

Section 1 - Site features affecting vulnerability to overheating		
Site location	Urban – within central London ³² or in a high density conurbation	
	Peri-urban – on the suburban fringes of London ³³	
Air quality and/or Noise sensitivity – are any of the following in the vicinity of buildings?	Busy roads / A roads	
	Railways / Overground / DLR	
	Airport / Flight path	
	Industrial uses / waste facility	
Proposed building use	Will any buildings be occupied by vulnerable people (e.g. elderly, disabled, young children)?	
	Are residents likely to be at home during the day (e.g. students)?	
Dwelling aspect	Are there any single aspect units?	
Glazing ratio	Is the glazing ratio (glazing: internal floor area) greater than 25%?	
	If yes, is this to allow acceptable levels of daylighting?	

³² Urban - as defined in CIBSE Guide TM49. Broadly equivalent to Central Activities Zone and Inner London areas in Map 2.2 of the London Plan.

³³ Peri-urban – as defined in CIBSE Guide TM49. Broadly equivalent to Outer London areas in Map 2.2. of the London Plan.

Security - Are there any security issues that could limit opening of windows for ventilation?	Single storey ground floor units	
	Vulnerable areas identified by the Police Architectural Liaison Officer	
	Other	

Section 2 - Design features implemented to mitigate overheating risk		Please respond
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	
	Will green roofs be provided?	
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	
Materials	Have high albedo (light colour) materials been specified?	
Dwelling aspect	% of total units that are single aspect	
	% single aspect with N / NE / NW orientation	
	% single aspect with E orientation	
	% single aspect with S / SE / SW orientation	
	% single aspect with W orientation	
Glazing ratio - What is the glazing ratio (glazing; internal floor area) on each facade?	N / NE / NW	
	E	
	S / SE / SW	
	W	
Daylighting	What is the average daylight factor range?	
Window opening	Are windows openable?	
Window opening	What is the average percentage of openable area for the windows?	
Window opening - What is the extent of the opening?	Fully openable	
	Limited (e.g. for security, safety, wind loading reasons)	
Security	Where there are security issues (e.g. ground floor flats) has an alternative night time natural ventilation method been provided (e.g. ventilation grates)?	

Shading	Is there any external shading?	
	Is there any internal shading?	
Glazing specification	Is there any solar control glazing?	
Ventilation - What is the ventilation strategy?	Natural – background	
	Natural – purge	
	Mechanical – background (e.g. MVHR)	
	Mechanical – purge	
	What is the average design air change rate	
Heating system	Is communal heating present?	
	What is the flow/return temperature?	
	Have horizontal pipe runs been minimised?	
	Do the specifications include insulation levels in line with the London Heat Network Manual ³⁴	

³⁴ http://www.londonheatmap.org.uk/Content/uploaded/documents/LHNM_Manual2014Low.pdf

Appendix 6

These emission limits are extracted from the GLA “Sustainable design and construction” SPG 2014 and presented here for information. The SPG may be updated from time to time and you should always check the GLA website for up to date guidance.

NO_x and PM₁₀ emissions limits for heating plant

As well as meeting the carbon reduction targets, it is important that emissions of Oxides of Nitrogen (NO_x) and Particulate Matter (PM₁₀) from heating and energy plant are minimised to reduce impacts on London’s air quality. A tiered approach has been developed for applicable emission standards based upon differentiation according to the baseline air quality in the area of development.

Emissions limits are summarised in the table below, full details of these limits and other technical standards needed to ensure the proper dispersion of pollutants from plant used in heating and power systems can be found in the GLA Supplementary Planning Guidance “Sustainable Design and Construction”.

Type of appliance	Emissions limit: NO _x	Emissions Limit: PM ₁₀	Where it applies
Boiler ^A	40 mg/kWh	-	All developments
Spark ignition engine (natural gas/biogas) ^B	250 mg/Nm ³	-	Annual Mean NO ₂ > 5% below national objective
Spark ignition engine (natural gas/biogas) ^B	95 mg/Nm ³	-	Annual Mean NO ₂ between 5% below or above national objective
Compression ignition engine (diesel/bio-diesel) ^B	400 mg/Nm ³	-	All developments
Gas turbine ^C	50 mg/Nm ³	-	Annual Mean NO ₂ > 5% below national objective
Gas turbine ^C	20 mg/Nm ³	-	Annual Mean NO ₂ between 5% below or above national objective
Solid biomass boiler ^D	275 mg/Nm ³	25 mg/Nm ³	Annual Mean NO ₂ and PM ₁₀ > 5% below national objective

Solid biomass boiler < 1MW _{th} input ^D	180 mg/Nm ³	5 mg/Nm ³	Annual Mean NO ₂ and PM ₁₀ between 5% below or above national objective
Solid biomass boiler ≥ 1MW _{th} input ^D	125 mg/Nm ³	5 mg/Nm ³	Annual Mean NO ₂ and PM ₁₀ between 5% below or above national objective

^A Combustion appliances operating less than 500 hours per annum are exempt from these standards

^B Emission standard quoted at reference conditions 273K, 101.3kPa, 5% O₂, dry gas

^C Emission standard quoted at reference conditions 273K, 101.3kPa, 15% O₂, dry gas

^D Emission standard quoted at reference conditions 273K, 101.3kPa, 6% O₂, dry gas

It should be noted that while it is necessary to meet these limits they may not be sufficient to prevent unacceptable local impacts on local air quality. The impact of communal and district heating systems with one or more energy centres should be considered as part of the Air Quality Impact Assessment or Environmental Impact Assessment for the development.

Other formats and languages

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

Public Liaison Unit

Greater London Authority

City Hall

The Queen's Walk

More London

London SE1 2AA

Telephone **020 7983 4100**

www.london.gov.uk

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

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