Greater London Authority Non-Domestic Carbon Dioxide Emissions Target:

FEASIBILITY AND VIABILITY STUDY APPENDICES

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Study 3 Report
Appendices
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8.0 Appendix A - Consultation Feedback

This section presents details from the consultation feedback, received as follows:

- Raw responses received to the questionnaires. Where respondents to the questionnaires were also interviewed and clarified or modified this feedback as part of the interviews, this is indicated near the response.
- Summary of key points from the interviews.

All responses received to each question are shown individually.

Questionnaires were sent to over forty organisations (over sixty individuals) from a wide range of industry bodies including developers, contractors, specialist contractors, design consultants, research bodies, and policy advisors. Stakeholders were given several weeks to response, and were sent several reminders. A total of twelve completed responses were received. Some responses were received as an individual's view, others as representative of their organisation.

Interviews were carried out with nine parties (eleven individuals) representing a mix of research organisations and industry groups involved in research and policy work, contractors, designers, and developers. They were carried out using the questionnaire as framework for discussion, although wider feedback was also provided on a voluntary basis by participants. These additional points are presented here and the resulting findings summarised in the main body of this report, section **Error! Reference source not found.**.

Among the interviewees, three also provided a response to the questionnaire and therefore the overall consultation responses represent eighteen parties.

1 Please indicate which boroughs/locations you think to be most suitable in market terms for the testing of each of the above types of development

Responses to questionnaires

High rise offices	Medium/ low rise offices	Premium Hotel	Budget Hotel	Large retail park	Warehouse/ industrial development	Mixed use residential and ancillary retail development
Location 1						
Westminster	Westminster	n/a	n/a	n/a	n/a	Westminster - retail units at ground floor in particular as shell and core, and fully fitted out
Southwark		Westminster				Westminster
City / Canary Wharf.	Any central London Borough.	Central London.	Zones 3-4	Outer London Boroughs.	Outer London Boroughs.	Any London Borough.
The City/ Corporation of London	Westminster	Westminster	Tower Hamlets	outer London	outer London	Southwark
Location 2						
City of London	City of London	n/a	n/a	n/a	n/a	City of London
All as question 1 above.						
Tower Hamlets	Hackney	Camden	Hackney	outer London	outer London	Lambeth
Location 3						
Camden	Camden	n/a	n/a	n/a	n/a	Camden
All as question 1 above.						
Hackney	Tower Hamlets	Kensington and Chelsea	Ealing	outer London	outer London	Tower Hamlets

Responses to interviews

No response.

2 A single carbon reduction target will apply to all non-domestic building types. From 2016, the GLA intends this target to be a stepping stone from the current target (35 per cent improvement on Building Regulations Part L 2013) to the Zero Carbon standard, which will be required from all new non-domestic development from 2019.

Following the current approach, the target will be achievable through maximised on-site carbon savings, in line with the existing energy hierarchy before off-setting any remaining savings.

Please indicate what in your opinion would be a viable target, as a percentage improvement if applicable, for the 2016-2019 period (total, including on-site and off-site carbon savings)

Responses to questionnaires
It will wholly depend upon the Part L 2016 targets for non-domestic buildings. But to effectively drive the necessary innovation it should be a similar percentage improvement as currently asked for, therefore assume 35% again.
35%
20%
50%
Personally, I think that justifying a single percentage improvement target covering all types of buildings, while keeping things straightforward, would be difficult to set due to the significant variations in cost uplifts that it would present to different developments. Going above the current 35% may end up being predominantly met through off-setting which potentially raises further questions of whether this would be contested by developers and whether there are appropriate measures in place within each Borough to utilise this money effectively.
100% on Building Regulations Part L 2013.
I believe a stepping stone would be appropriate but not a single carbon reduction target to all non-domestic building types. It should be aggregated, but split based on uses.
50%
Any Increase in in Carbon reduction targets will *adversely affect* the letting / saleability of non domestic buildings. Our business finds resistance to such proposals from *tenants* / purchaser / Investors.
(20% on part L 2013) *clarified at interview: intended as 20-30% on 2010 on-site saving only*
Responses to interviews
- Important for the GLA to establish a trajectory and for the target to be a stepping stone towards zero carbon – half way between or, say, 50% (if not 'real' mid-point 62.5%). Particularly important as part L 2013 was watered down - Previous work by the Green Building Council on this issue did not recommend a specific target. The work recommended to achieve zero carbon by following the same approach as for residences, ie fabric first, then further on-site savings, then allowable solutions. - Viability more critical in outer boroughs, want to avoid ghettos inner vs outer
- 100% improvement on part L 2013. for contractors, it is not a problem as costs would be borne by the developers - There should be a single target rather than different ones per building types, as it is already complicated enough
- London Plan target should be seen in wider context including EPBD and Part L 2016, due to be announced in april 2016 and for which work by the building regulations advisory committee (BRAC) has just started [as of February 2015] - Part L 2016 target and approach to carbon savings is expected to be informed by approach to resi, incl fabric first and allowable solutions e.g. 25% improvement on fabric performance - Own view: GLA should focus on allowable solutions - Is it worth the GLA updating the target for the 2016-2019 period?
- It would be good to anticipate the upcoming building regulations. The market needs to move, so the target should be somewhere between the current 35% and upcoming 100% on part L 2013 - Some building types will find it easier than others - London can lead the rest of the country
- Not sure – anticipate part L 2019? - 35% on 2013 is already challenging in refurbishment schemes and large retail - Increasing the target puts more reliance on carbon offsets, which have to be viewed with caution

- This viability assessment [i.e. the one covered in this report] should take account of benefits to occupiers, as well as wider benefits to designers and product manufacturers, who can export lessons learnt in London (as product or services) to wider UK and abroad - The benefits to UK Plc are difficult to quantify, but should not be ignored - We have not yet seen that increased standards and resulting higher capital costs lead to an increase in land value - We have not seen that increased carbon standards impact values and rentals, either up or down
- A target against part L is not the right approach [see 'other comments' for further feedback] - If a target against part L really is required, this will depend on what part L 2019 and zero carbon mean, and that is currently unknown - The London plan should set zero carbon buildings in 2019 as an aspiration, with a trajectory towards it rather than a 'simple number' target e.g. description of approaches to passive design, ventilation, orientation. This would rely on technically skilled local authorities. The trajectory should be informed by what is currently achieved e.g. 60% of buildings of this type achieve x% savings, to inform the new target for this building type - If the approach to a single target has to be kept, it should be informed by case studies on recent projects - The rules should be the same in every borough, but with case-by-case examination of the context and constraints
- It is difficult to set what the target should be since part L 2016 is not known - Commercial viability is starting to be challenging at 30-35% improvement on part L 2013, if savings are to be achieved on site - A step target between now and 2019 zero carbon will essentially be achieved through carbon offset payment to the local authority, not additional savings on site
- Useful for London to be seen to lead, and for the target to be a step between now and zero carbon - However, there needs to be the recognition that additional savings will mostly not equate to savings on site as most parameters have reached technical feasibility: savings would instead likely equate to additional offsets
- Increased on-site savings are unlikely to be significant as many parameters have reached the limits of technical feasibility, without commercial implications - The other problem with a target against Part L is that this looks at individual buildings and individual items, rather than systems and their integration and interaction with each other - An aspirational target is useful to drive innovation, but this will typically have longer timescales than the 2016-2019 timescale considered here

3 In your opinion, how much of the above target is able to be achieved through on-site measures alone (for example, using building efficiency measures and on-site renewable energy / CHP)?

Responses from questionnaires
Minimum 50%. This is based upon the assumption that Part L2 2016 has a similar target to the current London Plan, i.e. 35% improvement on Part L2 2013. While there may be more scope for on-site renewable energy / CHP improvements, the building envelope will struggle to improve without fundamental shifts in Architecture and Construction programming. Therefore off-site carbon savings may be a necessity for both the 'steeping stone' 2016 London Plan target and those eventually in Part L2 2019..
20%
100%
100%
Again, these proportions would vary significantly for different types of non-domestic building types both in terms of the split between onsite emission reductions and offsetting and the split between energy efficiency and amount that would be met through fabric and on-site renewable energy/CHP, both of which would result in different technical and financial implications. For some building types, certain retail uses for example, the proportion from offsetting could be quite high.
50% on Building Regulations Part L 2013, so 15% more than the current improvement targets. In our opinion, the approach to zero carbon buildings (definition to be agreed) is a combination of iterative improvements in current technologies and step-changes brought on by new technologies. We feel that a 50% improvement on 2013 regs can be made from the iterative improvements and that this can form the basis of the 2016 target. To reach zero we, as an industry, need to focus on the step-changes in technology and policy that are required to meet these targets. As an example, this could come from the following: • Sharing loads with other developments (with proper incentives for developers) • Off-site carbon sinks • Off-site energy production investment • Carbon credits • Credits for export of on-site energy generation • Improvements to local dwellings/buildings, where further improvements to the development are not feasible (perhaps in a section 106 style arrangement)
I think this should be building type specific. This should also take into consideration that most retail developments will be built to shell and core, and not able to take into fit-out. Therefore, it becomes incredibly challenging to be able to demonstrate energy efficiency measures above and beyond significant improvements to the building fabric. It becomes incredibly challenging to comparably achieve significant percentage improvements for a shell and core retail unit with a hotel or office, and this must be taken into consideration.
25%
Limited. Viability – namely, this is only adding costs not making buildings / space more lettable.
Roughly 15% through on site efficiency measures and 5% through CHP/on-site renewables
Responses from interviews
- 20-30% improvement on part l 2013 is currently typically achieved, depending on building type and extent of retail – possibly approximately 5% more is achievable: 'creep' up, but no step change - Probably better to keep flexibility rather than set on-site targets, allowing teams to decide based on technical feasibility and finances – 'need a case by case decision with sensible people'. Teams should however be required to declare their on-site savings. - Carbon offsets are currently cheaper than on-site savings, and do revenues from offsets allow local authorities to abate carbon ? more carbon will be saved with on-site measures than by offsets - People will try to avoid allowable solutions anyway
50% improvement on part L 2013 – should be achievable, though needs testing
Better to keep as overall target, without specific on-site component – to be assessed on a case by case basis
- Not sure – anticipate part L 2019, eg 20-30% improvement on 2010? - There should not be a set on-site target as site constraints vary vastly; minimum performance standards drive that anyway
There needs to be more emphasis on on-site savings, avoiding offsets; this should be reviewed by local authorities with attention to passive design, ventilation etc
Commercial viability is starting to be challenging at 30-35% improvement on part L 2013, if savings are to be achieved on site
Probably best to keep flexibility without a set on-site component, to allow variety of development, constraints, outer boroughs etc

4 Do you have additional comments on technical feasibility of carbon savings for individual building types?

High rise offices	Medium/low rise offices
Response from questionnaires	
The following comments on non-domestic building types are based on achieving improvements in passive measures (especially the external envelope) for carbon savings. High rise offices are often constrained by the land parcel, limiting the most efficient orientation for solar control. The introduction of vacuum formed insulation within IGUs will improve thermal efficiency of the envelope without changing the construction techniques.	
Legislation should limit the glazing percentage allowable. Investigation into district heating should be mandatory.	As 5
As with all tall buildings limited roof space (and competition for with amenity, plant and other uses) restricts the application of PV. Limited heating and hot water requirements can reduce the ability to achieve significant carbon savings through energy efficiency and the application of low carbon heating technologies.	Limited heating and hot water requirements can reduce the ability to achieve significant carbon savings through energy efficiency and the application of low carbon heating technologies.
In general, most speculative office developments are not able to make best use of free-cooling. How developers can be incentivised in this area could be a focus. As an example, this could affect the oft-quoted load assumptions for small power that are allowed for in cooling calculations. We understand, from data from the Green Construction Board, that heating loads in offices makes up 45% of the carbon emissions. This is likely to be from treatment to fresh air. Again, looking at assumed density of occupation and potentially from reclaimed low-grade heat, this could be a targeted reduction.	Tend to be less speculative than high-rise offices but many of the points above still apply.
Consideration of limits placed by heritage (e.g. listed buildings, Conservation Areas), particularly where buildings are being refurbished and not a complete new development. Perhaps balancing the embodied carbon associated with refurbishment, or even unregulated emissions where practicable should be taken into consideration particularly where overall carbon savings from regulated emissions is considered challenging to achieve.	Consideration of limits placed by heritage (e.g. listed buildings, Conservation Areas), particularly where buildings are being refurbished and not a complete new development. Perhaps balancing the embodied carbon associated with refurbishment, or even unregulated emissions where practicable should be taken into consideration particularly where overall carbon savings from regulated emissions is considered challenging to achieve.
Possibly the larger the scheme the easier to accommodate viably via district heating schemes.	Becomes challenging the smaller the scheme.
Dominated by cooling demand and difficult to address through on site renewables/CHP. GLA targets currently affect I designs and detailing (as they should).	As above
Response from interviews	
Mixed-mode ventilation often limited if high spec offices, e.g. concerns about noise	Mixed-mode ventilation, but need consideration to noise and air quality
- Free cooling opportunities if stricter controls on internal gains; this would not be possible in speculative offices. We should challenge the rules	
Offices are easier than retail [for developers as applicants] as developers have more control on the fit-out	Offices are easier than retail [for developers as applicants] as developers have more control on the fit-out
	- Opportunities by avoiding the trend for sealed buildings without openable windows. The implementation of mechanical ventilation should be more systematically

	questioned by the GLA. We do not find that noise or air quality are an issue for our office tenants. - Opportunities if more flexible rather than following standard approaches like BCO – for example, exposing ceilings (also benefits in reducing maintenance and floor-to-ceiling heights) and using displacement ventilation, possibly without cooling - Focus on comfort, not just air temperature: this could help reduce cooling requirements
- There are very few opportunities for on-site technical improvements left - We have carried out a lot of modelling against part L, and additional savings available are very limited ie 0.5-5% maximum (e.g. better u-values for curtain walls, 'active facades', reductions in glazing to optimum 40%, chiller SEER of 9) - Improving airtightness from 5 to 3.5 [BCO recommendation] makes part L performance worse - The next step of improvements would need market change away from BCO / fully air-conditioned buildings: this would be tenant-driven	

Premium hotel	Budget hotel
Response from questionnaires	
Similar constraints to the high rise office.	
CHP mandatory, Heat recovery from waste water and cooling systems mandatory. Thermal storage of waste heat mandatory.	As 7. Just because the rooms are sold cheaper shouldn't reduce the commitment to save energy.
Hotels tend to offer a number of technical and financially viable options for delivering onsite carbon reductions.	Hotels tend to offer a number of technical and financially viable options for delivering onsite carbon reductions.
Focus should be on water, sanitary ware, and the associated energy required to heat the water. Emphasis is often placed on resilience over efficiency and some restrictions can apply when the hotel is part of a wider mixed-us development with energy centre. Often in such cases, the hotelier is not on board to provide required specifications until much later in the design process.	
Should be viable due to scale and centralised plant / energy.	Viability driven. Might / will be challenged.
Easier to address through on-site CHP/Renewables b/c heat led for hot water. Efficiencies harder to gain	Easier to address through on-site CHP/Renewables b/c heat led for hot water. Efficiencies harder to gain
Response from interviews	
- Many hotels now have sealed facades – unclear whether this is a benefit or increases air conditioning needs - Issues with part L methodology and resulting hot water benchmark	As per premium hotel

Large retail park	Warehouse/industrial development	Mixed use residential, office and ancillary retail development.
Response from questionnaires		
District heating and CHP mandatory. Due to expanses of relatively cheap wall and roof area U values should be super insulated. Stringent control of lighting reducing display and feature lighting hours run. Increased use of daylighting mandatory.	Nothing to contribute meaningfully.	All the above brought together.
These developments offer greater potential for local renewable energy technologies to be incorporated. Particularly on roof spaces.	As for retail parks but it should be noted that roof space is not often rated to handle loads and access for roof mounted plant.	These schemes nearly always have a centralised energy centre and, as such, have greater potential for adaptation to new technologies. Greater incentives should be given for the developers to work with local authorities to investigate the feasibility of district heating schemes, for example.
		Consideration of limits placed by heritage (e.g. listed buildings, Conservation Areas), particularly where buildings are being refurbished and not a complete new development. Also, it is important to take into consideration of the level of design and fit-out, as tenants often end up fitting out spaces, and therefore only capped services are likely to be provided.
Should be achievable.	Should be achievable.	Can work, but different loadings and performance criteria required for different uses.
Very difficult to address efficiencies because tenant does fit out. Possible to do large areas of PV but still only 1 or 2 % of total carbon emissions.	No comment	easier to do energy sharing. Some concern about small retail development.
Responses from interviews		
- Technical improvements possible but limited by value / need for lease agreements on fit-out and need for central cooling. - Part L: problems with National Calculation Methodology (NCM) e.g. running profiles for chillers; daylight dimming (never specified in practice, but included in notional building). This was not addressed in part L 2013 consultation - Therefore, chiller and daylight dimming improvements could be tested, but with 'red flag'		As for large retail
Offices are easier than retail [for developers as applicants] as developers have more control on the fit-out		Offices are easier than retail [for developers as applicants] as developers have more control on the fit-out

5 Where do you think technical improvements will be achieved, contributing to the overall carbon reduction target? Please provide additional information on these measures, as appropriate.

Building fabric – high-rise, with curtain wall	Building fabric – low/ medium rise
Responses from questionnaires	
While highly insulated glazing and solid spandrel solutions already exist, thermal losses through the frame will have to be the biggest focus. Rationalization of unitized panel sizes, to reduce the ratio of framing within the overall area. Larger panels will push the current installation methodology, but is more a matter of cost than capability. The introduction of vacuum insulation within IGUs (such as the AIM panel from Dow Corning), again to reduced the amount of framing, while maintaining current architectural trends. More R&D and application of non-metallic solutions for curtain wall framing, including glulam timber and GFRP/composite plastics. More widespread use of double skin and active facades. Determined focus on high performance insulation types and arrangements that meet BRE BR135 and BS 8414 fire testing. And hence removing current compliance issues with installation above 18m in height with Building Control and insurers such as NHBC.	All items as per question 12 but also early project consideration for access and installation methodology to ensure thermally efficient solid walls are correctly specified. The danger is that the most efficient external walls generally require full external access to install. By panelizing and installing via less labour intensive methods, which have definite economic benefits, introduces unavoidable thermal bridging. Correct consideration of all openings within the external envelope to achieve even the current air leakage rates. Sash windows, slimline sliding doors, double doors can have a negative impact on air leakage compared to alternate solutions, although the architecture can be affected.
Useful savings should be achieved here	Useful savings should be achieved here
- solar analysis and energy modelling - passive design solutions – set targets or guidance on best practice - design for DEC ratings – use database of current usage (TM54/ Carbon Buzz) to validate data and mandate new buildings to input data into database -	As per high-rise office
Whole u-values for curtain wall systems have been reducing in recent years. Partly through the rationalisation of the vision glass element of the I, using insulated spandrels and opaque panels, and through more efficient glazing and framing systems.	Increasing use of higher performance windows and increased focus on thermal bridging.
For cooling led developments, such as offices, building fabric needs to be more adaptive to the seasons.	For lower density office developments, their location in London can have a detrimental effect on carbon performance, due to a narrower diurnal temperature range (warmer nights) and acoustic conditions that often rule out naturally ventilated solutions as potential options.
Passivhaus standards for residential developments and air tightness criteria should be explored.	
Yes, but costs will dictate viability.	As question 16.
Design reduction in floor to ceiling glazing	uncertain
Responses from interviews	
- We have carried out a lot of part L tests on impact of façade, but only small improvements are now available - Curtain wall improvements could be tested, but may not help part L performance as balancing heating vs cooling - Possible glazing improvements e.g. 'triple silver', with light transmittance:g-value better than 2:1 (0.60:0.28). Don't expect improvements if light transmittance went beyond 0.6. this could be tested against baseline eg 0.5:0.28	
curtain wall u-values quoted at 0.8W/m2K, but seem to increase (get worse) at later design and construction stages	
	The industry may be willing to change e.g. from brick and block to modular pre-fab, with increased insulation levels
Regulations and planning have already driven reductions in transparent areas (used to be fully glazed, typically)	

Curtain wall u-value improvements, but probably marginal and with significant increases in capital costs. the limit seems to be around 1W/m2K and further improvements do not lead to much saving [in high rise offices] anyway	

Building services: heating and hot water, ventilation, air conditioning, lighting, controls and building management systems	Community heating, including connection to a District Heat Network, on-site Combined Heat and Power and other technologies
Response from questionnaires	
Efficient building services should provide definite carbon savings	These technologies are not always possible or feasible
- solar analysis and energy modelling - passive design solutions – set targets or guidance on best practice - design for DEC ratings – use database of current usage (TM54/ Carbon Buzz) to validate data and mandate new buildings to input data into database encourage use of efficient systems and controls mandate building performance evaluations	use of renewable fuels
For many building types the lighting systems are responsible for a significant proportion of the carbon emissions so further development of LED technology and better control systems, plus modelling that is better able to reflect these systems, could lead to further reductions. The efficiencies of ventilation and air conditioning systems have also been increasing over recent years, driven by building regulations and planning targets. Also, a greater focus on demand side management could lead to improvements in operational carbon emissions but this would only be relevant if this was incorporated into models.	
Consultants performing design stage energy assessments are not often able to take full advantage of the benefits a particular constructor can bring. For example, Laing O'Rourke are heavily focussed on Design for Manufacture and Assembly (DfMA), a modular construction approach that can achieve high quality, air tight buildings and modularised, factory built building services modules. These modules include combined control systems that can operate the plant to peak system efficiency, rather than individual boiler, pump, chiller etc. efficiency. If this improved system efficiency could be included in the design stage, the benefits could be taken in the energy calculations.	Correct incentives should remain to include for space within energy centres for connections to external networks and for the incorporation of new technologies as and when they become available.
Would suggest that % reduction is very building type specific. For retail, the type of lighting will have a substantial impact on the carbon emissions.	This is likely to be smaller for offices/retail that have a comparatively lower DHW demand to hotels.
The industry has responded well and greatly improved the efficiencies of these services. Building management systems particularly high tech. and can be remotely operated.	All about scale of developments to be served. Small scale is harder to achieve viability.
Response from interviews	
- Lightin6 W/m2 seems technically feasible in open-plan offices but possible impact on value and quality with current products. Could also test 4W/m2 'industry promise' option - Water-cooled chillers an option for improvements under *part L*, but not guarantee of *actual* savings	
- LED lighting is now a mature industry	
- Lighting has changed a lot, building regs have evolved and the industry has matured - Possible improvements through use of waste heat from air conditioning, as pre-heat or into heat pump for domestic hot water production?	
- Best chiller SEER – 8 as claimed by manufacturer	

- Lighting efficiencies have significantly improved in 5 years; expect it has / will soon reach a plateau, and future changes will be reductions in capital costs as the technology matures; lighting improvements are based on assuming that the tenant will accept it in their fit-out	

Renewables – building scale	Renewables – large scale
Response from questionnaires	
Yes	Yes if possible
mandate renewables on all larger scale development plots. Where not feasible on a cost analysis (i.e. short term developer), incentivise the developer to put in renewables as an ESCO or similar deal	mandate renewables on all large scale infrastructure or commercial developments.
A new generation of PV technology, perovskite solar cells, which can be printed onto glass could provide buildings with large areas of glazing with the potential to save significant proportion of carbon. An example of one such system is here: http://www.oxfordpv.com/ for more details. This technology has been under development for a few years and looking to trail pilot projects in the near future.	
These are already being looked into in great detail on current developments. Improvements will come from improvements in the individual technologies themselves, which may then filter through to the developments in the design stages.	Any method to reduce the carbon content of the grid will have a beneficial effect on a developments' carbon assessment. The biggest investment in renewable is best placed off-site from developments and not necessarily in London.
Limited as we are restricted given heritage considerations.	
Solar PVs must be used on site	
Small scale buildings struggle to achieve any meaningful renewables even allowing for PV / solar.	More options become available. But costs can only be prohibitive.
Can't see innovation immediately	
Response from interviews	
- I don't think heat pumps should be seen as 'renewable' technology. - Air source heat pumps: Promises heating COP of 3 but this is rarely delivered. - Ground source heat pumps: heating COP of 3 should be achievable; in cooling, would not be better than good chiller - There is one unusual loop heat pump system in a crossrail station - Solar thermal: only viable in hotels - Wind: not except maybe in outer boroughs - Fuel cells not viable; also, are currently CHP, just not engine-based - PV developments eg facades / screens, but not in the 4-5 year timescale of the proposed London plan alteration - Carbon offsets will typically be cheaper than renewables	
- Opportunities for low/zero carbon technologies are very limited on commercial buildings - Have seen claims that PVs on full façade could save 18%, but this seems doubtful - Fuel cells potentially to save 4% in high rise offices: as per engine CHP, but less complex to implement	

Others – please advise
Response from questionnaires
different solutions need to be in place to deal with new build, refurbishment, or large or small developments to take into account different business models and to encourage everyone to benefit from taking a longer term view on developments, regardless of their own commercial (often short-term) requirements.
Reuse of waste heat, particularly on mixed use sites.
Response from interviews
- Buildings reactive to the weather / seasons: not just shading, but also glass (eg SAGE, although that is actively controlled and not ideal for light transmittance) and solar collectors in the façade - Optimising chiller and boiler controls, particularly at part loads
- District heating calculations can be 'a black art' and there is not as much consistency ('comparing apples with apples) as for buildings, where the guidance is very clear – further guidance from GLA and interrogation by GLA / local authorities would be useful. For example, how to account for the future performance of schemes with expansion plans, such as Citigen
- District heating o The GLA guidance on district energy is useful, but the GLA should tighten it, and more clearly link it with the London heat map and local authorities' district energy opportunity areas. This is particularly important as it will allow reductions in carbon offsets. It would also give utilities companies and district energy operators more confidence to invest o Less important should be given to district energy for schemes outside opportunity areas o There needs to be political leadership on district energy, to assist collaboration and the business side e.g. a board created, to take forward the London infrastructure plan

6 Please indicate other comments you may have on this consultation, including other potential ways of reducing carbon dioxide emissions, including, but not limited to:

- Non-regulated carbon emissions (e.g. small power, IT) – not covered by Building Regulations and London Plan targets, but contributing to total emissions in practice.
- Monitoring
- Demand site management
- the potential future impact of integration of secondary heat sources and technological advances

Responses from questionnaires
Non-reg carbon emissions should be reduced by ensuring that high efficiency appliances are used for the majority of highest unregulated uses. In the BREEAM scheme (Ene08 issue) many clients overlook this issue, probably because they feel it is costly, but by making efficient equipment more attractive (price, incentives etc) then the uptake for Clients will be greater.
Non regulated emissions would be difficult to include as these are obviously outside the control of the developer and for some building types could vary significantly depending on the end user. There might be a way of incorporating the potential benefits from demand side management into the calculations, for example if sufficient metering and control systems are provided.
• We agree that non-regulated loads should eventually be included in the calculations, as part of a whole life-cycle assessment of the development, also including embodied carbon. Perhaps, at least initially, these could be in the form of separate targets. • More and more precise monitoring is imperative to better gauge the effect of the proposals currently being put forward in developments. This could include seasonal commissioning. Government Soft Landings may help in this respect. • Demand side management, if implemented will likely have the effect of moulding the energy strategies to suit, particularly with respect to the incorporation of thermal storage. Whether different carbon contents can be attributed to different tariffs or not, is another question. • References to secondary (low grade) heat sources and capabilities to incorporate technological advances are provided in other answers.
- Embodied Energy: Westminster are currently looking at this piece of work. – Monitoring absolutely which should tie in with site management. – The relationship between tenants and developers. Probably more support required to ensure that tenants fit out spaces. Developers on their own do not necessarily have the ability to influence this.
We applaud the consultation. There are no easy solutions or easy wins. Costs will always be the stumbling block. As we seek to raise standards / reduce carbon through regulation, viability gets challenged. The market place / industry / economy is in a fragile recovery. The balance needs to be struck between lowering carbon emissions, whilst motivating investment, jobs and prosperity. Political head-line making targets often cannot be delivered.
Non regulated emissions are a large (30-60%) of a large offices total power load. These are poorly estimated. IT loads are coming down which should have a beneficial effect in these areas.
Responses from interviews
- Are the GLA planning to exert further control on local authorities' interpretation and application of planning policies? There is a wide discrepancy in approaches (e.g. Westminster), although standardised GLA requirements do help - Wide discrepancy in skills and resources of local authorities – some very loose / easy, others 'belt and braces'. We need well informed and well resourced local authorities to judge on- and off-site components. - Embodied energy should maybe be looked at - Unregulated energy: the scope of building regulations is probably already challenging enough - The impact of future carbon factors (incl. grid carbon content) would be worth testing. Part L carbon factors are 'catching up with reality' - Carbon offsets: o Acceptance of carbon offsets is growing, but achieving carbon savings as offsets on own estate is reputational risk o Should carbon offsets be calculated on the basis of same carbon, or same costs ? - Part L allows different interpretations eg whether to include server rooms in office floor plans (we typically use GAs as per planning);

- Opportunities through early design involvement of contractor, design flexibility and open tender process - Need more cooperation between developments e.g. sharing loads, carbon credits / improvements on other sites, off-site carbon sinks
- Part L 2016 is unlikely to extend what is regulated, such as lifts - It is important to look at enforcement mechanisms at completion, including submission of as-built information and monitoring of performance in operation - Building control resources and training may need improving to help enforcement. Calculations are not necessarily queried or accompanied by as-built tests - There is an issue with the competence of assessors, including part L and EPC calculations - There is a problem with the quality of the build, and what is built is not well recorded
- There should be more alignment with the London plan and borough policies with other directives, regulations, initiatives, design standards etc, as the varying requirements create time expenses and confusion o e.g. ESOS, CRC, heat networks regulations, EU directives… o e.g. potential conflicts between requirements for daylight, control of excessive solar gains, and carbon - Guidance from the GLA is useful, including targets and approach but also on how much detail is required in energy strategy submissions, how much modelling is required (e.g. part L modelling for each individual retail unit seems excessive at the planning stage) - There is discrepancy in skills and resources of local authorities - Carbon offsets: as for arrangements with local authorities on other S106 payments, it would be good to have some control /influence over how carbon offset funds are used e.g. as part of a developer / land owner's community engagement - There is a discrepancy between design and actual performance, and as long-term land owners we want performance beyond compliance - We try to engage tenants such as retailers, for example encouraging post-occupancy evaluation through memorandums of understanding and tenant guides - Refurbishments: o Should embodied carbon benefits be taken into account as alternative to BREEAM requirements and/or carbon reduction targets o The London plan policy on refurbishment is a missed opportunity; if the target applies to refurb, it should be clearer to applicants and local authorities - Unregulated emissions: would need tenant engagement
- Carbon offsets o Carbon offsets will typically be much cheaper than other options such as decentralised networks (typically 3-4 times cheaper) or on-site savings; they are not high enough to drive change, although I am not saying that carbon offset prices are too low o We would rather not have locally set prices (as for example Westminster local authority is trying to do) o I am not sure it is right to link / benchmark carbon offset prices against PVs o We would like more flexibility on local carbon offsets, such as being able to spend it on local school o Carbon offset costs are not high in proportion of project costs, but can add up to large amounts on large schemes eg over £1m. We need to be able to have reasonable discussions with local authority officers. o There should be a standard framework methodology for carbon offsets - Current carbon targets are not at all affecting viability (maybe in outer boroughs) - Refurb and extensions o There should be leeway for refurb eg could embodied carbon savings be taken into account in refurb projects, towards part L savings? o There is a bit of confusion on the interpretation of the carbon target applying to refurb and extension projects, in some cases a missed opportunity; some local authorities assume it, others don't; The approach should be simpler: if the project triggers the London plan requirements (incl large refurb and large extensions), the same carbon target should apply, possibly to the whole building not just the new-built extension - Part L o Different building types will find it more or less difficult to meet and improve on part L o Over the years there is evidence that part L changes have led to reduced energy consumption – we have seen this in our portfolio

○ There are however many issues with the part L methodology. We carry out CIBSE TM54 on our projects for energy consumption prediction; it works within 10-15%, and it typically 2-3 times higher than the part L results. ○ It would be good for the GLA to find a way to recognise and encourage applications that carry out CIBSE TM54 assessments - We try to engage with tenants on operational energy use
- The London plan and this consultation are crude and wrong to focus on a single number [the carbon reduction target] – there should be more emphasis on high quality, efficient buildings - The Mayor should encourage improvements eg use of CIBSE TM54 assessments, which we use on all our projects - Local authorities have inadequate skills and resources, and there are wide variations between boroughs; maybe the GLA should provide more guidance? - Part L and London Plan approach: ○ The London Plan is not pitched correctly and it is wrong to put emphasis on savings against part L, which do not translate in practice. The question should be how to really reduce carbon. ○ The London Plan should focus on real issues ie fabric, in-use consumption, and the right level of modelling, not just Part L. applicants should be ask to provide information on the approach to carbon reduction, design measures, how site constraints have been addressed etc, not just to produce a number against part L ○ Part L is not fundamentally wrong, it could be improved but would need government's effort - Viability appraisals (and profit margins) are not fully transparent - We engage with our tenants, but it is difficult on energy issues; we encourage SKA for fit-outs - The performance gap ○ This needs to be addressed ○ Some local authorities (eg Islington) ask for monitoring information post-completion, this is good - Carbon offsets ○ Technically they should not be allowed ○ We [applicants] do not know how and where the money is spent: this should change, we should know. ○ We should have some control to cut carbon / spend money on our own portfolio, or in nearby areas
- Carbon savings on site are more expensive than carbon offset payments, but we [as a developer and portfolio owner] seek to maximise on site savings as part of corporate responsibility and BREEAM objectives - There should be more guidance on carbon offsets and more flexibility for developers / land owners to spend it on their estate or near e.g. extensions to our community heating schemes - We engage with our tenants (very much in offices, starting with retail tenants) and encourage energy efficient and bream-compliant fit-outs
- Carbon offsets are much cheaper than on-site savings - Part L is not guarantee of actual carbon savings - Maybe the GLA could encourage the use of CIBSE TM54? - The performance gap is a real issue. The GLA should encourage monitoring of consumption in operation, for example as in Islington - There is currently too much emphasis on community heating and CHP, leading to CHP sometimes installed where it is not suitable eg small residential schemes (e.g. 80 residential units), far from any future network
- The london plan should be used to encourage collaboration between developers, and city-wide, to deliver much larger carbon savings - part l ○ it is meant as a compliance tool but is often used as design tool, which is a problem. this limits thinking and aspirations beyond compliance ○ it is limited in that it looks at individual buildings and individual components ○ it is no guarantee of carbon savings in practice - there is a big lack of compliance and enforcement. There is often no robust as-built assessment - there are large opportunities for carbon savings with unregulated loads, eg IT (thin client, off-site servers etc) - a stretching target is useful to drive innovation, but we should be careful not to introduce too much complexity. a problem with complexity and innovation is it is often introduced by people who will not be involved in the operation of the building

9.0 Appendix B – Part L Modelling - Additional Information

The main building characteristics and modelling inputs are described in the main body of the report. This section provides additional details, for information.

1.1 General Parameters

Weather Data: CIBSE London TRY (Test Reference Year)

Electricity Power Factor: > 0.95

Do Lighting Systems Have Provision for Metering? YES

Lighting Systems Metering Warns of 'out of range' Values YES

Table 9.1 Air permeability

Air permeability($m^3/hr/m^2$ @ 50Pa)			
	Baseline building	Part L2A 2013 limit	Notional Part L2A 2013 Building
High rise office, Premium hotel, Warehouse/industrial development	3	10	Varies
Medium/low rise office, Budget hotel and Large retail park	5	10	Varies
Ground floor commercial	8	10	Varies

1.2 Internal Conditions (NCM Activities)

Table 9.2 Internal conditions - High-Rise Office

Area	NCM Activity
Car park	NCM Office: Car park
Changing facilities	NCM Office: Changing facilities
Circulation area	NCM Office: Circulation area
Cupboard	NCM Office: Cupboard
Eating/drinking area	NCM Office: Eating/drinking area
Floor and ceiling cavity	NCM unheated space
Food preparation area	NCM Office: Food preparation area
Light plant room	NCM Office: Light plant room
Office / meeting rooms	NCM Office: Office
Retail	Do not include room in analysis
Reception	NCM Office: Reception
Toilet	NCM Office: Toilet
Unheated space	NCM unheated space

Table 9.3 Internal conditions - Medium / Low-Rise Office

Area	NCM Activity
Circulation area	NCM Office: Circulation area
Cupboard	NCM Office: Cupboard
Eating/drinking area	NCM Office: Eating/drinking area
Floor and ceiling cavity	NCM unheated space
Food preparation area	NCM Office: Food preparation area
Office / meeting rooms	NCM Office: Office
Reception	NCM Office: Reception
Toilet	NCM Office: Toilet
Unheated space	NCM unheated space

Table 9.4 Internal conditions – Premium hotel

Area	NCM Activity
Bathroom	NCM Hotel: Bathroom
Bedroom	NCM Hotel: Bedroom
Breakout Zone	NCM Hotel: Office (Tea)
Changing Rooms	NCM Hotel: Changing Facilities
Circulation	NCM Hotel: Circulation Area
Conference Room	NCM Hotel: Office (Open)
Entrance / Reception	NCM Hotel: Reception
Gym	NCM Hotel: Fitness Suite / Gym
Kitchen	NCM Hotel: Food Preparation Area
Linen	NCM Hotel: Cupboard
Meeting Room	NCM Hotel: Office (Meeting)
Plant Room	NCM Hotel: Light Plant Room
Restaurant	NCM Hotel: Eating / Drinking Area
Staff Area	NCM Hotel: Office (Common)
Stairs	NCM Hotel: Circulation
Swimming Pool	NCM Hotel: Swimming Pool
Toilets	NCM Hotel: Toilet

Table 9.5 Internal conditions – Budget hotel

Area	NCM Activity
Café / Drinks Area	NCM Hotel: Eating / Drinking Area
Circulation	NCM Hotel: Circulation
En Suite	NCM Hotel: Bathroom
Entrance Area	NCM Hotel: Reception
Guest Room	NCM Hotel: Bedroom
Linen	NCM Hotel: Laundry
Managers Office	NCM Hotel: Office
Plant Room	NCM Hotel: Light Plant Room
Staff Change	NCM Hotel: Changing Facilities
Staff Room	NCM Hotel: Office (Common)
Stairs	NCM Hotel: Circulation
Storage	NCM Hotel: Cupboard
Toilets	NCM Hotel: Toilet

Table 9.6 Large retail park

Area	NCM Activity
A1 Retail – Sales Area	NCM Ret: Sales Area - General
A1 Retail – Circulation	NCM Ret: Circulation Area
A1 – Cupboard	NCM Ret: Cupboard
A1 – Office	NCM Ret: Office
A1 – Tea Room	NCM Ret: Office (Retail: Tea)
A1 – Toilet	NCM Ret: Toilet
A3 – Eating Area	NCM RestPub: Eating/Drinking Area
A3 – Circulation	NCM RestPub: Circulation Area
A3 – Kitchen	NCM RestPub: Food Preparation Area
A3 – Cupboard	NCM RestPub: Cupboard
A3 – Tea Room	NCM RestPub: Office (Tea)
A3 – Toilet	NCM RestPub: Toilet
Warehouse Sales Area	NCM RetW: Retail Warehouse Sales Area – general (Warehouse)
Warehouse Circulation	NCM Ret: Circulation Area
Warehouse Tea Room	NCM Ret: Office (Retail:Tea)
Warehouse Changing Facilities	NCM Ret: Office (Retail:Changing)
Warehouse Cupboard	NCM Ret: Cupboard
Warehouse Toilets	NCM Ret: Toilet
Unheated Space	NCM: Unheated Space

Table 9.7 Warehouse/industrial development

Area	NCM Activity
Warehouse	NCM Ware: Warehouse Storage
Toilets	NCM Ware: Toilet
Store	NCM Ware: Cupboard
Reception	NCM Ware: Reception
Office	NCM Ware: Office
Meeting Room	NCM: Office (Warehouse: Meeting)
Plant	NCM Ware: Light Plant Room
Break out / eating area	NCM Ware: Eating / Drinking Area
Circulation Space	NCM Ware: Circulation Area
Changing Facilities	NCM Ware: Changing Facilities

Table 9.8 Ground Floor Retail / Commercial (with Residential above)

Area	NCM Activity
A1 Retail – Sales Area	NCM Ret: Sales Area – General
A1 Retail – Circulation	NCM Ret: Circulation Area
A1 – Cupboard	NCM Ret: Cupboard
A1 – Office	NCM Ret: Office
A1 – Staff / Tea Room	NCM Ret: Office (Retail: Tea)
A1 – Toilet	NCM Ret: Toilet
A3 – Eating Area	NCM RestPub: Eating/Drinking Area
A3 – Kitchen	NCM RestPub: Food Preparation Area
A3 – Tea Room	NCM RestPub: Office (Tea)
A3 – Toilets	NCM RestPub: Toilet
D2 Gym – Office	NCM D2Ct: Office (SportsCtr: Meeting)
D2 Gym – Store	NCM D2Ct: Cupboard (SportsCtr)
D2 Gym – Changing Facilities	NCM D2Ct: Changing Facilities (SportsCtr)
D2 Gym – Circulation	NCM D2Ct: Circulation Area (SportsCtr)
D2 Gym – Toilet	NCM D2Ct: Toilet (SportsCtr)
D2 Gym – Gym/Studio	NCM D2Ct: Fitness Suite/Gym (SportsCtr)

1.3 Construction Properties

Table 9.9 Construction properties

Building type	U-value	Part L2A 2013 Maximum U-value	Notional Building (L2A 2013) U-value
	W/m²K	W/m²K	W/m²K
All			
Basement walls	As per notional	0.35	0.26
Ground floor	As per notional (warehouse and large retail = 5% improvement)	0.25	0.22
Roof	As per notional (warehouse and large retail = 5% improvement)	0.25	0.18
Vehicle access and similar large doors	As per notional (warehouse = 5% improvement)	1.5	1.5
Pedestrian doors and high usage entrance doors	As per notional (warehouse and large retail = 5% improvement)	2.2	2.2
Internal wall	As per notional	N/A	1.8
Internal floor / ceiling	As per notional	N/A	1
High rise office and Premium Hotel			
Curtain wall - opaque panels (inc frame)	1.3	2.2 (curtain walling)	0.26 (wall)
Curtain wall - transparent panels (inc frame)	1.3	2.2 (windows)	1.6 (windows)
External wall	0.26	0.35	0.26 (wall)
Medium / Low-rise office and Budget Hotel			
External wall	As per notional	0.35 (wall)	0.26 (wall)
Glazing (inc frame)	1.3	2.2 (windows)	1.6 (windows)
Large Retail Park			
External wall	0.23 (10-15% improvement over notional)	0.35 (wall)	0.26 (wall)
Glazing	1.75	2.2 (windows)	1.6 (windows)
Warehouse / Industrial Development			
External wall	0.25 (5% improvement over notional)	0.35 (wall)	0.26 (wall)
Glazing	1.5 (5% improvement over notional)	2.2 (windows)	1.6 (windows)
Ground Floor Retail / Commercial (with Residential above)			
External wall	As per notional	0.35 (wall)	0.26 (wall)
Glazing	1.75 (display) 1.6 (non-display) i.e. A3 and office	2.2 (windows)	1.6 (windows)

1.4 Glazing Properties

Table 9.10 Glazing properties

Product	g-value	Light transmittance	U-Value (centre pane)	U-Value (inc frame)	Frame factor
			W/m²K	W/m²K	
High rise office, Premium hotel	0.27	0.5	1	1.3	10%
Medium/low rise office, Budget hotel	0.4	0.71	0.9	1.3	10%
Warehouse	0.63	0.74	1.3	1.5	10%
Large Retail	0.63	0.76	1.6	1.75	10%
Ground Floor Commercial	0.40	0.71	1.2	1.6	10%

1.5 Lighting

Table 9.11 Lighting - High rise office, Medium/low rise office

Area	Lighting (W/m²)
Car park	4
Open plan office (high rise only)	6
Open plan office (Medium/low rise only)	8
Changing facilities, Circulation area, Cupboard, Eating/drinking area, Food preparation area, Light plant room, cellular office / meeting rooms, Toilet	8
Reception	12

Table 9.12 Lighting - Premium Hotel

Area	Lighting W/m²
Bathroom	6.75
Bedroom	3.84
Breakout Zone	15
Changing Rooms	5.2
Circulation	5.2
Conference Room	11
Entrance / Reception	10.4
Gym	7.8
Kitchen	26
Linen	1.9

Meeting Room	15
Plant Room	7.5
Restaurant	7.8
Staff Area	15
Stairs	5.2
Swimming Pool	15.6
Toilets	10.4

Table 9.13 Lighting - Budget Hotel

Area	Lighting W/m^2
Café / Drinks Area	7.8
Circulation	4.8
En Suite	7.125
Entrance Area	10.4
Guest Room	3.827
Linen	1.875
Managers Office	15
Plant Room	7.5
Staff Change	5.2
Staff Room	15
Stairs	4.8
Storage	1.875
Toilets	10.4

Table 9.14 Lighting - Large Retail Park

Area	Lighting
Display (as per notional)	as per notional / Part L 2013
General (as per notional)	120 lumens/W

Table 9.15 Lighting - Warehouse

Area	Lighting
Display (as per notional)	as per notional
General (as per notional)	10% improvement on IES default figures (for warehouse) roughly equates to 10% improvement on Part L 2013 notional

Table 9.16: Lighting - Small Retail / Ground Floor Commercial

Area	Lighting
Display (as per notional)	as per notional / Part L 2013
General (as per notional)	120 lumens/W

1.6 Lighting Controls

Table 9.17: Lighting

Building type	Occupancy sensing	Daylight sensing
High rise office, Medium/low rise office	AUTO-ON-OFF (Foc = 0.90)	YES - Standalone, Dimming with Different Sensor to Control Back Half (only to zones with access to daylight).
Premium hotel	AUTO-ON-OFF (Foc = 0.90)	Standalone, Dimming – office, reception, restaurant and meeting rooms
Warehouse	AUTO-ON-OFF (Foc = 0.90)	Standalone, Dimming – warehouse zones only
Budget hotel, Large retail, Small Retail / Ground Floor Commercial	AUTO-ON-OFF (Foc = 0.90)	NO

All – parasitic power left as default 0.1W/m^2

1.7 HVAC Zones

The below table lists the current assumptions for the **main** HVAC system, excluding other systems in smaller areas e.g. extract only in toilets etc.

Table 9.18: Main HVAC System - High rise office, medium/low rise office (meeting rooms only)

Detail		Value
	UK NCM System Type	Fan coil system
Adjustment & Metering	Ductwork Air Leakage CEN Classification	Class B
	AHU Air Leakage CEN Classification	Class L2
	System Specific Fan Power (SFP)	1.6 W/l/s
	Terminal SFP	0.25 W/l/s
	Pump Type	Variable speed multiple pressure sensors
	Does the System have Provision for Metering	Y
	Does the Metering Warn "Out of Range" Values?	Y
	Cooling / Ventilation Mechanism	Air conditioning

Ventilation	Air Supply Mechanism	Centralised A/C or mechanical ventilation
	Heat Recovery Type	Thermal Wheel
	Heat Recovery Seasonal Efficiency	0.70

Table 9.19: Main HVAC System - Medium/low rise office (excluding meeting rooms)

	Detail	Value
	UK NCM System Type	Central Heating using water
Adjustment & Metering	Ductwork Air Leakage CEN Classification	Class B
	AHU Air Leakage CEN Classification	Class L2
	System Specific Fan Power (SFP)	1.6 W/l/s
	Terminal SFP	-
	Pump Type	Variable speed multiple pressure sensors
	Provision for Metering?	Yes
	Warn "Out of Range" Values?	Yes
Ventilation	Cooling / Ventilation Mechanism	Mechanical Ventilation
	Air Supply Mechanism	Centralised A/C or mechanical ventilation
	Heat Recovery Type	Thermal Wheel
	Heat Recovery Seasonal Efficiency	0.70

Table 9.20: Main HVAC System - Premium hotel

	Detail	Value
	UK NCM System Type	Fan coil system
Adjustment & Metering	Ductwork Air Leakage CEN Classification	Class B
	AHU Air Leakage CEN Classification	Class L2
	System Specific Fan Power (SFP)	1.8 W/l/s
	Terminal SFP	0.25 W/l/s
	Pump Type	Variable speed multiple pressure sensors
	Does the System have Provision for Metering	Yes
	Does the Metering Warn "Out of Range" Values?	Yes
Ventilation	Cooling / Ventilation Mechanism	Air conditioning
	Air Supply Mechanism	Centralised A/C or mechanical ventilation
	Heat Recovery Type	Thermal Wheel
	Heat Recovery Seasonal Efficiency	0.70

Table 9.21: Main HVAC System - Budget hotel

Detail		Value
	UK NCM System Type	Central Heating using water
Adjustment & Metering	Ductwork Air Leakage CEN Classification	Class B
	AHU Air Leakage CEN Classification	Class L2
	System Specific Fan Power (SFP)	1.8 W/l/s
	Terminal SFP	-
	Pump Type	Variable speed multiple pressure sensors
	Provision for Metering?	Yes
	Warn "Out of Range" Values?	Yes
Ventilation	Cooling / Ventilation Mechanism	Mechanical Ventilation
	Air Supply Mechanism	Centralised A/C or mechanical ventilation
	Heat Recovery Type	Thermal Wheel
	Heat Recovery Seasonal Efficiency	0.70

Table 9.22: Main HVAC System - Large Retail

Detail		Value
	UK NCM System Type	Fan coil system
Adjustment & Metering	Ductwork Air Leakage CEN Classification	Class B
	AHU Air Leakage CEN Classification	Class L2
	System Specific Fan Power (SFP)	1.6 W/l/s
	Terminal SFP	0.25 W/l/s
	Pump Type	Variable speed multiple pressure sensors
	Provision for Metering?	Y
	Does the Metering Warn "Out of Range" Values?	Y
Ventilation	Cooling / Ventilation Mechanism	Air conditioning
	Air Supply Mechanism	Centralised A/C or mechanical ventilation
	Heat Recovery Type	Thermal Wheel
	Heat Recovery Seasonal Efficiency	0.77 (10% improvement from notional)

Table 9.23: Main HVAC System - Warehouse

Detail		Value
	UK NCM System Type	Unflued forced air heaters
Adjustment & Metering	Ductwork Air Leakage CEN Classification	Class B
	AHU Air Leakage CEN Classification	Class L2
	System Specific Fan Power (SFP)	0.9 W/l/s (as per notional)
	Provision for Metering?	Y
	Warn "Out of Range" Values?	Y
Ventilation	Cooling / Ventilation Mechanism	Mechanical Ventilation
	Air Supply Mechanism	Centralised A/C or mechanical ventilation
	Heat Recovery Type	None (extract only system)
	Heat Recovery Seasonal Efficiency	N/A

Table 9.24: Main HVAC System - Small Retail / Ground Floor Commercial

Detail		Value
	UK NCM System Type	Fan coil system
Adjustment & Metering	Ductwork Air Leakage CEN Classification	Class B
	AHU Air Leakage CEN Classification	Class L2
	System Specific Fan Power (SFP)	1.8 W/l/s (as per notional)
	Terminal SFP	0.3 W/l/s (as per notional)
	Pump Type	Variable speed multiple pressure sensors
	Provision for Metering?	Y
	Warn "Out of Range" Values?	Y
Ventilation	Cooling / Ventilation Mechanism	Air conditioning
	Air Supply Mechanism	Centralised A/C or mechanical ventilation
	Heat Recovery Type	Thermal Wheel
	Heat Recovery Seasonal Efficiency	0.70 (as per notional)

1.8 Heating and Cooling

Table 9.25: Heating and Cooling efficiencies

	Heating (CoP)	Cooling (SEER)
High rise office, Premium hotel,	95%	6.5
Medium/low rise office, Budget hotel,	95%	No cooling (except meeting rooms and staff rooms 5.0)
Large retail	95% for DHW 3.12 (ASHP) for space heating (10% improvement on notional)	4.5
Warehouse	95% except server: 3.12 (ASHP) (10% improvement on notional)	No cooling except server: 4.5
Small retail	2.84 (ASHP) (as per notional)	4.74 (ASHP) (as per notional)

1.9 DHW

High rise office

Storage volume:	1,700litres
Storage losses;	0.0047 kWh/l.day
Secondary circulation loop length:	200m
Losses:	10W/m (default)
Time switch:	YES
Pump Power:	200W (default)

Low rise office

Instantaneous hot water only

DHW delivery efficiency 0.9

Premium hotel

Storage volume:	12,375litres
Storage losses;	0.0047 kWh/l.day
Secondary circulation loop length:	500m
Losses:	8W/m
Time switch:	YES
Pump Power:	750W

Budget hotel

Storage volume:	4,900litres
Storage losses;	0.0047 kWh/l.day
Secondary circulation loop length:	200m
Losses:	10W/m
Time switch:	YES
Pump Power:	200W

Large retail

Storage volume:	1,300litres
Storage losses;	0.0047 kWh/l.day
Secondary circulation loop length:	100m
Losses:	10W/m (default)
Time switch:	YES
Pump Power:	200W (default)

Warehouse

Storage volume:	400litres
Storage losses;	0.0047 kWh/l.day
Secondary circulation loop length:	50m
Losses:	10W/m (default)
Time switch:	YES
Pump Power:	200W

Small retail

Storage volume:	1,200litres
Storage losses;	0.0047 kWh/l.day
Secondary circulation loop length:	50m
Losses:	10W/m (default)
Time switch:	YES
Pump Power:	100W

10.0 Appendix C - Detailed Viability Assessment

This section sets out the assumptions and inputs used for the detailed viability assessment of each of the building types tested.

10.1 Overview and Limitations

The building types were selected to provide a representative cross section of commercial development across London. Due the financial and time constraints applied to this study, it has not been possible to test all types across a range of locations, nor to expand the building types to include more specialist uses such as buildings used for education purposes, places of worship, student accommodation, laboratories, airports, railway stations, major covered shopping malls, community facilities, hospitals etc.

This is in line with National Planning Policy Guidance:

"Assessing the viability of plans does not require individual testing of every site or assurance that individual sites are viable; site typologies may be used to determine viability at policy level. Assessment of samples of sites may be helpful to support evidence and more detailed assessment may be necessary for particular areas or key sites on which the delivery of the plan relies." [1]

"Evidence should be proportionate to ensure plans are underpinned by a broad understanding of viability. Greater detail may be necessary in areas of known marginal viability or where the evidence suggests that viability might be an issue – for example in relation to policies for strategic sites which require high infrastructure investment."[2]

The examples which have been selected are intended to be indicative of the majority of commercially driven development in the Capital. The locations that have been tested include representation in north, south, east, west and central London, and are intended to be the types of location in which to subject building type might normally be considered suitable for development. Clearly all sites will be different, and the market will only bring forward development proposals in locations that are considered to be appropriate and capable of supporting a viable baseline development.

10.2 Baseline Scheme Assumptions

Each development type is appraised against a set of market assumptions researched for the general location of the indicative scheme as set out on the following pages. In addition to these assumptions, a 5 per cent cost contingency has been included in all appraisals. The appraisals have been carried out using industry standard Argus Developer software.

[1] National Planning Policy Guidance, paragraph 5, http://planningguidance.planningportal.gov.uk/blog/guidance/viability-guidance/viability-and-plan-making/
[2] Ibid., paragraph 6

Study 1
High Rise Offices

Assumed indicative location: Tower Hamlets City Fringe

Summary of indicative development:

Floor area: GIA	49,600 m2 includes basement
Storey height	2.75M
No of floors	32
Footprint	40m X 40m
2 basement levels	Assumed to provide 160 spaces in total (or other equivalent uses for costing purposes)

Ground floor reception and other support facilities
26 floors open plan offices
1 floor café, break out space etc
1 floor meeting/conference/small catering
Roof accommodating plant

Appraisal assumptions:

Net to gross area	82% (in line with assumption adopted for Tower Hamlets CIL viability assessment)
Office rental value	£42 psf – based on market evidence (454/m2)
Rent Free Period	24 months
Yield	5.75%
Purchasers costs	5.75%
Baseline Build costs	£2,288/M2 including basement
Demolition	Assumed existing on site floor space extending to 25% of the proposed floor space, and a demolition cost of £10 per M2

Site works and off site works additional 10% of build costs

Professional fees	10% of total build costs
CIL	£125 per M2 for additional floor space plus £35 Mayoral CIL
Letting fees	10% of rent
Letting legal fees	5% of rent
Sales agent fees	1.25% sale price
Sales legal fees	0.5% sale price

Finance 6.75% on land and buildings

Construction period	9 months lead in 21 months build 3 months post construction
Profit on cost	20%

Study 2
Medium/Low Rise Offices

Assumed indicative location: Tower Hamlets (other – good quality secondary location)

Summary of indicative development:

Floor area: GIA	5040 m2
Storey height	2.75M
No of floors	6
Footprint	14m X 60m

Ground floor reception and other support facilities
2 meeting rooms per floor
50% open plan offices, 50% cellular
Small staff kitchen

Appraisal assumptions:

Net to gross area	82% (in line with assumption adopted for TH CIL viability assessment)
Office rental value	£30 psf – based on market evidence (323/m2)
Rent Free Period	12 months
Yield	6%
Purchasers costs	5.75%
Baseline Build costs	£2110/M2

Demolition Assumed existing on site floor space extending to 25% of the proposed floor space, and a demolition cost of £10 per M2
Road/site works including surface car parking additional 10% of build costs

Professional fees	10% of total build costs
CIL	Mayoral CIL £35
Letting fees	10% of rent
Letting legal fees	5% of rent
Sales agent fees	1.25% sale price
Sales legal fees	0.5% sale price

Finance 6.75% on land and buildings

Construction period	6 months lead in
	14 months build
	3 months post construction
Profit on cost	20%

Study 3
Premium Hotel

Assumed indicative location: Hammersmith & Fulham/Kensington & Chelsea borders, high quality facilities

Summary of indicative development:

Floor area: GIA	17640 m2
Rooms	275 – 225 First Class 35.8m2; 50 Luxury 41.8m2
No of floors	14
Floor to ceiling height	3.0m

Ground floor reception, restaurants & Kitchen, fitness suite including pool, plant room, storage and other support facilities
1st floor – conference facilities, offices, meeting rooms, storage etc

Appraisal assumptions:

Net to gross area	75%
Rental value	£500/m2 (overall) equates to circa £22,500 per room plus additional income from restaurants, conference, offices, meeting rooms, leisure facilities of circa £120,000pa
Rent Free Period	12 months
Yield	6.25%
Purchasers costs	5.75%
Baseline Build costs	£2797/M2
Demolition	Assumed existing on site floor space extending to 25% of the proposed floor space, and a demolition cost of £10 per M2
Road/site works and off site works	additional 10% of build costs
Professional fees	10% of total build costs
CIL	Mayoral CIL £50
Letting fees	10% of rent
Letting legal fees	5% of rent
Sales agent fees	1.25% sale price
Sales legal fees	0.5% sale price
Finance	6.75% on land and buildings
Construction period	9 months lead in 21months build 3 months post construction
Profit on cost	20%

Study 4
Budget Hotel

Assumed indicative location: Hillingdon, related to Heathrow Airport

Summary of indicative development:

Floor area: GIA	4200 m2
Rooms	140
No of floors	5
Floor to ceiling height	2.75m

Basement storage
Ground floor reception, cafe and other support facilities
1st floor – conference facilities, offices, meeting rooms, storage etc

Appraisal assumptions:

Net to gross area	75%
Rental value	£330/m2 (circa £7,600 per room plus circa £40,000 income from other facilities)
Rent Free Period	6 months
Yield	6.75%
Purchasers costs	5.75%
Baseline Build costs	£1830/M2
Demolition	Assumed existing on site floor space extending to 25% of the proposed floor space, and a demolition cost of £10 per M2
Road/site works	including surface car parking additional 10% of build costs
Professional fees	10% of total build costs
CIL	Mayoral CIL £35
Letting fees	10% of rent
Letting legal fees	5% of rent
Sales agent fees	1.25% sale price
Sales legal fees	0.5% sale price
Finance	6.75% on land and buildings
Construction period	6 months lead in 12 months build 3 months post construction
Profit on cost	20%

Study 5
Retail Park

Assumed indicative location: Barnet NW14
Summary of indicative development:

Floor area: GIA	16200 m2
Units	12
No of floors	1
Floor to ceiling height	6m

Retail park anchored by large unit, with a mix of smaller units and restaurants

Appraisal assumptions:

Net to gross area	90%
Rental value	£range from 215-260/m2 retail (circa £21.25 - £24 psf) to 325/m2 restaurants (circa £30 psf)
Rent Free Period	24 months
Yield	5.75% (anchor tenant) through to 7%(restaurants)
Purchasers costs	5.75%
Baseline Build costs	£860/m2
Demolition	Assumed existing on site floor space extending to 25% of the proposed floor space, and a demolition cost of £10 per M2
Surface car parking	800 surface spaces
Professional fees	10% of total build costs
CIL	135 Barnet plus £35 mayoral
Letting fees	10% of rent
Letting legal fees	5% of rent
Sales agent fees	1.25% sale price
Sales legal fees	0.5% sale price
Finance 6.75% on land and buildings	
Construction period	6 months lead in 12 months build 3 months post construction
Profit on cost	20%

Fit out completed by the tenants in accordance with market practice

Study 6
Distribution warehouse

Assumed indicative location: London Borough of Brent
Summary of indicative development:

Floor area: GIA	10000 m2
Units	1
No of floors	1
Floor to ceiling height	14m

Warehouse/industrial unit with 5% ancillary office space and services

Appraisal assumptions:

Net to gross area	95%
Rental value	£110/m2 (circa £10 psf)
Rent Free Period	6 months
Yield	8%
Purchasers costs	5.75%
Baseline Build costs	£560 per m2

Demolition Assumed existing on site floor space extending to 25% of the proposed floor space, and a demolition cost of £10 per M2
Site works and off site works additional 10% of build costs

Surface car parking	25 lorry spaces and 60 car spaces
Professional fees	10% of total build costs
CIL	Mayoral CIL £35
Letting fees	10% of rent
Letting legal fees	5% of rent
Sales agent fees	1.25% sale price
Sales legal fees	0.5% sale price

Finance 6.75% on land and buildings

Construction period	6 months lead in 9 months build 3 months post construction
Profit on cost	20%

Tenant fit out applies: shell other than 5% office fitted out

Study 7
Commercial element of mixed use

Assumed indicative location: Merton (South Wimbledon)
Summary of indicative development:

Floor area: GIA	2200 m2
Units	5
No of floors	Ground and Basement (Residential above)
Floor to ceiling height	3.5m

Mix of small commercial uses under residential development including restaurant, shops, gym, small offices

Appraisal assumptions:

Net to gross area	85%
Rental value	£350/m2 (averaged across uses) (circa £32.50 psf average)
Rent Free Period	24 months
Yield	8%
Purchasers costs	5.75%
Baseline Build costs	£1321 blended rate
Demolition	Assumed existing on site floor space extending to 25% of the proposed floor space, and a demolition cost of £10 per M2
Site works and off site works	additional 10% of build costs
Professional fees	10% of total build costs
CIL	Merton CIL of £100/M2 plus Mayoral CIL £35
Letting fees	10% of rent
Letting legal fees	5% of rent
Sales agent fees	1.25% sale price
Sales legal fees	0.5% sale price
Finance	6.75% on land and buildings
Construction period	6 months lead in 15 months build with 100 flats above 3 months post construction
Profit on cost	20%

All shell finish other than small offices

10.3 Costing of Technical Options (Baseline and on site carbon dioxide reductions)

Gardiner & Theobald's baseline costings for each case study are set out below. Costings for each 'baseline' building types are based on area rates (i.e. £/square foot or £/sqm, as applicable) based on Gardiner and Theobald's previous experience and the exercise of professional judgement informed by this previous experience. Where considered appropriate to the building type and level of information available, more detailed costings were carried out, i.e. for the high-rise office, low/mid-rise office, and warehouse.

CASE STUDY 3 BASELINE COSTS

SCENARIO 1 HIGH RISE OFFICES

	Qnt	Unit	Rate	£	£/M2
Basement					
Basement box comprising piled perimeter wall, basement raft slab, intermediate and ground level slabs, waterproofing	34455	sf	116	3,996,780	
Substructure					
Substructure piling	499,454	sf	2	998,908	
Pile caps, ground beams etc	499,454	sf	5	2,497,270	
Superstructure					
Steel frame ground & above with fire protection, bracing and stairs	499,454	sf	30	14,983,620	
External walls					
External walls assuming 4m floor to floor panelised system	18,560	m2	900	16,704,000	
Allowance for roof plant louvres and support	640	m2	500	320,000	
Entrance revolving doors	2	no	50000	100,000	
Escape doors/pass doors	6	no	10000	60,000	
Cleaning gantries	1	no	400000	400,000	
Roof coverings					
Roof coverings	1600	m2	120	192,000	
Rainwater installation	1	no	50000	50,000	
Internal Walls & Partitions					
Lightweight construction ncore walls and doors	499,454	sf	5	2,497,270	
Internal Finishes					
Office finishes comprising raised floor, suspended ceiling, decorations etc say 82%of GEA	38,048	m2	85	3,234,080	
Core finishes	6,960	m2	150	1,044,000	
Fixtures & Fittings					
Toilet cubicles, sanitary ware, vanoty units, signage, handrails & balustrades etc	499,454	sf	5	2,497,270	
Mechanical & Electrical					
Chillers, Ahu's, Boilers, pipework & ductwork distribution, fan coils. Hot & cold water.Soil & Vent Pipework. Electric switchgear & distribution. Landlord small power. Lighting to offices Fire alarm & smoke detection, sprinklers.	499,454	sf	50	24,972,700	
Heat recovery				incl	
Best practice chillers				incl	
LED lighting	499,454	sf	1.2	599,345	
PV'S	160	m2	600	96,000	
Power to offices	409,552	sf	3	1,228,657	
Builders Work					
Holes, fire stopping, support steelwork, gantries etc	5	%		1,248,635	
Lifts					
Lifts basement to level 29	8	no	375000	3,000,000	
External Works,					
Hard and soft landscaping etc	499,454	sf	6	2,996,724	
				83,717,259	
Preliminaries	14	%		11,720,416	
				95,437,676	
Overheads & Profit	6	%		5,726,261	
				101,163,936	
Contractor Risk	2	%		2,023,279	
				103,187,215	
Contingency	10%			10,318,721	
Total				113,505,936	
Cost Per m2					2288

CASE STUDY 3 BASELINE COSTS

SCENARIO 2 MED RISE OFFICES

	Qnt	Unit	Rate	£	£/M2
Substructure					
Substructure piling	54,250	sf	2	108,500	
Pile caps, ground beams etc	54,250	sf	5	271,250	
Superstructure					
Steel frame ground & above with fire protection, bracing and stairs	54,250	sf	25	1,356,250	
External walls					
External walls assuming 4m floor to floor stick system	3,552	m2	650	2,308,800	
Allowance for roof plant louvres and support	444	m2	450	199,800	
Entrance revolving doors	1	no	35,000	35,000	
Escape doors/pass doors	2	no	10,000	20,000	
Roof coverings					
Roof coverings	840	m2	100	84,000	
Rainwater installation	1	no	30,000	30,000	
Internal Walls & Partitions					
Lightweight construction ncore walls and doors	54,250	sf	5	271,250	
Internal Finishes					
Office finishes comprising raised floor, suspended ceiling, decorations etc say 82%of GEA	4,133	m2	80	330,624	
Core finishes	756	m2	140	105,840	
Fixtures & Fittings					
Toilet cubicles, sanitary ware, vanity units, signage, handrails & balustrades etc	54,250	sf	4.5	244,125	
Mechanical & Electrical					
Chillers, Ahu's, Boilers, pipework & ductwork distribution, fan coils. Hot & cold water.Soil & Vent Pipework. Electric switchgear & distribution. Landlord small power. Lighting to offices Fire alarm & smoke detection, sprinklers.	54,250	sf	40	2,170,000	
Heat recovery			incl		
Daylight sensing to lighting			incl		
Power to offices	44,486	sf	2.5	111,215	
PV'S to 10%	84	m2	600	50,400	
Builders Work					
Holes, fire stopping, support steelwork, gantries etc	3	%		65,100	
Lifts					
Lifts basement to level 5	2	no	78,000	156,000	
External Works,					
Hard and soft landscaping etc	54,250	sf	5	271,250	
				6,189,404	
Preliminaries	12	%		982,728	
				9,172,132	
Overheads & Profit	5	%		458,607	
				9,630,739	
Contractor Risk	1	%		96,307	
				9,727,046	
Contingency	10%			972,705	
Total				10,699,751	
Cost Per m2					2123

CASE STUDY 3 BASELINE COSTS

SCENARIO 3 PREMIUM HOTEL

Premium hotel	17640m2	189790 sf	260	49345400
Cost/m2				2797

CASE STUDY 3 BASELINE COSTS

SCENARIO 4 BUDGET HOTEL

Budget hotel	4200m2	45210 sf	170	7685700
				7685700 **1830/M2**

CASE STUDY 3 BASELINE COSTS

SCENARIO 5 RETAIL PARK

					£/M2
Retail warehouse in shell	5000m2	53820 sf	60	3,229,200	
Med retail in shell	4000m2	43060 sf	70	3,014,200	
Small retail in shell	6000m2	64585 sf	80	5,166,800	
Restaurants in shell	1200m2	12920 sf	120	1,550,400	
				12,960,600	800
PV'S to10%	1,610 m2		500	805,000	
Preliminaries	8 %			64,400	
				869,400	
Overheads & Profit	5 %			43,470	
				912,870	
Contractor Risk	1 %			9,129	
				921,999	
Contingency	10%			92,200	1,014,199	63
				13,974,799	**863**

CASE STUDY 3 BASELINE COSTS

SCENARIO 6 WAREHOUSING

	Qnt	Unit	Rate	£	£/M2
Substructure piling					
Pile caps, ground beams etc	107,641	sf	3	322,923	
Warehouse slab	9,771	m2	40	390,840	
Superstructure					
Steel frame 14m to haunch	104,951	sf	9	944,559	
Steel frame to offices and fire protection	5,380	m2	10	53,800	
Deck to office say 50% office area	500	m2	60	30,000	
External walls					
Insulated composite wall cladding on purlins	7,105	m2	70	497,350	
EO allowance for office windows	128	m2	400	51,200	
Entrance screen & doors	1	no	20,000	20,000	
Escape doors/pass doors	10	no	2,000	20,000	
Lining to external office walls	340	m2	20	6,800	
Roof coverings					
Roof coverings	9,771	m2	70	683,970	
Rooflights 15% EO	840	m2	30	25,200	
Rainwater installation	490	m	100	49,000	
Internal Walls & Partitions					
Lightweight construction core walls and doors to offices	5,382	sf	4	21,528	
Separating wall office to warehouse	340	m2	70	23,800	
Internal Finishes					
Office finishes comprising raised floor, suspended ceiling, decorations etc	410	m2	65	26,650	
Core finishes	90	m2	90	8,100	
Fixtures & Fittings					
Toilet cubicles, sanitary ware, vanoty units, signage, handrails & balustrades etc	5,000	sf	3	15,000	
Mechanical & Electrical					
Office ventilation and heating. Hot & cold water.Soil & Vent Pipework. Electric switchgear & distribution. Landlord small power. Lighting to offices Fire alarm & smoke detection.	5,000	sf	28	140,000	
Heat recovery			incl		
Presence detection to lighting			incl		
Power to offices	4,413	sf	2.5	11,033	
Builders Work					
Holes, fire stopping, support steelwork, gantries etc	2	%		2,800	
Lifts					
Lifts 1 level	1	no	25,000	25,000	
External Works,					
External service yards, lorry parking, car parking, landscaping, fencing etc	107,641	sf	10	1,076,410	
				4,445,963	
Preliminaries	8	%		355,677	
				4,801,640	
Overheads & Profit	5	%		240,082	
				5,041,722	
Contractor Risk	1	%		50,417	
				5,092,139	
Contingency	10%			509,214	
Total				5,601,353	
Cost Per m2					560

CASE STUDY 3 BASELINE COSTS

SCENARIO 7 GROUND FLOOR COMMERCIAL WITH RESIDENTIAL ABOVE

				£	£/M2
Restaurant in shell	300m2	3230 sf	100	323,000	
Small retail in shell	200m2	2150 sf	100	215,000	
Gym in shell	700m2	7535 sf	100	753,500	
Offices up to CAT A	1000m2	10,765 sf	150	1,614,750	
				2,906,250	1321

The cost assessments for the maximised on-site carbon dioxide reductions option are as follows:

Scenario	1	2	3	4
Area	High Rise Office 49,600	Med/Low Rise Office 5,040	Premium Hotel 17,640	Budget Hotel 4,200
BASE DEVELOPER WORKS				
Building Envelope				
Orientation	[redacted]	No Construction Cost, design constraint	No Construction Cost, design constraint	No Construction Cost, design constraint
U Values	414,720	174,960	Change from glass to solid, assume design constraint rather than cost	162,000
North Facing Rooflights- change in insulation value and light transmitance, rooflights would be provided in base scheme	[redacted]	[redacted]	[redacted]	[redacted]
Reduced glazing to reduce summer solar gain	No Construction Cost, design constraint	No Construction Cost, design constraint	No Construction Cost, design constraint	No Construction Cost, design constraint
Glazing Spaces	276,480	[redacted]	[redacted]	[redacted]
Air tightness	[redacted]	46,656	[redacted]	43,200
HVAC				
Best practice air cooled chiller	IN BASE	[redacted]	705,600	[redacted]
Water cooled chiller Extra to Above	248,000	[redacted]	88,200	[redacted]
10-15% efficiency improvement - Developer Works only	[redacted]	[redacted]	[redacted]	[redacted]
Mixed mode ventilation	[redacted]	151,200	[redacted]	25,200
Thermal mass - Assume Concrete frame as base design	[redacted]	no extra to automated mixed mode	Base design assumed as concrete frame and curtain wall	Base design assumed as concrete frame and some solid elevation
Demand controlled ventilation	161,200	[redacted]	[redacted]	[redacted]
Lighting				
Daylight linking in large areas	[redacted]	[redacted]	105,840	[redacted]
LED/ Improved lighting lighting	IN BASE	60,480	211,680	50,400
Future development of LED lighting	Assumes technological development absorbed in LED price which will reduce as used more widely	[redacted]	[redacted]	[redacted]
Lease agreement for 10-15% improvement	[redacted]	[redacted]	[redacted]	[redacted]
LCT				
Medium PV array 25% roof area, 25% extra to base	[redacted]	[redacted]	287,728	164,640
Medium PV array 25% roof area, 15% extra to base	195,120	98,784	[redacted]	[redacted]
Large PV array 75% roof area,65% extra to 25%	Not reqd	Not reqd	Not reqd	Not reqd
PV array 950m2 to warehouse	[redacted]	[redacted]	[redacted]	[redacted]
PV array 4380m2 to large retail	[redacted]	[redacted]	[redacted]	[redacted]
Total Cost	1,295,520	532,080	1,399,048	445,440
Additional Cost/m2	26.1	105.6	79.3	106.1
TENANT WORKS				
Area	**49,600**	**5,040**	**17,640**	**4,200**
HVAC				
Best practice air cooled chiller	[redacted]	[redacted]	[redacted]	[redacted]
10-15% efficiency improvement - Tenant Works only	[redacted]	[redacted]	[redacted]	[redacted]
Lighting				
Daylight linking in large areas	[redacted]	[redacted]	[redacted]	[redacted]
LED/improved lighting	[redacted]	[redacted]	[redacted]	[redacted]
Lease agreement for 10-15% improvement	[redacted]	[redacted]	[redacted]	[redacted]
LCT				
Medium PV array 25% roof area, 15% extra to base	[redacted]	[redacted]	[redacted]	[redacted]
Large PV array 75% roof area, 65% extra to base	[redacted]	[redacted]	[redacted]	[redacted]
Total Cost	0	0	0	0
Additional Cost/m2	0.0	0.0	0.0	0.0

Scenario	5	6	7
Area	Large Retail Park 16,200	Warehouse/Industrial 10,000	Gnd Flr Retail/ Commercial Above 2,200
BASE DEVELOPER WORKS			
Building Envelope			
Orientation	[redacted]	[redacted]	[redacted]
U Values	10,000	[redacted]	76,371
North Facing Rooflights- change in insulation value and light transmitance, rooflights would be provided in base scheme	Tested but not included in scenario	[redacted]	[redacted]
Reduced glazing to reduce summer solar gain	[redacted]	[redacted]	[redacted]
Glazing Spaces	[redacted]	[redacted]	17,280
Air tightness	81,000	IN BASE	20,366
HVAC			
Best practice air cooled chiller	Empty Units, works by occupiers	[redacted]	[redacted]
Water cooled chiller Extra to Above	[redacted]	[redacted]	[redacted]
10-15% efficiency improvement - Developer Works only	Empty Units, works by occupiers	[redacted]	23,760
Mixed mode ventilation	[redacted]	[redacted]	[redacted]
Thermal mass - Assume Concrete frame as base design	[redacted]	[redacted]	[redacted]
Demand controlled ventilation	[redacted]	[redacted]	[redacted]
Lighting			
Daylight linking in large areas	Empty Units, works by occupiers	IN BASE	[redacted]
LED/ Improved lighting lighting	Empty Units, works by occupiers	12,000	[redacted]
Future development of LED lighting	[redacted]	[redacted]	[redacted]
Lease agreement for 10-15% improvement	[redacted]	18,000	17,820
LCT			
Medium PV array 25% roof area, 25% extra to base	[redacted]	[redacted]	Assumed not feasible
Medium PV array 25% roof area, 15% extra to base	[redacted]	[redacted]	Assumed not feasible
Large PV array 75% roof area,65% extra to 25%			Assumed not feasible
PV array 950m2 to warehouse	[redacted]	598,500	[redacted]
PV array 4380m2 to large retail	2,759,400	[redacted]	[redacted]
Total Cost	2,850,400	628,500	155,597
Additional Cost/m2	176.0	62.9	70.7
TENANT WORKS			
Area	**16,200**	**10,000**	**2,200**
HVAC			
Best practice air cooled chiller	36,000	[redacted]	[redacted]
10-15% efficiency improvement - Tenant Works only	12,000	No a/c to warehouse storage area	29,040
Lighting			
Daylight linking in large areas	38,880	21,600	[redacted]
LED/improved lighting	194,400	108,000	[redacted]
Lease agreement for 10-15% improvement	[redacted]	Assumed in LED cost	21,780
LCT			
Medium PV array 25% roof area, 15% extra to base	[redacted]	In Above	[redacted]
Large PV array 75% roof area, 65% extra to base	[redacted]	In Above	[redacted]
Total Cost	281,280	129,600	50,820
Additional Cost/m2	17.4	13.0	23.1

11.0 Appendix D – Estimated Part L 2013 Performance with Heat Networks

For information, the Part L 2013 performance of each building type was calculated in addition to the calculations carried out as per GLA methodology, which are presented in the main body of this report. This is provided for information only.

Table 11.1: Summary of potential improvement against Part L 2013 from low-carbon heat networks (after all on-site improvement options combined)

Estimated Part L 2013 performance, after all on-site improvements					
Building case study	On-site plant, no network	With high-carbon CHP heat network	With typical CHP heat network (e.g. mixed-use scheme)	With 'best practice' CHP heat network	With best-in-class CHP + biomass low-carbon heat networks
High rise office	39%	39%	39%	43%	46%
Low / medium rise office	36%	35%	35%	43%	47%
Premium hotel	35%	1%	1%	27%	39%
Budget hotel	41%	0%	0%	32%	45%
Large retail park	76%	76%	76%	79%	80%
Warehouse	29%	29%	29%	29%	32%
Small ground floor commercial	6%	6%	6%	21%	28%

Due to the Part L 2013 methodology, additional savings on the 'all on-site improvements' options will only be achieved in the case of best practice networks with carbon content of heat of less than 0.15kgCO_2/kWh and, in the case of hotels, best-in-class networks with very low carbon content of heat.