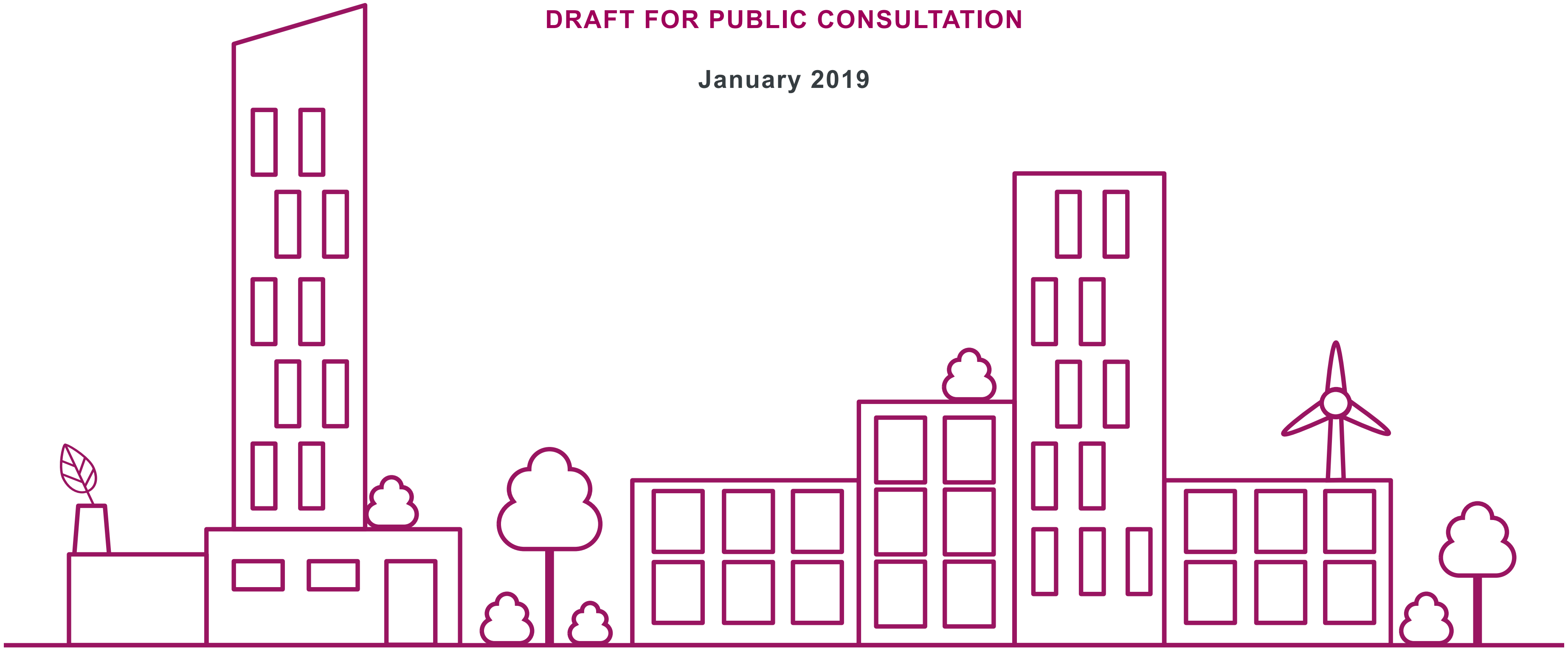
OPDC
OLD OAK AND PARK ROYAL DEVELOPMENT CORPORATION

Passive Energy Performance, Daylight and Overheating in High-Density Development

Supplementary Planning Document

DRAFT FOR PUBLIC CONSULTATION

January 2019



MAYOR OF LONDON

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1 Introduction

WHEN AND HOW TO RESPOND

1.1. Public consultation runs from:

10 January to 22 February

1.2. Respond by email to:

planningpolicy@opdc.london.gov.uk

1.3. Respond by post to:

SPD Consultation
Old Oak and Park Royal Development Corporation,
City Hall,
Queen's Walk,
London SE1 2AA

HOW TO FIND OUT MORE

Visit our website

1.4. This SPD can be read and downloaded from:

www.london.gov.uk/opdcconsultations

View a hard copy

1.5. Paper copies of the SPD consultation documents are available to view during normal office hours at the following locations:

- Brent Civic Centre, Engineers Way, Wembley, HA9 0AF;
- City Hall, Queens Walk, London, SE1 2AA;
- Ealing Council Offices, Perceval House, 14/16 Uxbridge Road, W5 2HL; and
- Hammersmith Town Hall, King Street, W6 9JU;
- Harlesden Library, Craven Park Road, NW10 8SE.

1.6. Alternatively, hard copies can be made available on request by contacting OPDC, either via email or by post (see above).

What is the role of the SPD?

1.7. The SPD provides supplementary planning guidance to OPDC's Local Plan to:

a) Add further detail to Local Plan's polices in the Strategic, Design and Environment and Utilities Chapters;
b) Ensure that proposals deliver development which meets the London Plan and Local Plan carbon targets, is future proofed against climate change and delivers high quality homes and work space.

1.8. The SPD covers:

a) passive energy standards;
b) daylight standards; and
c) management of heat risk;

with specific reference to high density development.

1.9. This document has been produced by OPDC. The guidance will be applied to all development proposals in the OPDC area.

Supporting Evidence documents

1.10. This SPD is supported be the following documents:

- OPDC Energy, Daylight and Overheating in Tall Buildings Study[1]
- OPDC Environmental Standards Study[2]
- London Environment Strategy[3]
- AECOM, GLA Energy Efficiency Target, development case studies report[4]
- Driving Energy Efficiency Savings Through the London Plan summary report and data analysis report[5]

What is the timetable?

- 10 January to 22 February 2019 – Consultation on the draft SPD
- Summer 2019 – Envisaged SPD Adoption

1: london.gov.uk/sites/default/files/16._energy_overheating_and_daylight_in_tall_buildings_study_2018.pdf
2. london.gov.uk/sites/default/files/17._environmental_standards_study_0.pdf
3. london.gov.uk/sites/default/files/london_environment_strategy.pdf
4. london.gov.uk/sites/default/files/gla_energy_efficiency_target_-_development_case_studies_-_aecom.pdf
5. london.gov.uk/sites/default/files/driving_energy_efficiency_savings_through_the_london_plan_-_data_analysis_report_-_buro_happold_.pdf

Figure 1.1: SPD Structure

1. INTRODUCTION
Sets out the status of the SPD, consultation information and context.

2. VISION AND OBJECTIVES
Sets out the vision and key objectives.

3. CHALLENGES
Sets out the challenges of meeting environmental and wellbeing standards.

4. GUIDANCE
Comprised of 'Principles' and 'Ambitions'.

- The Principles reflect and build on the Mayor's London Plan and OPDC Local Plan requirements, as well as incorporating relevant national guidance. Applicants will be expected to achieve these core principles.
- The Ambitions set out more proactive approaches that applicants could take. Applicants are not required to accord to these ambitions but OPDC as the Local Planning Authority would work with applicants to encourage them to do so.

5. DELIVERY AND IMPLEMENTATION
Highlights the specific approaches that could be taken by applicants to achieve the core principles and ambitions in chapter 3. It includes case study examples of the trade-offs between passive energy, daylight and overheating within a high density context.

APPENDICES

- Appendix 1: Check list of information that should be provided by applicants within their Sustainability Statements
- Appendix 2: Relevant Local Plan and London Plan policies
- Appendix 3: Case study example
- Appendix 4: Further detail on options to optimise passive energy, daylight and reduce overheating, including viability information.
- Appendix 5: Glossary

STATUS OF THE SPD

Legal status

1.11. This document is a Supplementary Planning Document (SPD). Part 5 of the Town and Country Planning (Local Planning) (England) Regulations 2012 sets out the procedure for the production of SPDs. This version of the SPD constitutes the consultation version required to be carried out under Regulation 12.

1.12. A Strategic Environmental Assessment (SEA) screening of the SPD has been carried out. This identifies that an SEA is not required.

Guidance status

1.13. The guidance in this SPD is a material consideration for the determination of planning applications alongside relevant policies in the OPDC Local Plan, the National Planning Policy Framework (NPPF), London Plan, West London Waste Plan DPD, any 'made' Neighbourhood Plans and any other supplementary guidance.

1.14. The guidance in this SPD is consistent with the National Planning Policy Framework (NPPF) and does not conflict with the policies in the London Plan (2016), the Draft New London Plan (2017) or OPDC's Local Plan.

1.15. The SPD supplements guidance within the NPPF, London Plan, Local Plan and other SPDs. Therefore, this SPD should be read in conjunction with these documents.

1.16. The guidance period for the SPD aligns with the Local Plan period from 2018 to 2038.

CONTEXT

1.17. The Mayor of London has set policy in the London Plan for all development to be zero carbon. In addition, providing good quality daylight into units and ensuring development does not suffer from overheating are identified as important risks to provision of good quality development by the Mayor.

1.18. There is a high risk of poor energy performance, daylight standards and overheating in high-density developments. The reasons for this are set out in section 3 on Challenges.

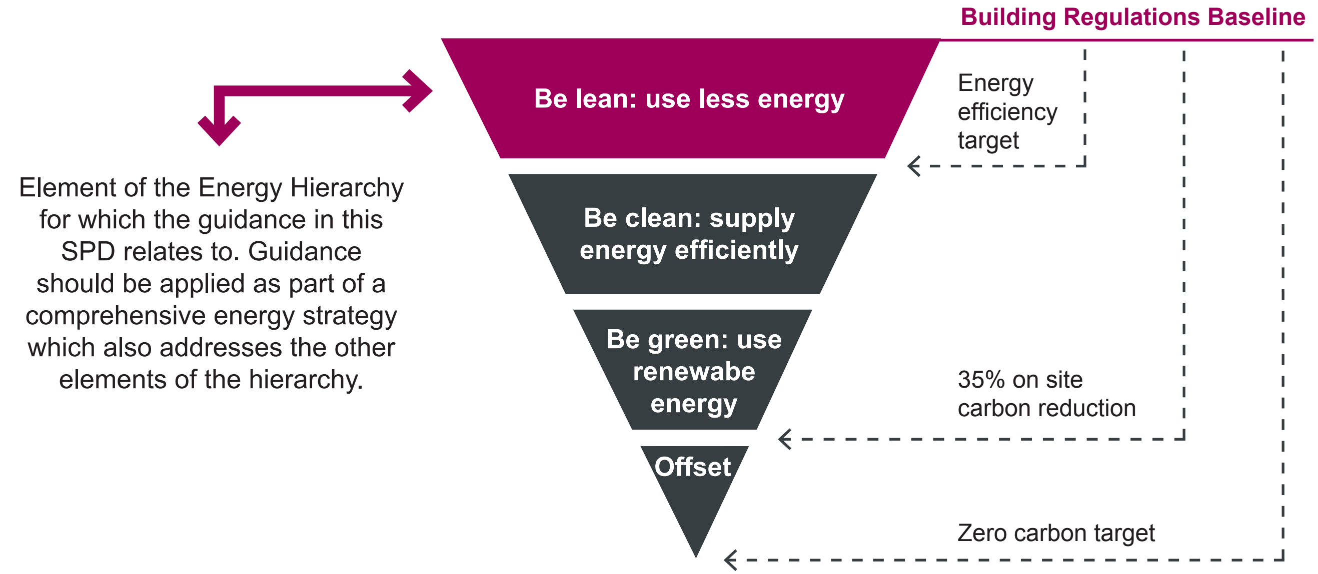
1.19. Problems are particularly acute in single aspect units which are common in large blocks. This impacts on ventilation and the ability of daylight to penetrate apartments.

1.20. The problem is often exacerbated by poor in-use performance. Research by the Zero Carbon Hub on the energy performance[6] and overheating[7], suggests that design standards for passive energy and overheating are often not achieved in practice. The research suggests that residential development emits on average 2.6 times more carbon and non-residential 3.6 times more carbon than estimated during design using the Standard Assessment Procedure (SAP).

1.21. The impact of poor performance on residents and workers health and wellbeing can be significant as people spend as much as 90% of their time in buildings.

1.22. The research by the Zero Carbon Hub showed that buildings which prioritise passive energy measures to reduce carbon emissions tend to have a smaller performance gap than those relying on active measures. In addition, the Mayor of London is promoting higher passive energy performance as the most effective way to achieve its zero carbon targets, reduce heating bills for residents and and increase urban resilience to impacts like climate change.

Figure 1.2: Energy Hierarchy (Draft New London Plan)



1.23. OPDC therefore believe it is important to actively promote high passive energy performance measures, good daylight standards and design that will reduce the risk of overheating in both residential and non-residential buildings.

6: zerocarbonhub.org/sites/default/files/resources/reports/Closing_the_Gap_Between_Design_and_As-Built_Performance-Evidence_Review_Report_0.pdf
7: zerocarbonhub.org/current-projects/tackling-overheating-buildings

Figure 1.3: External moveable shading - Gasholders, Kings Cross

2 Vision and Objectives

VISON

Development within the OPDC area will achieve the highest standards possible in passive energy design, natural daylight levels and in mitigating the risks of overheating.

OBJECTIVES

This SPD provides guidance on how to:

1. improve passive energy performance and reduce costs associated with the running of residential and non-residential buildings by adopting enhanced targets for energy efficiency in line with the London Plan;
2. promote good daylighting, thereby improving the occupants' quality of life whilst reducing the amount of energy used to artificially light development;
3. mitigate the risk of high temperatures in buildings using current and future climate scenarios and ensure steps are taken to prevent overheating;
4. optimise the trade-off between good daylight standards, risk of overheating and carbon emissions;
5. achieve high passive energy design, daylight and thermal comfort standards using solutions that are commercially viable; and
6. close the gap between the estimated and actual energy consumption in building, known as the 'performance gap'.

OUTCOMES

The outcomes that the guidance seeks to deliver includes:

1. reduced energy costs for occupants;
2. reduced environmental impact over the life of the development;
3. reduced risk to indoor occupier comfort, and improved health and wellbeing;
4. reduced need for air-conditioning and the associated increase in operation costs and carbon emissions; and
5. reductions in CO2 emissions in line with the Mayor of London's ambitions.

3 Challenges

3.1. The proposed level of investment in transport infrastructure and the planned public transport accessibility improvements, on a brownfield site in zone 2/3 west London, provides a strong rationale for the design and delivery of new high-density development including new tall buildings in appropriate locations.

3.2. To achieve the homes and jobs targets for the area, the Development Capacity Study by OPDC shows that densities will have to achieve 450 units per hectare on average across the OPDC area. Densities will range across the area, with lower densities and building heights in more sensitive locations and increased densities and building heights away from sensitive locations and in areas of high public transport accessibility

3.3. The development will include a range of building heights including tall buildings (defined as 15 residential storeys or 48 metres or more above ground level).

3.4. High density development poses several challenges including high energy demand to operate tall buildings; provision of adequate daylight in shaded aspects of development blocks; and the difficulty in designing out risk of overheating especially in unshaded south and west elevations.

3.5. The key challenges for residential and non-residential buildings are summarised in Table 3.1.

Table 3.1: Key challenges in residential and non-residential buildings

Residential	Non-Residential
» Residential units typically have high heating and hot water demands. They often use gas fired combined heat and power (CHP) systems to meet these demands. CHP is becoming less carbon efficient in relation to mains electricity and conventional boilers as electricity from the national grid decarbonises. CHP systems can also impact on local air quality. » Heat loss from heat networks within buildings is common due to poor internal heat pipe design and lagging, and poor performance of heat interface units. » High density developments and tall buildings have limited roof space for solar power and heat. » South and west aspects in dense development are prone to overheating, whilst north-facing units have increased heating demands but are less prone to overheating. » Dense multi storey developments often have a preponderance of single aspect dwellings especially in large blocks which can compound the risk of overheating due to lack of natural ventilation and poor daylight penetration. » Daylight levels are often poor in units that are overshadowed. » Floor to ceiling glazing can contribute to overheating, especially on south and west facing elevation.	» The most effective way to meet good passive energy standards in non-residential development is to adopt best practice in lighting design. However, lighting specifications are often determined by the occupant who may not be willing to invest in low carbon lighting systems. » Use of passive cooling measures (like natural ventilation), which reduce energy demand, can be unreliable on warm days. » In deep plan buildings it can be difficult to get good levels of daylight into the centre of the building. » Depending on the degree of shading in offices and retail units, it is often difficult to provide sufficient daylight without impacting on overheating. » The guidance below is designed to ensure these challenges are addressed by applicants

4 Guidance

4.1. The guidance sets out Principles and Ambitions for both residential and non-residential development. Proposals will be required to comply with Principles. The Principles are designed to ensure development complies with London Plan standards, or where standards doesn't exist, good practice guidance, for example, BRE daylight guidance and CIBSE standards for overheating.

4.2. Ambitions set out more ambitious requirements which proposals aren't required to adopt. These are designed to encourage developers to create buildings that deliver very high standards in health and wellbeing and to address the gap between modelled and actual performance in buildings.

4.3. To ensure all passive energy design, adequate daylight and heat risk have been considered, planning applications will be assessed in accordance with the checklist in Appendix 1. All relevant information should be provided to show compliance with the required principles and ambitions. Where relevant information is not available at the time of application, planning permission may be granted subject to information being provided during the detailed design phase of the development.

Principles

R1 To reduce carbon emissions using passive energy measures, proposals should:

a) comply with the London Plan energy policies adopted at the time and specifically policies on passive energy requirements; and
b) achieve 10% or greater carbon reduction against the most current version of Part L of the Building Regulations through energy efficiency measures; (this target has been set by the London Plan and may change from time to time as further evidence is developed)

R2 To deliver good daylight, proposals should maximise the use of dual aspect units and ensure that all single aspect units provide good quality daylight into all habitable rooms and achieve:

a) an average daylight factor of 1% for bedrooms, 1.5% for living rooms and 2% for kitchens; and
b) a minimum of 15% Vertical Sky Component at the centre of the largest window where daylight is required.

R3 To minimise overheating risk, proposals should:

a) avoid development of single aspect units where possible and demonstrate that in all units the risk of overheating has been assessed and mitigated and good levels of ventilation are provide;
b) demonstrate that the design complies with CIBSE TM59, based on Design Summer Year 1(DSY1) 2020 weather files, high emissions and the 50% percentile scenario; and
c) demonstrate how the GLA cooling hierarchy has been followed to reduce and mitigate overheating risk.

R4 To optimise environmental design, proposals should demonstrate through modelling how the proposed design aims to balance the priorities for carbon reduction, adequate internal daylight and a reduction in the risk of overheating.

R5 To ensure compliance with these principles, proposals should:

a) demonstrate compliance with the daylight and overheating principles as part of an applicant's Daylight, Sunlight and Microclimate Assessment; and
b) demonstrate compliance with the carbon emissions reduction principles as part of an applicant's Sustainability Statement.

Ambitions

Proposals are encouraged to take additional measures to:

R1 further reduce regulated and unregulated carbon emissions including:

a) undertaking in-use energy performance modelling at design development stage using either CIBSE guidance or empirical data to identify the potential performance gap; and
b) aiming to exceed the London Plan on-site carbon targets and achieve carbon reductions greater than 10%, through energy efficiency measures.

R2 exceed minimum daylight standards by:

a) avoiding development of any north facing single aspect units;
b) maximising daylighting in shaded locations, aiming to achieve an average daylight factor of more than 1.5% in living spaces whilst mitigating overheating; and
c) use climate-based daylight simulation, aiming to maximise Useful Daylight Illuminance.

R3 minimise the risk of overheating by:

a) developing an adaptation strategy for future compliance with CIBSE TM59 or CIBSE Guide A criteria (if mechanically cooled), using 2050 weather files; and
b) demonstrating that the present-day design complies with CIBSE TM59 criteria (if naturally ventilated) or CIBSE Guide A criteria (if mechanically cooled), based on 2050 DSY weather file.

NON-RESIDENTIAL DEVELOPMENT

Principles

NR1 To reduce carbon emissions using passive energy measures, proposals should:
- a) comply with the London Plan energy policies adopted at the time;
- b) achieve 15% or greater carbon reduction against the against the most current version of Part L of the Building Regulations energy efficiency measures (this target has been set by the draft New London Plan and may change from time to time as further evidence is developed); and
- c) carry out operational energy performance modelling at design stage, to identify the potential performance gap and look at ways to reduce it.

NR2 To deliver good daylight, proposals should:
- a) demonstrate how the design has sought to optimise daylight for different types of building use within the Design and Access Statement.

NR3 To minimise overheating risk, proposals should:
- a) ensure that the design complies with CIBSE TM52 criteria (if naturally ventilated) or CIBSE Guide A criteria (if mechanically cooled), based on 2020 Design Summer Year (DSY) weather files; and
- b) demonstrate how the GLA cooling hierarchy has been followed to reduce and mitigate overheating risk.

NR4 To optimise environmental design, proposals should:
- a) demonstrate through modelling how the proposed designs aim to balance consideration of carbon, daylight and overheating.

NR5 To ensure compliance with these principles, proposals should:
- a) demonstrate compliance with the daylight and overheating principles as part of an applicant's Daylight, Sunlight and Microclimate Assessment; and
- b) demonstrate compliance with the carbon emissions reduction principles as part of an applicant's Sustainability Statement.

Ambitions

Proposals are encouraged to take additional measures to:

NR1 further reduce carbon emissions including:
- a) putting in place green lease agreements or equivalent in shell and core spaces, to ensure that fit out is designed to meet the objectives in this guidance; and
- b) aiming to exceed the on-site London Plan requirements and exceed the London Plan carbon reduction targets through energy efficiency measures.

NR2 exceed minimum daylight standards by:
- a) achieving an average daylight factor of 2% or more in all occupied spaces, where technically feasible; and
- b) using climate-based daylight simulation, aiming to maximise Useful Daylight Illuminance.

NR3 minimise the risk of overheating by:
- a) developing an adaptation strategy for future compliance with CIBSE TM52 or CIBSE Guide A criteria (if mechanically cooled), using 2050 weather files; and
- b) aiming to show that the present-day design complies with CIBSE TM52 criteria (if naturally ventilated) or CIBSE Guide A criteria (if mechanically cooled), based on 2050 DSY weather files.

SUPPORTING TEXT

4.4. In view of the importance of achieving good passive energy design, daylight and internal thermal comfort and in recognition of the challenges of achieving these targets in high density development, OPDC has produced principles to guide development.

4.5. OPDC commissioned Buro Happold to review the impact of the Draft New London Plan policy on passive energy design, adequate daylight provision and managing heat risk to understand whether it is technically and economically viable to meet the standards. OPDC's Energy, Daylight and Overheating in Tall Buildings Study[8] suggest that it is possible to achieve and potentially exceed the targets.

4.6. In residential development within the OPDC area, all development should seek to achieve or exceed a target of 10% improvement in energy performance against Part L of the Building Regulations 2013 through passive measures alone.

4.7. Meeting these targets can help reduce reliance on low carbon energy supply and renewable energy generation technologies, which can be expensive to deliver and operate.

4.8. The "Building Performance Evaluation Programme: Findings from domestic projects," 2016 research by Innovate UK, also suggests that buildings that are designed to meet high passive energy standards are more likely to achieve these standards in practice.

4.9. OPDC's Energy, Daylight and Overheating in Tall Buildings Study suggests that the most effective ways to achieve high performance targets are to:

» use triple glazed windows;
» prevent direct heat gain in summer through careful use of balconies and external shutters, whilst allowing direct solar gain in winter;
» achieve high air tightness standards and avoid cold bridging through careful detailing; and
» use mechanical ventilation and heat recovery.

4.10. These methods can all be achieved cost effectively but careful detailing and good quality construction together with training for residents about how to operate their apartment is important. Using modern methods of construction can help deliver higher performance standards.

4.11. Work by Roecklein and Rohan, entitled "Seasonal Affective Disorder (SAD): an overview and update" published 2005 in the US national Library of Medicine suggests that daylight can play a key role in mental health and wellbeing. Vulnerable residents, who may spend a lot of time in doors, can be very susceptible to SAD, which can result in depression. Standards have been established by the Building Research Establishment (BRE) based on low density development. The International Well Building Institute have developed more challenging targets and more dynamic modelling techniques to understand the amount of time good quality daylight is available within units and how far it can penetrate.

4.12. For the purposes of meeting the principles set out for daylight in residential development, applications should model the daylight using either the BRE assessment for measuring the average daylight factors, which can be found in BRE handbook, Site Layout Planning for Daylight and Sunlight, a Guide to Good Practice and British Standard BS8206-2:2. or other recognised methods. Examples of alternative modelling approaches can be found in the Environmental Framework Modelling Study[9].

4.13. In general, single aspect apartments should be avoided, as they often suffer from poor daylight towards the rear of units. This effect is particularly acute on north facing and overshadowed units.

4.14. Achieving adequate daylight standards in high density development is highly dependent on the type and position of an individual unit in relation to the block and adjoining development.

4.15. Of critical importance is the provision, where possible, of dual aspect units as this influences air flow, ventilation and daylight. Care needs to be taken to model the units that are most at risk of not meeting good daylight standards and action should be taken to mitigate against this.

4.16. Use of floor to ceiling glazing, higher floor to ceiling heights, reflective surfaces and light colours, bays, dual aspect units, internal balconies etc. can all be adopted to help increase daylight. Developments should seek to meet and where possible exceed the daylight standards and meet the Well Building Institutes daylight standards.

8: london.gov.uk/sites/default/files/16._energy_overheating_and_daylight_in_tall_buildings_study_2018.pdf
9: london.gov.uk/sites/default/files/17._environmental_modelling_framework_study_2018.pdf

4.17. Overheating has become a major concern in high-density homes. This is caused by a combination of factors including high levels of solar gain, use of floor to ceiling glazing, high levels of insulation and poor ventilation especially in single aspect apartments and heat loss from central heating systems.

4.18. The risk is likely to increase due to climate change and the urban heat island effect associated with development, which can change the micro climate and result in temperatures that are 5^{o}C or more warmer than surrounding rural areas.

4.19. In response to the growing threat of overheating, the Chartered Institute of Building Services Engineers (CIBSE) has developed tools to model the risk. These models use weather data taken from the meteorological office to predict the likelihood of overheating. The weather data uses climate change predictions to understand the potential impact of climate change on development in the future. CIBSE have developed a model called TM 59 to assess overheating risk in residential development and TM 52 to assess risk to commercial development. The draft new Mayor's London Plan recommend the use of these models for assessing overheating risk on development and OPDC expects applicants to use these modelling techniques. Currently the recommendation is that weather files generated by Exeter University that look at predictions in 2020 are used but 2050 weather files should be considered to provide additional resilience.

4.20. There are potential conflicts between design to achieve good daylight standards and design to mitigate against overheating. The choice of design approach can also impact on overall passive energy performance. Floor to ceiling glazing for example can enhance daylight levels but also increases the risk of overheating. Design approaches should therefore seek to optimise performance in all three areas rather than maximise the performance of a specific parameter.

4.21. Different strategies will need to be adopted on different buildings and parts of buildings depending on the degree of daylight and overshadowing.

4.22. A similar set of principles have been developed for non-residential development which are set out in the Energy, Daylight and Overheating in Tall Buildings Study supporting OPDC's Local Plan. The study identified that a 15% improvement over Part L of the Building Regulations 2013 is both technically achievable and viable.

4.23. The key to achieving these standards is to ensure that low carbon lighting and very efficient cooling systems are adopted. Ideally, non-residential space should be dual aspect and where spaces are overshadowed, glazing areas should be maximised.

4.24. Achieving good daylight standards can be more challenging as retail, industrial and commercial development is often very deep plan and windows are used for display in retail units. Daylight modelling will be required to demonstrate that daylight is adequate and ideally of a high quality, especially in areas where employees spend extended periods of the day working.

4.25. Overheating can be a major challenge. It is often difficult to design non-residential buildings that use passive approaches to cooling. Applicants will be expected to demonstrate that their buildings have been modelled using CIBSE TM52 and are addressing the risk of overheating whilst also minimising carbon emissions.

4.26. In some cases, it will be possible to go beyond 15% improvement in Part L through passive approaches and OPDC encourage applicants to achieve the best standards possible. Meeting the more ambitious targets will provide additional resilience over the long term.

5 Delivery and Implementation

5.1. The following section provides a summary of the measures that should be considered to meet the Principles and Ambitions outlined in the preceding section. A more detailed list of measures are set out in Appendix 5. The tables in Appendix 5 also include an analysis of the capital costs of meeting the targets.

5.2. The strategies are divided into measures that are relevant to residential and non-residential buildings.

5.3. The strategies and measures have been developed by OPDC supported by Buro Happold and Curry Brown. Extensive modelling was undertaken on a generic indicative block (see Case Study below and figures 5.1 and 5.2) to understand what measures might need to be adopted by developers to achieve passive energy, daylight and overheating standards in residential and non-residential buildings.

5.4. The solutions are not intended to be prescriptive and developers will need to commission their own modelling to understand how their building is performing against the policy targets set out above.

RESIDENTIAL DEVELOPMENT

Passive Energy Design Measures

5.5. Achieving the London Plan targets for greenhouse gas emissions will be challenging but the Energy Daylight and Overheating in Tall Buildings Study that was commissioned by OPDC and suggests that it is both technically feasible and financially viable.

5.6. The type of measures that will need to be adopted to meet the enhanced passive energy standards will vary across buildings depending on building type and context but may include:

» Use of triple glazing to enhance insulation (U-values);
» Achieving air tightness standards of 3m3/m2/hr;
» Use of whole apartment mechanical ventilation and heat recovery (MVHR);
» Calculating thermal bridging performance rather than using default values; and
» Careful placement of balconies to minimise sunlight into apartments and the need for cooling in summer whilst optimising winter sunlight.

5.7. These standards push the boundaries of conventional building performance but have been achieved on a range of schemes.

5.8. Further detail showing how the targets can be achieved is set out in two documents that are part of the evidence base supporting the draft new London Plan 2017:

» AECOM, GLA Energy Efficiency Target, development case studies report[10].
» Driving Energy Efficiency Savings Through the London Plan summary report and data analysis report[10].

Daylight Measures

5.9. The challenges of meeting good daylight standards are closely related to the position of the residential unit in a block and the proximity of adjacent buildings, which impact on the amount of overshadowing.

5.10. In exposed locations with good sky views (e.g. higher floors in tall building), it is possible to achieve good or even very good daylight (as measured by an Average Daylight Factor (ADF) >1.5% -5%) with a variety of glazing ratios and g-values. In these situations, overheating is likely to be a significant issue and design therefore needs to focus on managing that risk whilst maintaining a good quality of daylight.

5.11. In high density developments, the lower floors of a building can be susceptible to overshadowing. In these cases, meeting the target can be challenging, especially in single aspect units.

5.12. Potential design solutions in areas that receive low levels of daylight include:

» Increasing the glazing area;
» using glass with high visible light transmittance;
» using projecting balconies rather than inset balconies;
» using reflective surfaces on the outside of surrounding buildings whilst ensuring glare is appropriately addressed; and
» increasing floor to ceiling heights.

5.13. Generally, dual aspect units perform best at the lower floors of buildings, in part because they typically have more glazing and because the daylight is more evenly distributed.

10: https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/examination-public-draft-new-london-plan/eip-library

Overheating Measures

5.14. The risks of climate change coupled with the impact of high-density development on the micro climate (the urban heat island effect), together with high thermal performance, high levels of solar exposure and potential for prevalence of single aspect apartments, can result in a significant risk of overheating in new developments.

5.15. This can be addressed by adopting design solutions that mitigate the risk. Developers should adopt the GLA's cooling hierarchy and avoid where possible the need for air conditioning over the life of the development. (See Appendix 2, London Plan Policies, SI4 B)

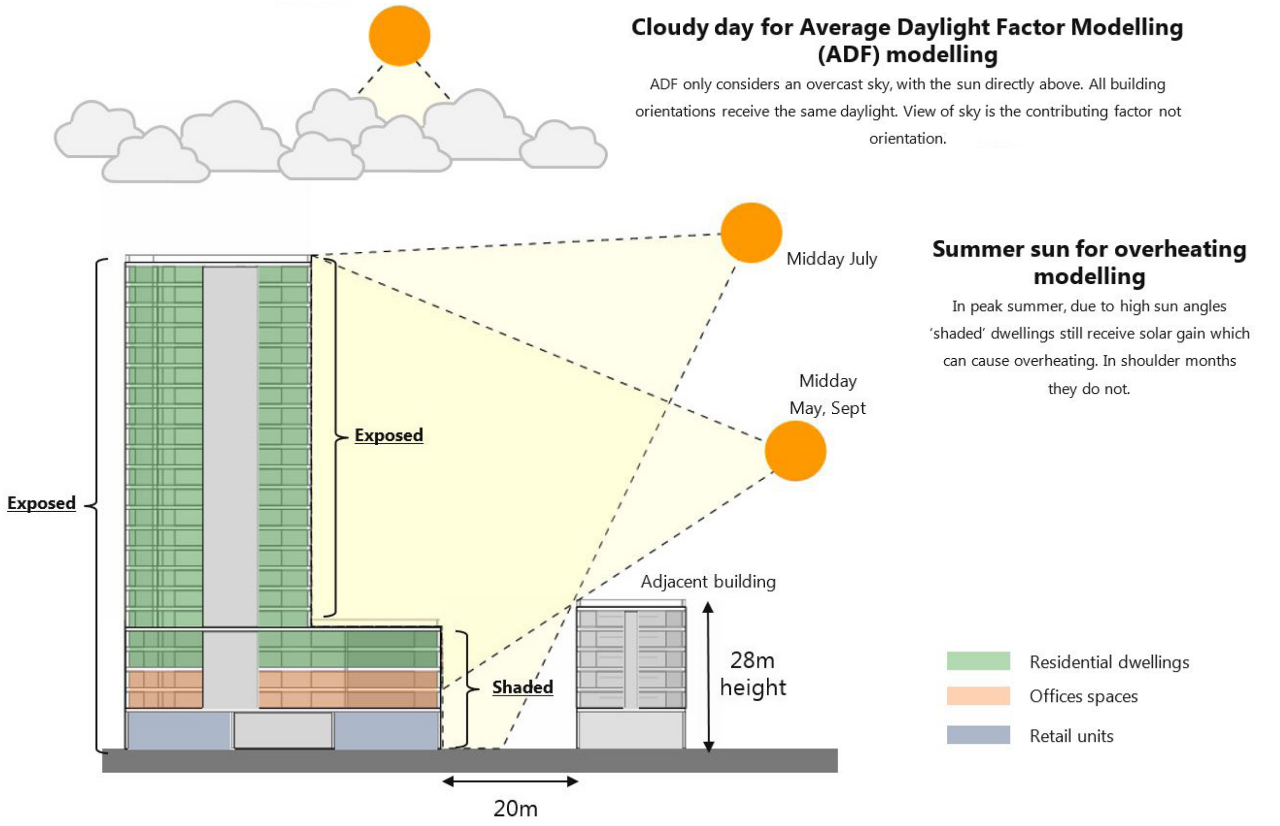
5.16. The challenge of achieving good thermal comfort standards as defined in CIBSE TM59 (using 2020 DSY data) will vary greatly depending on orientation; north and north-east facing elevations are at minimal risk of overheating; east, south-east and north-west elevations are at medium risk of overheating and south, south-west and west elevations are at high risk of overheating.

5.17. In medium risk elevations the glazing ratio should be no greater than 25% of the floor area.

5.18. In high risk elevations it can be extremely challenging to pass the CIBSE TM 59 assessment for overheating, and bespoke project specific solutions will need to be identified. Options could include:

- Use of tilt and turn windows and windows that can be opened at the top and bottom to increase ventilation rates;
- Use of carefully positioned thermal mass;
- Careful positioning of windows so where possible they are shaded by balconies as illustrated in Figure 5.4;

Figure 5.1: Diagram showing exposed and shaded areas within a generic high-density building



- Use of external shutters and other movable shading features; and
- G-values for glazing will need to vary depending on risk and whether a space is single or dual aspect. On dual aspect units it is best to focus glazing on one primary facade and limit glazing on the secondary facade to the maximum needed to achieve good daylight and ventilation standards.

5.19. It is most difficult to prevent overheating in three-bedroom apartments where occupancy rates can be high, which increases internal heat gain.

5.20. Overheating can also be an issue where air quality and noise are poor and creating good cross ventilation is difficult. In these scenarios, it is likely that air conditioning or mixed mode systems will be needed and measures minimise carbon emissions should be adopted.

Optimising the balance between passive energy design, providing adequate daylight and managing heat risk

5.21. Trade-offs will need to be made between passive energy performance, daylight and overheating. Detailed modelling should therefore be carried out to identify apartments at risk and to review the impact of different design solutions in optimising the building and individual units against all three requirements.

5.22. In exposed locations at the top of a high-density developments and tall buildings, there is an abundance of daylight so the key challenge is designing to minimise overheating.

5.23. Lower down a building, where the sky view is poorer but high sun can still cause overheating at the height of summer, greater effort needs to be placed on optimising daylight whilst ensuring overheating does not become an issue.

5.24. On south and west-facing elevations, where it can be most challenging to balance all three considerations, a potential design approach could include:

» Triple glazing;
» Mechanical Ventilation with Heat Recovery (MVHR) instead of Mechanical Extract Ventilation (MEV);
» Air tightness < 3m3/m2/hr;
» Thermal bridging calculated instead of using default values;
» Glazing area <35%;
» G value = 0.3;
» Single aspect one bed units potentially preferred in this context but needs consideration against wider policy objectives; and
» Introduction of further passive design measures such as thermal mass, external movable shading, optimised window design to maximise ventilation rates.

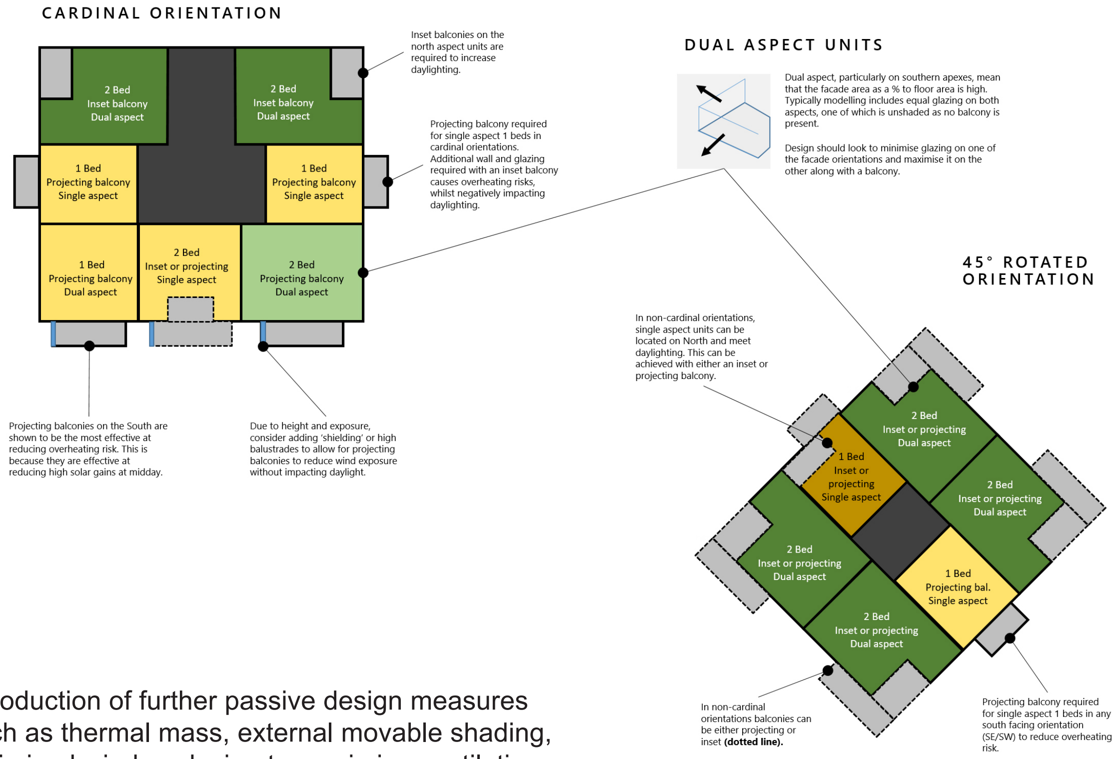
5.25. A more detailed list of solutions can be found in Appendix 3, tables 2 and 3.

5.26. Applicants should consider from the outset whether it is possible to adjust the orientation of blocks and buildings to enhance daylight performance whilst reducing the risk of overheating.

5.27. Adjusting orientation can alter solar exposure and therefore risk of overheating. An example of a design option that is impacted by orientation is the position of balconies. On a building that faces north-south it is best to use projecting balconies on east, south and west facing facades and internal balconies on north facing apartments.

5.28. Where orientation is rotated by 45 degrees there is more scope to use inset balconies. Where possible developers should consider orientating their buildings to minimise the impact of overheating. Figure 5.2 shows how orientation can change the design response.

Figure 5.2: Relationship between building orientation and balcony layout



5.29. One of the key ways in which daylight and overheating can be addressed is to adjust the glazing ratio.

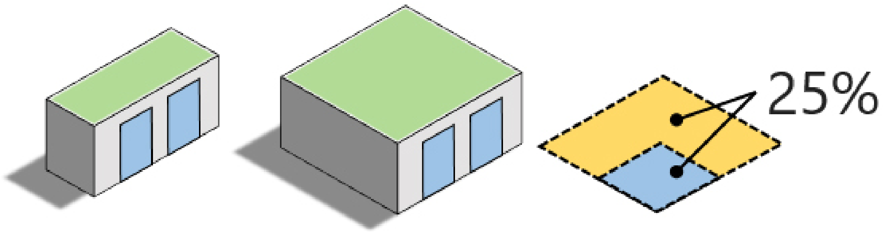
5.30. To optimise glazing ratios, the area of glazing should be defined in relation to floor area rather than external wall area, as this better reflects the internal layout of the unit.

5.31. Figure 5.3 provides guidance on the glazing ratios that should be used for different size of unit and whether a unit is single or dual aspect and in a shaded or exposed location.

5.32. The location of glazing is also important and can have a significant impact on both daylight and overheating. Dual aspect units have a higher risk of overheating especially in south-west corners due to increased solar exposure across long periods of the day. This is most significant during summer in evenings when residential units are occupied.

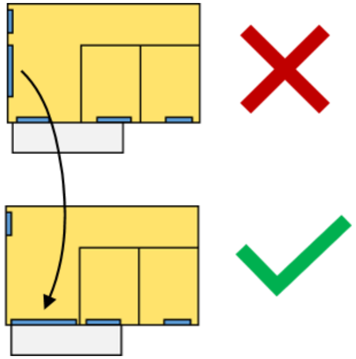
5.33. Different locations and façades should have different glazing/ fenestration strategies. In order to reduce overheating risk in an exposed dual aspect apartment, glazing on the secondary facade should generally be minimised. Glazing could be moved for example to an area shaded by a balcony (see figure 5.4). In shaded locations where daylighting is challenging additional glazing could be added to increase daylight uniformity.

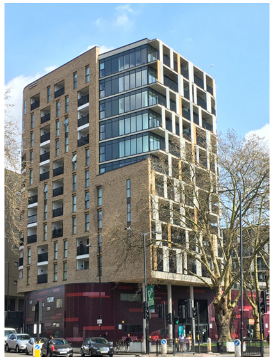
Figure 5.3: Area showing glazing ratio in relation to floor area



GLAZING RATIOS BY UNIT SIZE	GLAZING RATIOS BY SOLAR EXPLORE
Glazing ratios as a % of floor area is a more useful metric to understand performance compared to a % of external wall. This accounts for floor plan depth and unit size relative to facade area. **1 Beds:** Set glazing area to be 25% or internal floor area, to minimise overheating and provide greatest flexibility in facade specification. **2 Beds:** Glazing ratio should be more stringent due to increased number of people in the apartment. Glazing ratio of 15 to 25% of internal floor area.	Glazing ratio in shaded locations: - 30% to 35% (single aspect units) - 25% to 35% (dual aspect units) A glazing ratio of above 25% of floor area is required to meet good daylighting. A glazing ratio of lower than 35% of internal floor area is required to reduce overheating risk Glazing ratio in exposed locations: - 20% to 35% (single aspect units) - 15% to 25% (dual aspect units) Dual aspect units gain higher solar gains for longer periods of time, therefore glazing ratios should be reduced on these units to reduce overheating in exposed locations.

Figure 5.4: Windows carefully positioned to minimise risk of overheating





NON-RESIDENTIAL DEVELOPMENT

Passive Energy Targets

5.34. In many offices and retail units it is technically feasible to meet the 15% energy efficiency carbon reduction target set out in the Draft New London Plan (2017).

5.35. The target may be more challenging in other non-residential building types like schools and industrial premises, but understanding the impacts will require detailed investigation. The Draft New London Plan target is approximately in line with the performance required for BREEAM Outstanding, which is challenging but achievable.

5.36. The most effective way to achieve the target in naturally ventilated non-residential buildings is to adopt best practice lighting design (with high efficacy and daylight/occupancy controls). This can reduce CO2 emissions by as much as 50% compared to a Building Regulation compliant development. However, developers are not always responsible for fitting out units and will therefore need to work with leaseholders and tenants to ensure best practice lighting is adopted.

5.37. In conditioned spaces, auxiliary and cooling consumption are a major contributor to carbon emissions alongside lighting. Measures designed to save carbon also often reduce solar gains. Solutions can include reducing the glazing g-value from 0.5 to 0.3, which can reduce carbon emissions by 3% or more.

5.38. Other opportunities to reduce cooling demand include reducing glazing areas and using high efficiency systems to reduce fan energy.

5.39. These measures should be achievable without impacting significantly on the capital cost of construction and will reduce operating costs (see Appendix 4).

Daylight Standards

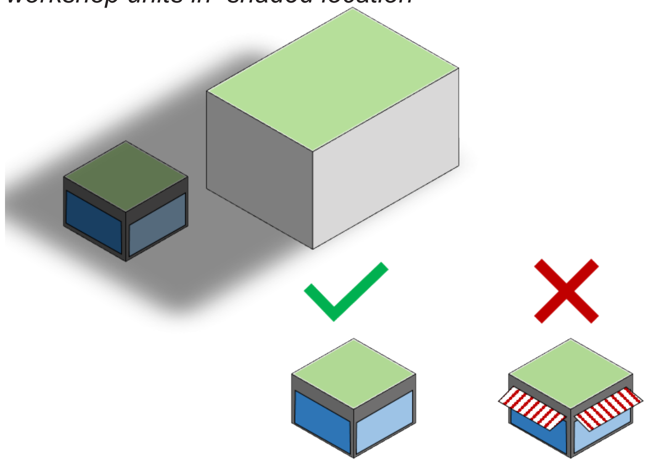
5.40. Where non-residential buildings are not overshadowed by adjacent buildings, it is possible to deliver minimum daylight levels (an average daylight factor of at least 2%) and, often, Well Building standards for daylight. More detail can be found in the Well Building Standard[11] which is used in the USA and increasingly in good quality development in the UK.

5.41. Town centre units tend to have higher average daylight factors compared to offices and industrial units as they generally have a shallower floorplate.

5.42. Overshadowing by adjacent buildings can have a considerable impact on daylight. This can be a significant issue for non-residential development in mixed use buildings as non-residential floorspace is often located on the lower floors.

5.43. Single aspect units are most at risk of poor daylight, and it is possible that in tall high-density development, very few spaces will achieve a 2% daylight factor. Dual aspect units are therefore preferable in locations with poor sky views.

Figure 5.5: Shading requirements in town centre and workshop units in shaded location



To meet the minimum daylighting requirements in shaded retailed locations:

- *Position town centre and workshop units in dual aspect locations (increasing active frontage)*
- *Minimise horizontal shading and fins*
- *If shading is used ensure it is retractable*

Overheating Standards

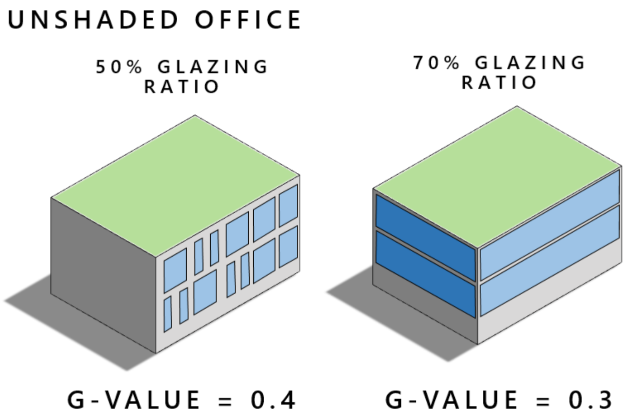
5.44. Overheating of non-residential space is a serious risk. The impact of orientation is significant. South-facing units and dual aspect south and south-west facing units are particularly prone to overheating, whereas north and north-east orientations are generally at low risk.

11: https://www.wellcertified.com/sites/default/files/resources/WELL Building Standard - Oct 2014.pdf

5.45. Design solutions to address overheating include:

- Providing a sufficient area of openable windows and positioning windows to provide cross ventilation;
- using thermal mass in carefully positioned areas to absorb heat coupled with night-time cooling;
- specifying glazing to minimise direct solar gain;
- balancing the area of glazing with the G-value (see figure 5.6)
- Providing external shading.

Figure 5.6: Balancing G-value in glazing with area of glazing



In unshaded locations, modelling has shown that daylight is not critical. However overheating risk and cooling loads for Part L needs to be controlled. The following should be done to meet all criteria, especially in South-facing spaces:

- *G-value should be balanced with glazing ratio on single or dual aspect*
- *Resultant G-value of 0.2 (factor of glazing ratio, shading and G-value of glass)*
- *Occupant control of blinds*
- *Mixed mode strategy or provide comfort cooling if overheating risk still present*

Optimising the balance between passive energy design, daylight and overheating

5.46. OPDC's Energy, Daylight and Overheating in Tall Buildings Study suggests it is very difficult to meet all the energy, daylight, and overheating requirements in naturally ventilated spaces except perhaps in the most shaded locations (a north-facing, single-aspect unit) with a g-value of 0.3.

5.47. On south-facing non-residential units where the risk of overheating is highest, a G-value of 0.2 or lower is needed.

5.48. This can be achieved in a range of ways including for example:

- adopting a 70% glazing ratio and g-value of 0.3;
- adopting a 50% glazing ratio combined with a g-value of 0.4;
- incorporating shading elements to reduce direct heat gains and cooling loads

5.49. Best-practice lighting design is essential to achieve carbon savings, whilst also reducing negative impacts on overheating and daylight.

5.50. Measures aimed at increasing solar exposure have a positive effect on daylight, but a negative effect on overheating risk, especially in naturally ventilated spaces. However, increasing solar exposure in fully conditioned space increases carbon savings.

5.51. It is very challenging to balance daylight, overheating and carbon emissions in partially shaded areas where daylight is an issue. Measures should be taken to maximise solar gain in these areas.

5.52. Strategies that could be adopted include:

- creating dual aspect spaces;
- specifying movable shades;
- design facades with a 70% glazing ratio and 70% Visual Light Transmittance (VLT);
- avoid natural ventilation where overheating is a risk.

5.53. To address cooling risk, solutions could include:

- a mixed mode approach to cooling in which cooling is provided in peak summer conditions and natural ventilation is used for the rest of the year in shaded or partially shaded areas;
- full air conditioning with reduced glazing g-value (keeping a VLT at 70%) to 0.4 or lower and/ or add movable shading depending on precise orientation of space.

5.54. A carefully considered approach should go through the steps set out in figure 5.7 when deciding which strategy to adopt.

Figure 5.7: Decision making process to achieve adequate daylight whilst managing heat risk

Can it be moved to an unshaded location?

No →

Daylight is critical

Measures to meet daylight:

- Dual aspect
- 70% glazing ratio
- VLT of 0.7

→ Is natural ventilation feasible? (considering air quality, noise, fresh air requirements)

No →

SHADED OFFICE – COOLED

Daylight and carbon are critical

Maximising daylight leads to high solar exposure. Cooling loads need to be limited, in order to achieve 15% carbon savings. The following should be done to meet all criteria:

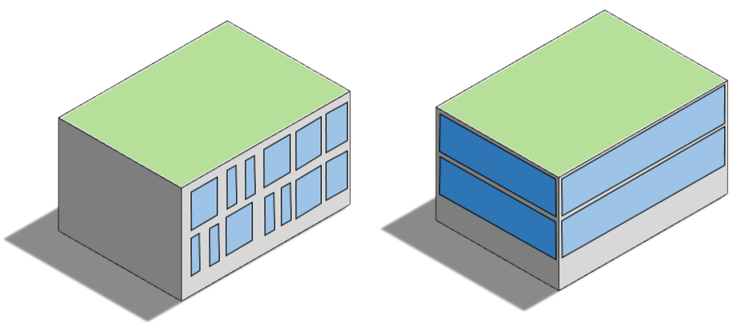
- Measures required to meet daylight
- Mechanical cooling
- G-value of 0.4 or lower and/or movable shading
- If South-facing, g-value of 0.3 or lower and/or movable shading

Yes ↓ (Can it be moved to an unshaded location?)

UNSHADED OFFICE - COOLED

50% GLAZING RATIO

70% GLAZING RATIO



G-VALUE = 0.4

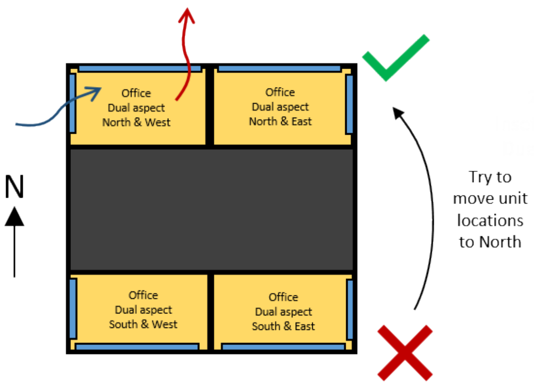
G-VALUE = 0.3

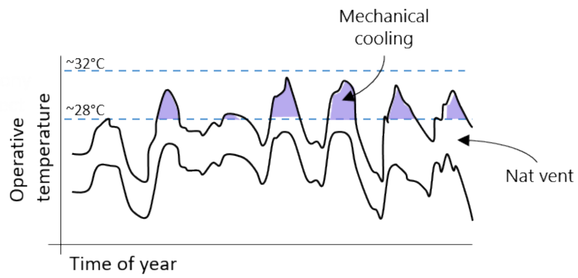
In unshaded locations modelling has shown that daylight is not critical. However overheating risk and cooling loads for Part L need to be controlled. The following should be done to meet all criteria, especially in South-facing spaces:

- G-value should be balanced with glazing ratio on single or dual aspects
- Resultant G-value of 0.2 (factor of glazing ratio, shading and G-value of glass)
- Occupant control of blinds
- Natural ventilation with comfort cooling only in peak summer conditions, or fully conditioned if overheating risk still present

Yes ↓ (Is natural ventilation feasible?)

SHADED OFFICE – NATURAL VENTILATION





Mechanical cooling only for peak overheating conditions, Naturally cooled for shoulder seasons

Daylight and overheating are critical

Natural ventilation allows achieving large carbon savings. However, the measures required to maximise daylight lead to high overheating risk. This can be mitigated through a mixed mode strategy, where cooling is only used in peak summer conditions. The strategy to meet all criteria is the following:

- Requirements to meet daylight
- Natural ventilation
- Comfort cooling only in peak summer conditions
- Avoid S/SE/SW orientations

APPENDICES

Appendix 1

Passive Energy Design, Adequate Daylight and Managing Heat Risk Checklist for Applicants

This checklist sets out quantifiable and simple tangible considerations that applicants are required to address as part of their planning application.

Included within Sustainability Statement submitted for planning?	Yes/No or Value
Energy	
Has Performance or Predictive energy modelling been undertaken?	Y/N
For residential what is the average Lumens/circuit Watt of fixed lighting specified?	lumens/W
For residential has MVHR been considered?	Y/N
For residential what proportion of units will be air-tightness tested?	X%
For residential what is the average glazing ratio, as a proportion of external wall?	X%
For non-residential what is the average Lumens/circuit Watt of display lighting specified?	lumens/W
For non-residential what is the average Lumens/circuit Watt of ambient lighting specified?	lumens/W
Daylighting	
Have overheating and daylighting results been combined for the proposed development?	Y/N
% of residential units where the daylight factor has been modelled?	X%
% of non-residential units where the average daylight factor has been modelled?	X%
Has any other daylight modelling approaches been used other than ADF?	Y/N
Overheating	
Has the application of natural ventilation for commercial spaces been reviewed?	Y/N
If so has natural ventilation been applied? (Spaces types or unit types)	Y/N
Has dynamic overheating modelling been undertaken using 2020 London Heathrow weather files?	Y/N
Has further overheating analysis been undertaken using 2050 London Heathrow weather files?	Y/N
Do the commercial units show an overheating risk in line with CIBSE TM52 or CIBSE Guide A for conditioned spaces?	Y/N

Appendix 2

Relevant London Plan and Local Plan Policies

The GLA has introduced new energy efficiency targets and daylight and overheating guidance within the Draft New London Plan, published for consultation in December 2017.

The key policies that relate to this SPD include:

ENERGY AND CARBON

The London Plan's approach to energy continues to require development to be zero carbon including a minimum 35% reduction against Part L of the Building Regulations 2013 from on-site measures and by off-setting the remaining carbon emissions.

In previous London Plans, a core component of the strategy was to use gas fired Combined Heat and Power (CHP) to supply low carbon heating and hot water in major development. Gas fired CHP delivered a significant carbon reduction when compared with conventional heating systems and grid-based electricity. The benefits have become marginal and will shortly be negative as carbon emissions from grid electricity fall rapidly as supply transitions from coal to renewable energy generation. As a result, it will become more difficult for developers to meet the carbon reduction targets from decentralised generation. GLA is considering its approach to emission factors in this transition period. One approach GLA have adopted is to introduce a new heating hierarchy for selecting appropriate heating systems, which consider among other things air quality. In addition, GLA has set ambitious targets for energy efficiency. The following policies directly promote energy efficiency:

Policy S12 Minimising greenhouse gas emissions

Policy B: Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.

Policy C: A minimum on-site reduction of at least 35 per cent beyond Building Regulations 2013, (if these are updates, the policy threshold will be reviewed), is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures.

DAYLIGHT

High-density developments can impact on vertical sky access and available daylight. High-density developments often have many deep plan single aspect apartments which can exacerbate this challenge. The Mayor is concerned about the risk of poor daylight on health and wellbeing and has set out policy to encourage good daylight standards as follows:

Policy D4: Housing quality and standards
E: Residential development should maximise the provision of dual aspect dwellings and normally avoid the provision of single aspect dwellings. A single aspect dwelling should only be provided where it is considered a more appropriate design solution to meet the requirements of Policy D1 London's Form and Characteristics than a dual aspect dwelling, and it can be demonstrated that it will have adequate passive ventilation, daylight and privacy, and avoid overheating.

F: The design of development should provide sufficient daylight and sunlight to new housing that is appropriate for its context, whilst avoiding overheating, minimising overshadowing and maximising the usability of outside amenity space.

Policy D8 Tall Buildings
To ensure tall buildings are sustainably developed in appropriate locations, development plans must undertake the following:

3) Environmental Impact a) Wind, daylight, sunlight penetration and temperature conditions around the building(s) and neighbourhood must be carefully considered and not compromise comfort and the enjoyment of open spaces, including water spaces, around the building

MANAGING HEAT RISK

High-density development and tall buildings can create urban forms that are prone to overheating especially on unshaded south and west facing elevations. The problem can be exacerbated where: Floor to ceiling glazing systems are used; where apartments are single aspect and have no natural cross ventilation; where insultation levels are high; and where internal heat losses from centralised heating and hot water systems is high. In addition, the impact of high-density development on the local micro climate can result in a phenomenon known as the Urban Heat Island effect, where temperatures can be several degrees warmer than surrounding low density and green space sites. The Mayor recognises this is a major problem and has therefore developed policy to address this as follows:

Policy SI2 Minimising Carbon Emissions; section 9.2.10 f. the results of dynamic overheating modelling which should be undertaken in line with relevant Chartered Institution of Building Services Engineers (CIBSE) guidance, along with any mitigating actions (see Policy SI4 Managing heat risk).

Policy SI4 Managing heat risk

A: Development proposals should minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.

B: Major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) reduce the amount of heat entering a building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2) manage the heat within the building through exposed internal thermal mass and high ceilings
3) provide passive ventilation
4) provide mechanical ventilation
5) provide active cooling systems.

Section 9.4.5 in Policy SI4: The Chartered Institution of Building Services Engineers (CIBSE) has produced guidance on assessing and mitigating overheating risk in new developments, which can also be applied to refurbishment projects. TM 59 should be used for domestic developments and TM 52 should be used for non-domestic developments. In addition, TM 49 guidance and datasets should also be used to ensure that all new development is designed for the climate it will experience over its design life. Further information will be provided in guidance on how these documents and datasets should be used.

Policy D4 E; see policy D4 E and F in the section on daylight also address overheating.

RELATED POLICIES IN THE LOCAL PLAN

The Local Plan seeks to reinforce London Plan policies. The following Policies reiterate the importance of these three standards:

Policy EU9: Minimising carbon emissions and overheating

Major development proposals will be supported where they:

a) i) meet or exceed the on-site carbon emission targets set out in the London Plan energy hierarchy;

a) v) demonstrate that the risks of overheating have been addressed through the design of the development. To address the risks of overheating, applicants for major developments should accord with the Mayor’s cooling hierarchy and carry out modelling in line with the most up to date guidance from the GLA and CIBSE. Modelling should take account of the predicted risks of climate change;

Policy D6: Amenity

a) Proposals will be required to deliver an appropriate standard of amenity by submitting a Daylight, Sunlight and Microclimate Assessment where the scale of proposed buildings has the potential to affect the amenity of sensitive neighbouring uses.

Appendix 3

Case Studies

Generic block study by Buro Happold to test technical feasibility and financial viability of meeting the GLA ambitions.

The Buro Happold study which was commissioned by OPDC to provide evidence to support this SPD looked at a generic high-density block with a tower, shoulder development, podium and a range of uses (see Figure A.1). Extensive parametric modelling was undertaken to understand how the 3 policy areas could be optimised. The modelling looked at the impact of orientation, floor level, degrees of shading, glazing ratios, balcony positions (inset or overhanging) and a range of building fabric solutions (g-value of glazing, U-values in walls etc.).

The study concludes that it is possible to achieve the passive energy design standards set out in the principles, provide adequate daylight and manage heat risk in high-density development. Some trade-offs will need to be made between daylight and overheating which impact on passive energy performance.

Achieving the targets will be complex as different elevations and floors in buildings, different uses, unit sizes, aspects and depths etc. impact on daylight levels and risk of overheating and require different mitigation measures.

The modelling generated a range of solutions that could be used to meet the planning requirements. The costs of adopting these solutions was assessed to understand impact on viability. A summary of the modelling undertaken and a list of solutions that can be adopted to achieve the principles are set out in Appendix 4 and 5.

Figure A.1: Generic indicative high-density block section and plan

Appendix 4

Further detail on options to optimise passive energy, daylight and reduce overheating

Background information on modelling and detailed list of options to optimise passive energy, daylight and reduce overheatinge in residential development

The modelling performed by Buro Happold for OPDC within the Energy, Daylight and Overheating in Tall Buildings Study demonstrated that there were a range of measures that could be adopted in shaded and unshaded parts of a development to meet the policy requirements.

Design options include choice of balcony position depending on aspect; choice of glazing ratios; overall building orientation; and optimising fabric performance. Choosing the right combination depends on the building, unit and context.

The parameters modelled included:

- Balcony position: inset or projecting for single and dual aspect apartments;
- A range of glazing ratios;
- Two different orientations: cardinal and off-set (45 degrees); and
- A range of fabric performance levels for: wall insulation; glazing insulation; G-value; thermal bridging; ventilation system and exposure.

Figure A.2 represents the different parameters addressed and the number of configurations for each of the parameters that were modelled.

The modelling generated a long list of measures that could be adopted under different conditions. These are set out in Table 1 for residential development and Table 2 for non-residential development.

Figure A.2: Number and range of parameters modelled

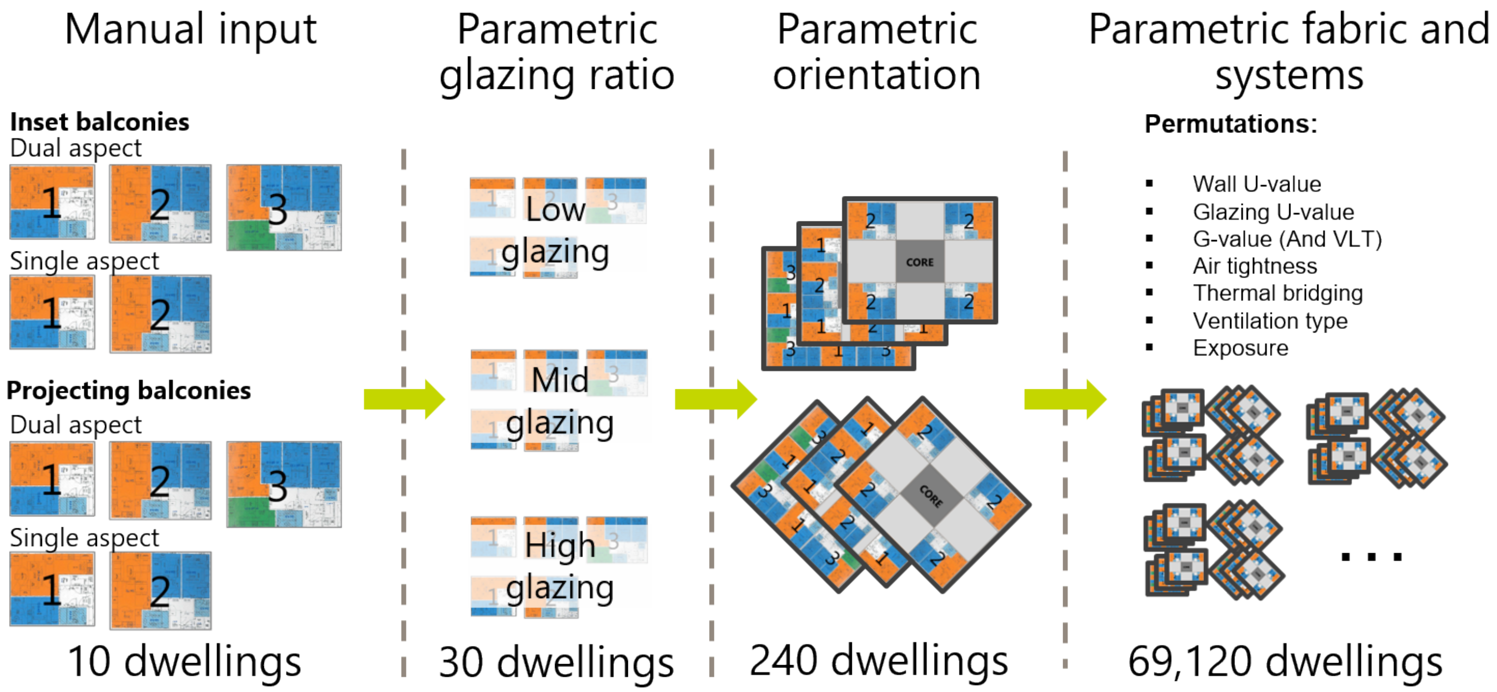


Table 1: Potential options for achieving the SPD principles in residential buildings

Table 1 sets out possible ways to meet carbon, daylight and overheating targets for shaded and unshaded aspects of a building. These have been generated by Buro Happold who carried out detailed parametric modelling of a generic high-density block that might be found in the OPDC area.

Cost impacts are also set out in the table. More information about costs can be found in OPDC's Energy, Overheating and Daylight in Tall Buildings Study.

Modelled Outputs	Shaded	Unshaded	Cost impacts
Design responses generated by the parametric modelling that met minimum policy requirements	1. Less than 35% glazing ratio (window/floor) to maximise daylight whilst reducing overheating risk	1. < 25% glazing ratio (win/floor) to maximise daylight & reduce risk of overheating 2. Use of MVHR 3. Triple glazing 4. Airtightness ≤3 5. For default thermal bridging: Airtightness ≤3 for Units facing S, SE, SW, W 6. For calculated bridging: Airtightness ≤3 for Units facing S 7. Projecting balconies for units facing S, SW, W 8. Projecting balconies for glazing ratio (win/wall) ≥ 0.65 9. Glazing ratio (win/wall) ≤ 0.5 for 2 bed units 10. Single aspect 1-beds (inset balcony) can meet all targets with 50% glazing ratio (win/wall) 11. Single aspect 1-beds (projecting balcony) can meet all targets with 65% glazing ratio (win/wall). Need to consider wider policies regarding single aspect units. 12. G-values of 0.3 in locations at risk of overheating 13. To mitigate overheating whilst maintaining daylight and energy performance, prioritise single aspect 1-bed units with projecting balconies on South and South-East facades	Reduced glazing ratios will reduce overall development costs as glazing is typically more expensive than opaque areas. Typical cost uplift of £1500 per unit for increasing glazing ratio by 15% relative to wall area MVHR will increase costs by £2,800 per unit. Careful siting of MVHR units can help to reduce ducting lengths and costs. Triple glazing will increase development cost with uplift levels dependent on glazed area (£53/m2 of glazing) Air tightness must be tightened to at least 3m3/m2/hr before MVHR is considered. Typical cost uplift of reducing airtightness from 5 to 3 m3/m2/hr £300 per unit.
Key considerations	1. In zones with overheating risk, maximise ventilation by increasing the free openable area of windows 2. Reduce glazed area in dual aspect units (which typically have fewer daylighting issues) to reduce overheating risk	1. In zones with overheating risk, maximise ventilation by increasing the free openable area of windows 2. Reduce glazed area in dual aspect units (which typically have fewer daylighting issues) to reduce overheating risk	Reduced glazing ratios will reduce overall development costs as glazing is typically more expensive than opaque areas.
Further measures to review	1. Consider use of external shutters or shades to address overheating and maintain daylight and energy performance	1. Consider external shutters/shades to mitigate overheating during times of extreme heat, whilst maintaining daylighting and energy performance	External shutters will increase cost. Applicants should balance this against the cost of additional glazing

Table 2: Potential options for achieving the SPD principles in non-residential buildings

Table 2 sets out possible ways to meet carbon, daylight and overheating targets for shaded and unshaded aspects of a building have been generated by Buro Happold, as part of OPDC's Energy, Daylight and Overheating in Tall Buildings Study. Buro Happold carried out detailed parametric modelling of a generic high-density block that might be found in the OPDC area. Cost impacts are also set out in the table.

Modelled Outputs	Shaded	Unshaded	Cost impacts
Design responses generated by the parametric modelling that met minimum policy requirements	1. Efficacy of lighting should exceed notional levels 2. Include lighting controls including daylight dimming and occupancy sensing **Office:** 3. Dual aspect 4. Balance higher glazing ratios with lower g-values 5. High VLT of glass 6. Consider locating units away from south and south-west direction, to allow for natural/assisted ventilation whilst limiting overheating risk 7. In naturally ventilated spaces, use low g-values (0.3 or lower) 8. Use exposed soffits to increase thermal mass 9. Provide sufficient opening free area for ventilation **Retail:** 10. Mechanical cooling 11. Dual aspect 12. Avoid fixed shading elements, such as fins and overhangs	1. Efficacy of lighting exceeding Notional levels 2. Lighting controls including daylight dimming and occupancy sensing **Office:** 3. Consider natural/assisted ventilation for single aspect north-facing units 4. Use low g-values (0.3 or lower) 5. Use exposed soffits to increase thermal mass 6. Provide sufficient free area for ventilation 7. When mechanically cooled: 8. Balance higher glazing ratios with lower g-values 9. Use g-values of 0.4 or lower in South-facing spaces **Retail:** 10. Mechanical cooling 11. Reduce solar gains, especially in South-facing units, through either low g-values, lower glazing ratios, shading or less stringent fabric U-values	1. Achieving the targets in unshaded conditions is considered to present no cost uplift. Further details can be found in the Energy, Daylight and Overheating Study. 2. The measures for offices in shaded conditions have a cost uplift of £102/m2 compared to the baseline (represented by the unshaded conditions achieving 2% ADF). The main contribution to cost is given by the larger glazing areas due to shifting from single aspect to dual aspect units and using higher glazing ratios. 3. Similarly, retail spaces in shaded conditions need to be dual aspect to maximise daylight and for this reason present a cost uplift of £107/m2 over the considered baseline.
Modelled design responses to support improved standards	1. LED lighting with best practice efficacy 2. Lighting controls including daylight dimming and occupancy sensing **Office:** 3. None of the cases modelled achieve all minimum requirements. Measures should maximise daylight while limiting cooling loads **Retail:** 4. Mechanical cooling 5. Dual aspect 6. Avoid fixed shading elements, such as fins and overhangs 7. Reduce solar gains in south-facing locations through low g-values and low glazing ratios to reduce operational energy and provide future climate resilience where this doesn't compromise daylight.	1. (Same as minimum requirements because the limiting factor is overheating not daylight) 2. LED lighting with best practice efficacy 3. Lighting controls including daylight dimming and occupancy sensing 4. Office: 5. Consider natural/assisted ventilation for single aspect North-facing units 6. Use exposed soffits to increase thermal mass 7. Provide sufficient free area for ventilation 8. When mechanically cooled: 9. Balance higher glazing ratios with lower g-values 10. Use g-values of 0.4 or lower in South-facing spaces 11. Retail: 12. Mechanical cooling 13. Reduce solar gains, especially in South-facing units, through either low g-values, lower glazing ratios, shading or less stringent fabric U-values	14. The requirements don't impact the carbon, overheating and daylight targets and therefore do not necessarily lead to a capital cost uplift. However, additional consultancy/managerial cost may be required, e.g. due to additional modelling and Green Lease Agreements.

Modelled Outputs	Shaded	Unshaded	Cost impacts
Key considerations	15. Lighting is the main driver to reduce carbon emissions. 16. Daylight is critical in shaded locations; therefore, measures are aimed at maximising sunlight exposure. This increases the risk of overheating, thus generally requiring cooling to achieve thermal comfort. The daylight target is harder to achieve in deeper floorplates (as in the case of offices) and therefore further measures need to be considered to allow for better daylight while limiting solar gains.	17. Lighting is the main driver to reduce carbon emissions. 18. In unshaded locations, solar gains are critical and therefore measures should be taken to reduce the cooling load or allow for natural ventilation.	
Further measures to review	20. Albedo of public realm and/or surrounding elements 21. Change plan depth and geometry of units 22. Move units to unshaded locations where possible 23. Use high-reflectance materials and paints 24. Use windows with high VLT and low g-value 25. Use movable shading elements to be used during summer months to reduce solar gains, while not compromising daylight for the remaining part of the year 26. Consider a mixed mode strategy using mechanical cooling only during summer months and natural ventilation during the remaining months 27. Consider internal cross-ventilation through atria or chimneys	28. Consider a mixed mode strategy using mechanical cooling only during summer months and natural ventilation during the remaining months 29. Consider internal cross-ventilation through atria or chimneys	

Appendix 5

Glossary

Term	Definition
ADF	Average Daylight Factor measured in (%)
ASHP	Air Source Heat Pump is a heating or cooling generation unit. It utilised the ambient air temperature to pre-heat gas, which is then compressed to increase the temperature. This heat can then be used for space heating or hot water. The heat pump can work in reserves and moves unwanted internal heat to the ambient air, acting as an air conditioning system.
BEIS	The Department for Business, Energy & Industrial Strategy (formally DECC)
BER	Building CO^2 Emission Rate is a measure of the CO^2 emissions produced by a non-residential space on an m^2 over an annual basis from a Part L 2A complaint calculation. This is created based upon the design geometry along with input system parameters as per the as designed performance.
BMS	Building Management Systems that provides centralised control of building services systems.
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Method is a voluntary certification system for non-domestic buildings in UK covering a wide range of environmental and sustainability categories.
Carbon offsetting	Carbon Offsetting is a mechanism for applicants to commitment to ensure the shortfall of carbon emissions emitted from site is met through off-site means. This is facilitated through a fund (controlled and operated by the London Borough) paid into by the applicant or by directly offsetting with measures identified by the applicant.
CHP	Combined Heat and Power is an energy generation unit, producing useful heat and electricity. Normally a gas engine is used.
CIBSE TM52	Chartered Institution of Building Services Engineers Technical Memorandum 52 - The Limits of Thermal Comfort: Avoiding Overheating in European Buildings outlines thermal comfort judgement criteria for assessment in both residential and non-residential buildings.
CO^2 emissions or Carbon	Carbon Dioxide Emissions measured in kilograms (kg)
DCLG	Department for Communities and Local Government
DECC	Department of Energy and Climate Change (Now known as BEIS)
DSY 1	Design Summer Year 1 is a near-extreme weather files of April–September average temperature (middle of the upper quartile) with a return period of 9 years. Weather data from London Heathrow Airport (LHR) from the year 1989 representing a moderately warm summer. CIBSE TM59 asks for compliance with this weather file.
DSY 2	Design Summer Year 2 based on the 2003 year, represents a more extreme year with two-week extreme heat wave with a return period of 19 years. CIBSE TM59 suggests that design should consider risk of this weather file, however it is not strictly required to show compliance.
DSY 3	Design Summer Year 2 based on the 1979, represents a more extreme year with a more persistently warm summer return period of 27 years. CIBSE TM59 suggests that design should consider risk of this weather file, however it is not strictly required to show compliance.

Term	Definition
Dual aspect	Where a dwelling or building has two external walls, which can be either adjacent or opposite.
Fully conditioned	A fully conditioned strategy refers to a building with MVHR or other auxiliary systems for ventilation providing fresh air. Fixed mechanical cooling to condition air to required temperatures all year round.
GLA	Greater London Authority
Glazing ratio (Window/floor)	A ratio of the glazing area as a % of net internal area of a dwelling or space. This considers unit depth and normalises the glazing ratio.
g-value	A measure of the total solar gain transmitted through a glass element as a proportion of total solar radiation onto the external face of the glass. A high g-value allows more solar gain in than a low g-value, which can provide benefits in winter but drawbacks in the summer.
HS2	High Speed Rail 2
ICT	Information Communication Technology
kWh	A unit of energy to dictate the power and time of consumption. A kilowatt hour is equal to one kilowatt of power being used for one hour of time. This can denote both energy consumption and a demand.
LED lighting	Light Emitting Diode lightings
LLDC	London Legacy Development Corporation
lumens/W	Lumens of light produced per circuit watt of electrical power required for a light fitting
MEV	Mechanical Extract Ventilation
Mixed mode or assisted ventilation strategy	A mixed mode strategy refers to a building with MVHR or other auxiliary systems for ventilation providing fresh air. Fixed mechanical cooling can be provided but only to mitigate overheating or adverse thermal comfort in summer peaks. In this condition cooling is not included within Part L modelling but will be considered in operational energy modelling.
MVHR	Mechanical Ventilation and Heat Recovery,
Natural ventilation	A natural ventilation strategy refers to a building with no mechanical fixed cooling or auxiliary ventilation systems. Baseline ventilation rates are met by operable windows, passive vents and cross ventilation.
OPDC	Old Oak and Park Royal Development Corporation
Part L	Building Regulation Approved Document Part L: Conservation of fuel and power. Part L 1A is applied for residential dwellings and Part L 2A for non-residential spaces (including communal areas and entrances ways of communal residential blocks)
SAP	Standard Assessment Procedure is a steady-state calculation methodology for residential energy modelling. Compliant software uses this methodology for Part L calculations to provide Dwelling emissions rates.
Single aspect	Where a dwelling or space has only one external wall
SPD/ SPG	Supplementary Planning Document or Guidance

Term	Definition
Thermal comfort	That condition of mind which expresses satisfaction with the thermal environment, as defined by BS EN ISO 7730.
U-value	Heat transfer coefficient of a material, the lower the value the better the insulating properties of that material are
VAT	Value Added Tax
VLT	Visual Light Transmittance - A measure of the total visual light transmitted through a glass element as a proportion of total visible light onto the external face of the glass
Well Building Standard	Well Building Standard is an accreditation tool for certifying healthy buildings. It is operated by the International Well Building Institute
Zero Carbon	As defined by the GLA, are developments where at least a 35 % reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site is achieved. The remaining regulated carbon dioxide emissions, to 100%, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

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