Hawley Primary School

Energy Statement

Stanley Sidings Limited

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Waterman Building Services Ltd.

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Quality Assurance – Approval Status

This document has been prepared and checked in accordance with
Waterman Group's IMS (BS EN ISO 9001: 2008 and BS EN ISO 14001: 2004)

Issue	Date	Prepared by	Checked by	Approved by	Description
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E	08/04/2014	Vejay Patel	Firoze Rustomji	Paul Titley	For planning

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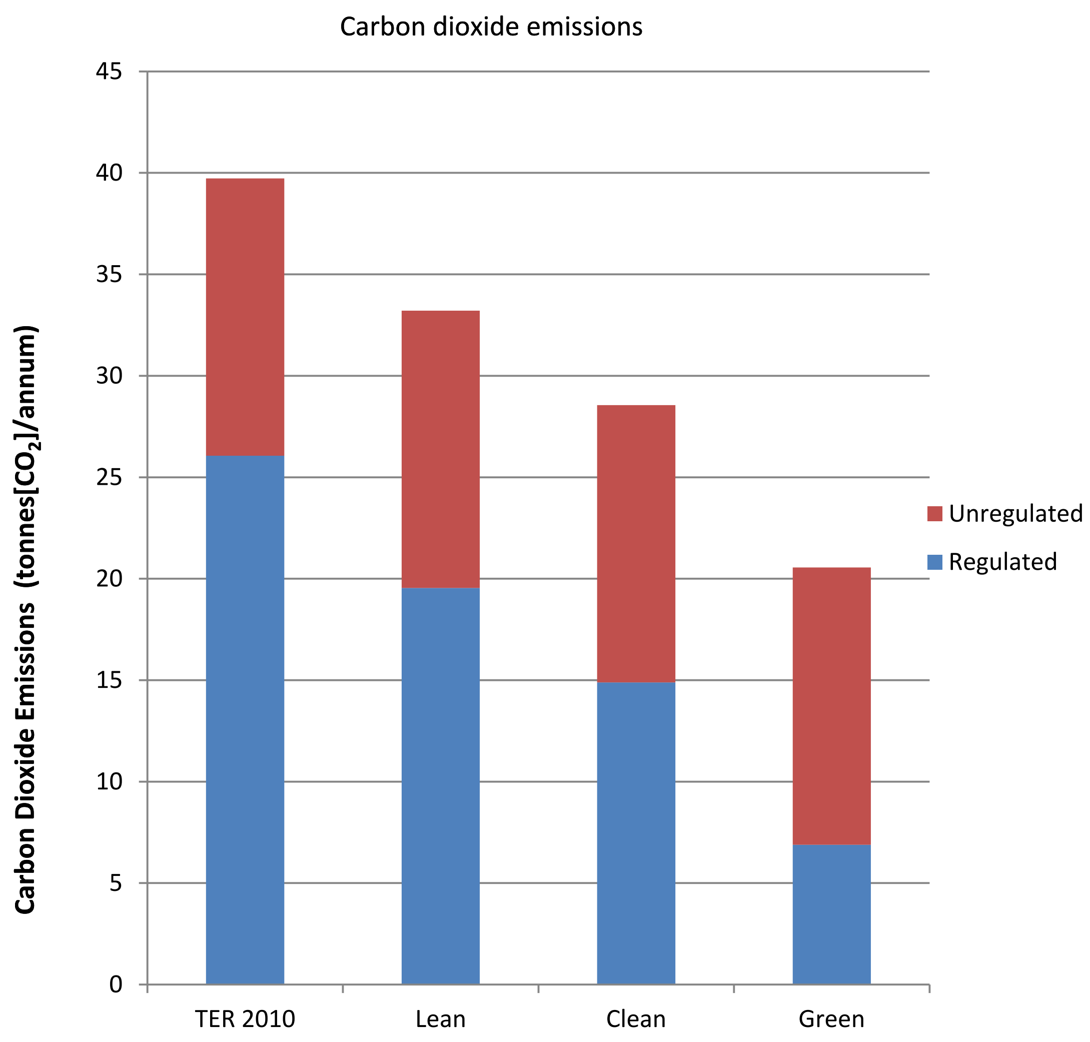
1. EXECUTIVE SUMMARY

This Energy Statement forms part of a reserved matters application in respect of Hawley Primary School. The carbon dioxide (CO_2) emissions for the proposed Hawley Primary School have been considered with respect to the approved document ADL2A 2010 of the Building Regulations. The development comprises Hawley Primary School split into two discrete buildings. The majority is a 3 storey new build. In addition the existing 1 Hawley Road which is Grade II listed will be refurbished. Following the Mayor of London's Energy Hierarchy, this will be achieved through investment in high performance building fabric and energy efficient engineering systems together with combined heating and power and roof mounted photovoltaic modules. The new build development surpasses the requirements of the London Plan 2011 target by ~34% and the Part L 2010 target by ~74%. The schools meet the mandatory energy targets for BREEAM Excellent.



	Carbon dioxide emissions (tonnes[CO_2]/annum)		
	Regulated	Unregulated	Total
TER 2010	26	14	40
Lean	20	14	33
Clean	15	14	29
Green	7	14	21

	Carbon dioxide savings (tonnes[CO_2]/annum)		Carbon dioxide savings (%)	
	Regulated	Total	Regulated	Total
Lean savings	6.5	6.5	25.00%	16.40%
Clean savings	4.7	4.7	23.83%	14.02%
Green savings	8.0	8.0	53.72%	28.01%
Total savings	19.2	19.2	73.56%	48.26%

The energy efficiency and generation initiatives proposed to deliver this performance are summarised below:

- Provision of a school wide heating system to serve all parts of the school utilizing on site Combined Heat and Power energy centre.
- Roof mounted solar electric PV modules.
- Carefully considered façade engineering that optimises daylight penetration whilst limiting summer heat gains. This will include the use of high performance glazing technology that affords low G value and U value and high light transmittance.
- Heat recovery on main air handling plant.
- Variable speed drives on pumps and fans with hydraulic systems tuned to respond to varying building load.
- Demand controlled ventilation
- Use of low energy lighting in incorporating the latest LED technology where appropriate. Many areas will include presence detection and low energy fittings.
- Passivhaus type thermal fabric standards with triple glazing and highly insulated opaque elements and exceptionally low air permeability.

2. INTRODUCTION

Supporting the reserved matters application for Hawley Primary School for a modern new Primary School, this report provides a technical appraisal of the regulations and guidance that apply, the energy options considered for the project and the energy conservation measures that will be adopted for the Hawley Primary School development. Each section summarises the proposed key investments that will be implemented in the development to reduce building energy consumption and CO_2 emissions. Renewable energy provision has been assessed with respect to the energy use of the school.

The focus of the design approach has been to limit building energy consumption and CO_2 emissions through optimising the performance of the building envelope, together with energy efficiency measures. The result targeted is a building that surpasses the anticipated required performance for carbon dioxide emissions of Building Regulations Part L 2010.

This philosophy follows the Mayor of London's "Energy Hierarchy" which identifies building design and resultant energy use to be considered in the following order of priority:

1. Use less energy
   "Be Lean"

2. Supply energy efficiently
   "Be Clean"

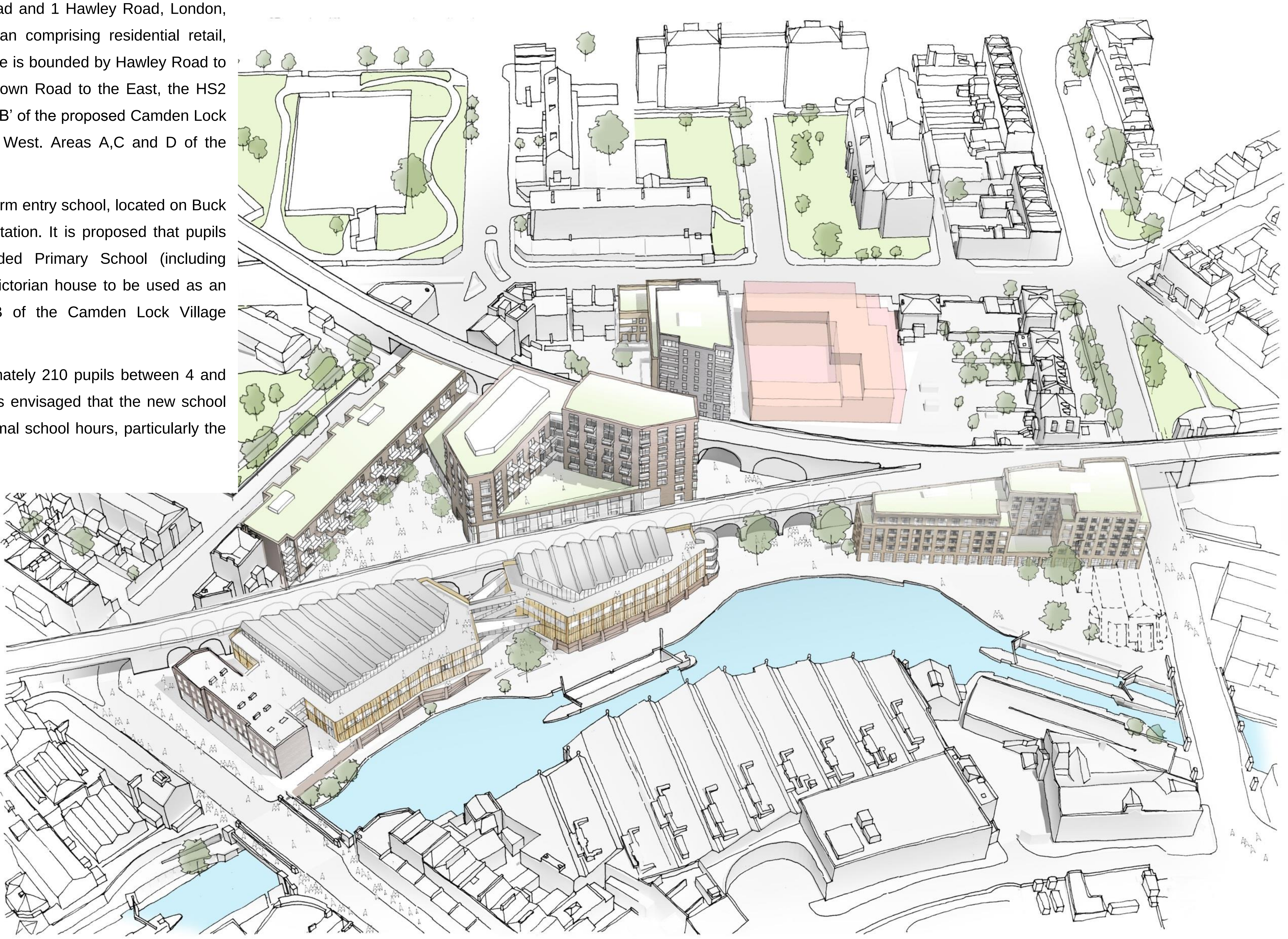
3. Use renewable energy
   "Be Green"

2.1 Description of Development

The application site is at Land at Hawley Road and 1 Hawley Road, London, NW1 and it forms part of a wider masterplan comprising residential retail, employment, leisure and open spaces. The site is bounded by Hawley Road to the North, the terraced housing on Kentish Town Road to the East, the HS2 earmarked railway line to the South and 'Area B' of the proposed Camden Lock Village (outline consent 2012/4628/P) to the West. Areas A,C and D of the approved masterplan are also adjacent.

The existing Hawley Infants School is a one-form entry school, located on Buck Street, near to Camden Town underground station. It is proposed that pupils and staff be relocated to a new, expanded Primary School (including refurbishment of an existing Grade-II listed Victorian house to be used as an Annexe), which will be built within Area B of the Camden Lock Village Development, off Hawley Road.

The new school shall accommodate approximately 210 pupils between 4 and 11 years of age, plus a 26-place nursery. It is envisaged that the new school will be used by the community outside of normal school hours, particularly the multi-purpose Hall.



Area Schedule

HAWLEY Schedule of Accommodation - audit of draft Stage C report 11.9.13	ground		first		second		AHMM revised Stage C drawings 23.10.13	
	total rooms	total area	total rooms	total area	total rooms	total area	total rooms	total area
basic teaching								
annexe								
nursery room	1	61					1	61
reception class	1	66					1	66
infant class base	2	120					2	120
junior class base	1	60	2	121	1	60	4	240
Total classbase	**5**	**307**	**2**	**121**	**1**	**60**	**8**	**487**
specialist practical								
food/ science/ D&T					1	60	1	60
food/ science/ D&T							0	0
ICT/ group room: (no. of computers)							0	0
Total classbase practical	**0**	**0**	**0**	**0**	**1**	**60**	**1**	**60**
halls								
main hall (used for dining)	1	180					1	180
small hall							0	0
studio							0	0
Total halls	**1**	**180**	**0**	**0**	**0**	**0**	**1**	**180**
learning resource areas								
Library resource centre	1	23					1	22
small group room (SENco)					1	13	1	13
small group rooms	1	10	1	12			1	22
Nursery group room	0						0	0
Total learning resource	**2**	**33**	**1**	**12**	**1**	**13**	**3**	**57**
TOTAL TEACHING AREA	**8**	**520**	**3**	**133**	**3**	**133**	**13**	**784**
staff and admin.								
Total staff and admin	**6**	**82**	**2**	**42**	**1**	**17**	**9**	**141**
storage								
Total storage	**20**	**88**	**6**	**24**	**4**	**15**	**30**	**129**
TOTAL NON-TEACHING AREA	**26**	**170**	**8**	**66**	**5**	**32**	**39**	**270**
TOTAL NET AREA	**34**	**690**	**11**	**199**	**8**	**165**	**52**	**1054**

2.2 Policy and Legislation

The following policies have been considered when developing the energy strategy for this scheme:

2.2.1 Building Regulations Approved Document L2A 2010 - New buildings other than dwellings.

In order to meet the requirements of the Energy Performance of Buildings Directive 2002/91/EC and 2010/31/EU of the European Parliament and Council on energy efficiency of buildings, the UK government introduced an updated edition of Approved Document L2A (ADL2A). The implementation of Part L2 2010 on 1st October 2010 required a 25% improvement over the previous 2006 energy target (regulated emissions). A further Part L2 revision was due to be published in October 2012 and implemented for April 2013. Part L2 2013 is anticipated to represent a further 9% improvement on 2010. Part L2 2010 requires each 'space' in a building to have solar gain not exceeding that of a reference east-facing elevation comprising 1m height of glazing, a 10% frame factor and a glazing g value of 0.68. The calculations appended with this report have been extracted from Bentley Systems Design Database v25.05 steady state thermal modelling software suite which has been used to evaluate the building models performance against the notional building and to demonstrate compliance using SBEM. To achieve BREEAM rating, the compliance document Technical Data Sheet must be used obtain to figures for actual and notional, total energy consumption (kWh/m^2), heating and cooling demand (MJ/m^2), and total CO_2 emissions (kg/m^2).

2.2.2 BREEAM New Construction SD5073 2011 – Technical Manual (2011)

The 2011 version of the BREEAM UK New Construction Scheme is affiliated to BRE Global international Code for A Sustainable Built Environment. The BRE Global Code for a Sustainable Built Environment is a set of strategic principles and requirements which define an integrated approach to the design, management, evaluation and certification of the environmental, social and economic impacts of the built environment. The Code is interpreted through the BREEAM Core Process and Technical Standards. These linked documents set out the requirements that a compliant scheme must meet in order to be affiliated with the Code. The Standards ensure that a common scientific and performance basis is used by all compliant schemes operated by National Scheme Operators whilst ensuring that these can be adapted to suit local demands, standards and practices.

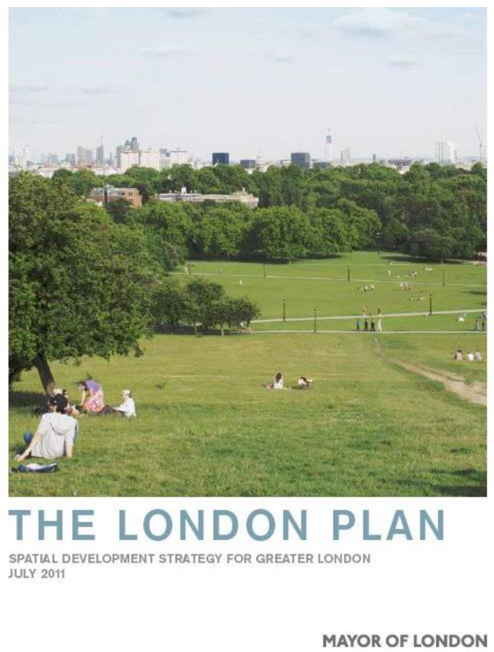
The overall project environmental impact has been assessed through a BREEAM audit.

2.2.3 The London Plan - Spatial Development Strategy for Greater London (July 2011)

The London Plan is the overall strategic plan for London, and it sets out a fully integrated economic, environmental, transport and social framework for the development of the capital to 2031. It forms part of the Development Plan for Greater London. In July 2011 version is the current iteration of the London Plan. This document has been produced after a series of alterations to the London Plan originally published in 2004. This broadly follows the National Planning Policy Framework. The London Plan sets the strategic planning structure for all major developments in London. Some energy related key policies stated in the plan are summarised below:

- *Policy 5.2 Minimising carbon dioxide emissions*:
  - 5.2A - Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:
    1) Be lean: use less energy
    2) Be clean: supply energy efficiently
    3) Be green: use renewable energy

  - 5.2B - The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019:



- 5.2C - Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy

- 5.2D - As a minimum, energy assessments should include the following details:
  a) calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations at each stage of the energy hierarchy
  b) proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services
  c) proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)
  d) proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

- *Policy 5.3 Sustainable design and construction:* The Mayor will expect all major developments to demonstrate that the proposed heating and cooling systems have been selected in accordance with the following order of preference:
  - 5.3B - Development proposals should demonstrate that sustainable design standards are integral to the proposal, including its construction and operation, and ensure that they are considered at the beginning of the design process

  - 5.3C - Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve other policies in the Plan and the following sustainable design principles:
    a) minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)
    b) avoiding internal overheating and contributing to the urban heat island effect
    c) efficient use of natural resources (including water), including making the most of natural systems both within and around buildings
    d) minimising pollution (including noise, air and urban run-off)
    e) minimising the generation of waste and maximising reuse or recycling
    f) avoiding impacts from natural hazards (including flooding)
    g) ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions
    h) securing sustainable procurement of materials, using local supplies where feasible, and
    i) promoting and protecting biodiversity and green infrastructure.

- *Policy 5.6 Decentralised energy in development proposals*:
  - 5.6A - Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

  - 5.6B - Major development proposals should select energy systems in accordance with the following hierarchy:
    1) Connection to existing heating or cooling networks
    2) Site wide CHP network
    3) Communal heating and cooling.

  - 5.6C - Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

- *Policy 5.7 Renewable energy*:
  - 5.7B - Within the framework of the energy hierarchy, major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible

- *Policy 5.9 Overheating and cooling*:
  - 5.9B - Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:
    1) minimise internal heat generation through energy efficient design
    2) reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
    3) manage the heat within the building through exposed internal thermal mass and high ceilings
    4) passive ventilation
    5) mechanical ventilation
    6) active cooling systems (ensuring they are the lowest carbon options).
  - 5.9C - Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible.
- *Policy 5.13 Sustainable drainage*:
  - 5.13A - Development should utilise sustainable urban drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:
    1) store rainwater for later use
    2) use infiltration techniques, such as porous surfaces in non-clay areas
    3) attenuate rainwater in ponds or open water features for gradual release
    4) attenuate rainwater by storing in tanks or sealed water features for gradual release
    5) discharge rainwater direct to a watercourse
    6) discharge rainwater to a surface water sewer/drain
    7) discharge rainwater to the combined sewer.

    Drainage should be designed and implemented in ways that deliver other policy objectives of the Plan, including water use efficiency and quality, biodiversity, amenity and recreation.
- *Policy 5.15 Water use and supplies:*
  - 5.15B - Development should minimise the use of mains water by:
    a) incorporating water saving measures and equipment
    b) designing residential development so that mains water consumption would meet a target of 105 litres or less per head per day.
  - 5.15C - New development for sustainable water supply infrastructure, which has been selected within water companies' Water Resource Management Plans, will be supported.

2.2.4 GLA Energy Team Guidance on Planning Energy Assessments (September 2011)

This guidance note provides further detail on addressing the London Plan's energy hierarchy through the provision of an energy assessment to accompany strategic planning applications. The purpose of an energy assessment is to demonstrate that climate change mitigation measures are integral to the scheme's design and evolution, and that they are appropriate to the context of the development.

2.2.5 Camden Borough Council (CBC) Core Strategy (2010)

CBC has prepared a Core Strategy that sets out their overall approach to managing Camden's growth. The strategy, adopted in 2010, contains a range of policies relating to sustainable development that aim to help achieve a sustainable Camden that adapts to a growing population – one of the elements in the vision in the Camden Community Strategy. In particular:

- *CS13: Tackling Climate Change through Promoting Higher Environmental Standards:*
  The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:
  - ensuring patterns of land use that minimise the need to travel by car and help support local energy networks
  - promoting the efficient use of land and buildings
  - minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:
    - ensuring developments use less energy
    - making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks
    - generating renewable energy on-site
    - ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change

2.2.6 Camden Borough Council Development Policies (2010)

CBC's DPs contribute to delivering the Core Strategy by providing detailed policies that are used when determining applications for planning permission. They also ensure that development contributes towards CBC's sustainability targets.

- *DP22 - Promoting sustainable design and construction:*
  The council expects non-domestic developments of 500sqm of floorspace or above to achieve BREEAM "Very Good" until 2016, BREEAM "Excellent" from 2016 onwards and encouraging developments to be zero carbon from 2019. Furthermore the Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:
  - summer shading and planting
  - limiting run-off
  - reducing water consumption
  - reducing air pollution
  - not locating vulnerable uses in basements in flood-prone areas

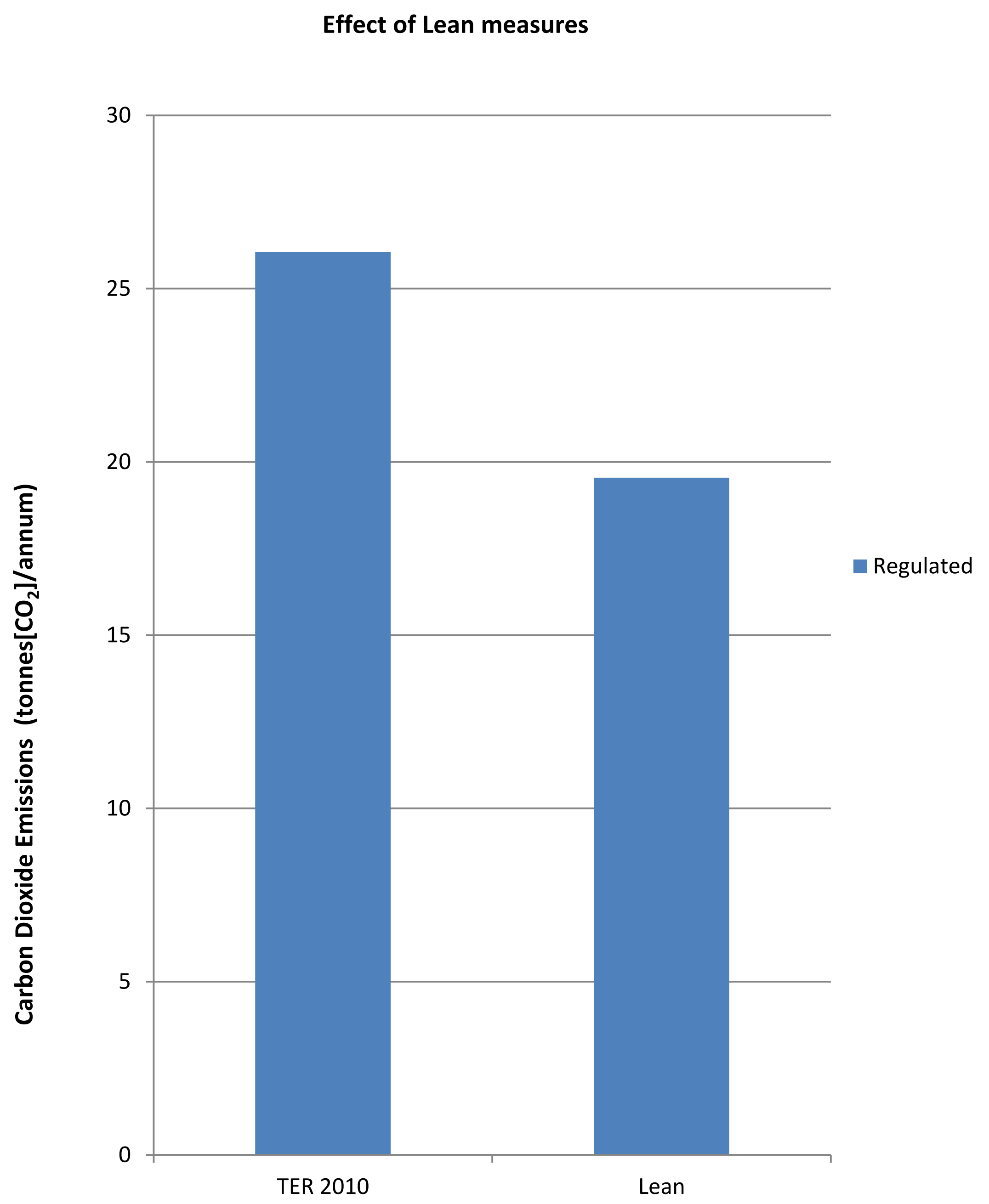
3. REDUCING ENERGY DEMAND

In line with the London Plan energy efficiency measures are proposed in order to minimise the energy used by the proposed development and consequently the associated carbon emissions. Furthermore, in order that the London Plan policy 5.2B target is achieved, the proposed energy efficiency measures will ensure that the proposed development is 25% better than the minimum requirements set out in ADL2A 2010 (Approved Document Part L2A which sets out Building Regulations energy efficiency and emissions targets for new built non-domestic developments) for lean savings alone. In order to realise this potential, both passive and active energy efficiency measures will be adopted.

The approach taken has been to firstly reduce the required energy for heating and cooling by careful façade design. This approach also takes cognisance of the fact that artificial lighting is a major consumer of power in many buildings and therefore the design is not just a wall of highly reflective glazing, more a façade with carefully considered proportions of high performance neutral type glazing and solid elements in key areas.

Secondly, active elements such as mechanical ventilation heat recovery, highly efficiency motors, variable speed fans and pumps, and high efficiency LED lighting technology will be utilised to achieve the target of a building which not only complies with Part L 2010 but also is estimated to surpass the CO_2 emissions reductions expected to be set by Part L 2013.

The CO_2 emissions were calculated using EDSL Tas version 9.2.1 dynamic thermal modelling software suite. The software utilised has been approved by the Department for Communities and Local Government for use in calculating the energy performance of buildings, for the purpose of Regulation 17A of the Building Regulations (Part L).



3.1 Heat Transfer – Space Heating

A reduction in space heating demand not only has an advantageous impact on the overall carbon emissions of the site, but also reduces the heat emitter and heating plant size.

The space heating requirement is reduced by:

- addressing fabric heat losses with:
  - highly insulated building envelope
  - airtight construction
- exposed thermal mass where possible to level peaks and troughs of internal temperature

3.1.1 Building Fabric Performance

The focus of the design team approach has been to limit building energy consumption and carbon emissions through consideration of the performance of the building envelope. The approach has aimed to reduce solar gains and heat losses to levels commensurate with good practice benchmarks as opposed to reliance on energy efficient measures adopted solely to offset the weakness of a poorly performing building.

As glass is inherently a poor insulator, the façades of the fully heated zones incorporate the optimum proportion of opaque elements over translucent elements, balancing the need for space heating reduction and daylight penetration.

Good air tightness design will reduce heat losses in winter and heat gains in summer and will increase the efficacy of heat recovery of the mechanical ventilation proposed. The proposed minimum air tightness for the development is 1.0 m^3/m^2/hr at 50 Pa. This represents an improvement of 90% over the minimum requirements set out in ADL1A 2010 (i.e. minimum is 10 m^3/m^2.hr at 50 Pa) and is considered as best practice leakage rate.

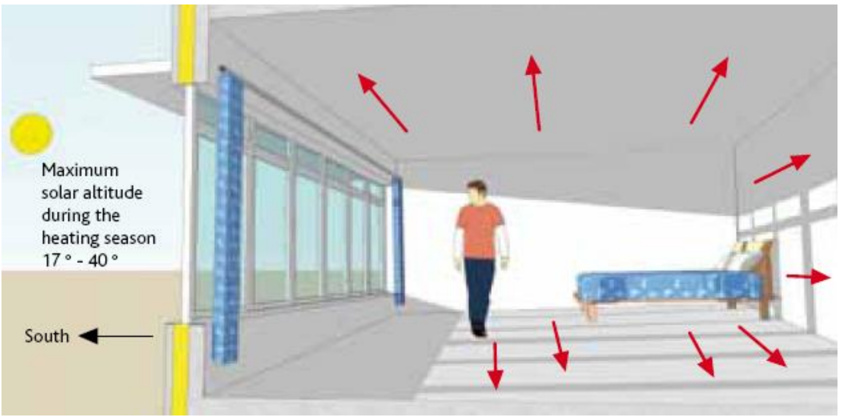
Thermal and permeability parameters

- External wall area weighted U-value ≤ 0.10 W/m^2.K
- Exposed floor area weighted U-value ≤ 0.10 W/m^2.K
- Roof area weighted U-value ≤ 0.10 W/m^2.K
- Vertical window and frame U-value area weighted ≤ 1.20 W/m^2.K
- Roof window and frame U-value area weighted ≤ 1.80 W/m^2.K
- Air permeability ≤ 1.0 m^3/m^2/hr at 50 Pa

3.1.2 Exposed Thermal Mass

Thermal mass exposed to the internal conditioned spaces can help reduce fuel consumption during the heating season when used in passive solar design. This approach to design seeks to maximise the benefit of solar gain in winter, using the thermal mass to absorb gains from windows, along with heat produced by lighting, people and appliances. This is then slowly released overnight as the temperature drops, helping to keep the building warm and reducing the need for supplementary heating. By applying simple passive solar design techniques, fuel savings of up to 10% be made.

Winter day



- During the heating season, the low angle of the sun can shine through windows, and the heat is absorbed by thermal mass in the floor and walls.
- In the evening when the sun goes down and the temperature drops, the heat flow is reversed and passes back into the room.

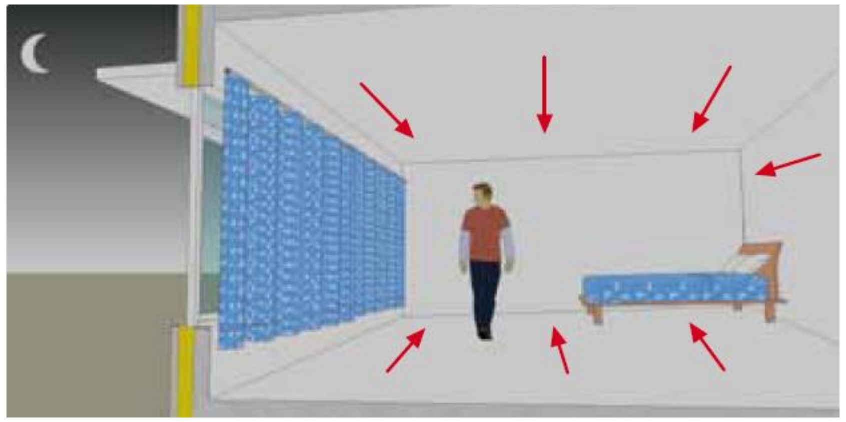
Exposed thermal mass counters heat gains and losses and flattens peaks and troughs of internal temperature by acting as a heat sink. Internal walls will be of heavy-weight construction and exposed to the air in the conditioned spaces. Exposed soffits and solid partitions will form a major source of thermal capacity for the classrooms.

The list below gives minimum thermal capacitance targets which offer a cost effective low carbon stratagem in line with the overall energy demand minimisation scheme:

Kappa values ('k' value)

- Internal wall ≤ 100 kJ/m^2.K
- Ground floor ≤ 140 kJ/m^2.K
- Intermediate floor ≤ 120 kJ/m^2.K

Winter night



- At night, blinds are closed and windows kept shut to minimise heat loss.
- Heat continues to be released by the thermal mass and heating is adjusted so only the minimal amount is used.
- By morning the thermal mass will have given up most of its heat and the occupants will typically have to rely on heating until later in the day.

3.2 Heat Transfer – Ventilation air heating

The key focus of the ventilation design is the strategy for teaching spaces. The site is immediately adjacent to a mainline railway line earmarked for HS2 and two busy roads, A400 Kentish Town Road and A502 Chalk Farm Road. The Air Quality study in the 2011 Environment Statement highlighted high background pollutant levels typical of busy Central London locations.

A natural ventilation strategy cannot provide effective acoustic attenuation or pollutant filtration as the driving pressures are too low to overcome the pressure drop of attenuators and filters. On that basis, mechanical ventilation must be specified for all occupied areas.

The ventilation air heating requirement will be optimized with the following strategies:

- incorporating heat recovery into ventilation systems
- controls system optimising ventilation rates for increased air flow during periods of greatest requirement

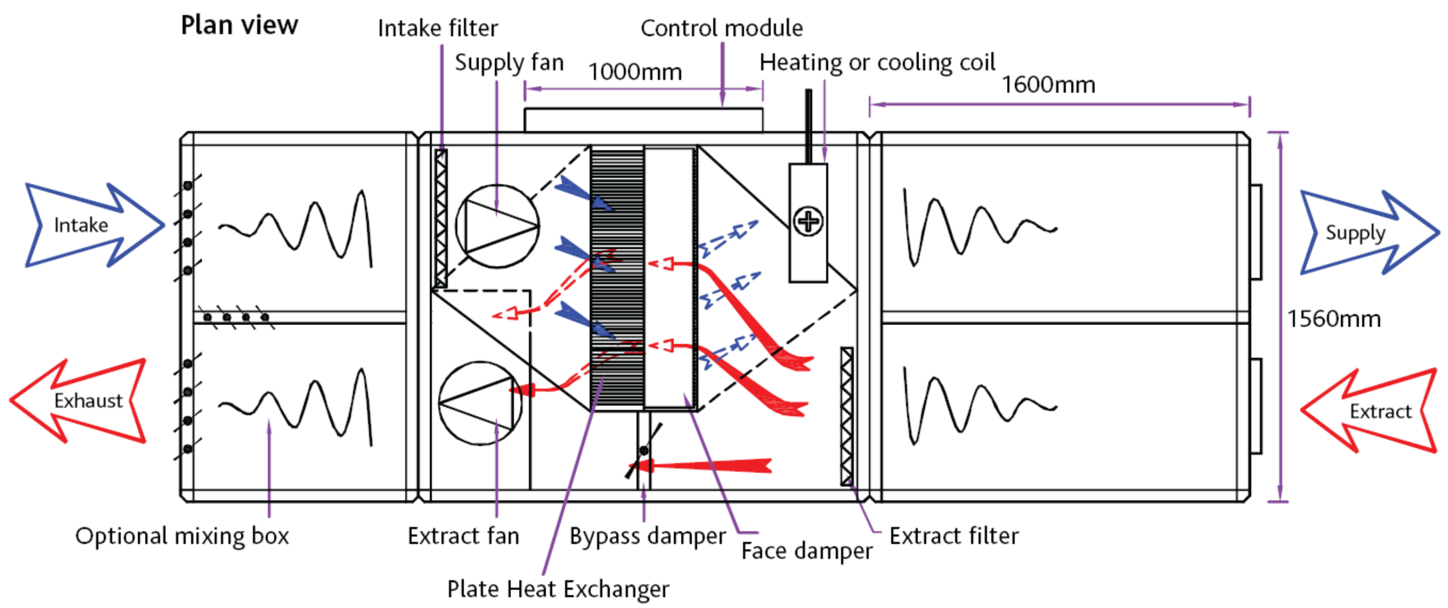
3.2.1 Mechanical Ventilation with Heat Recovery

Classrooms and other occupied areas utilise Mechanical Ventilation with Heat Recovery (MVHR) units. This strategy was chosen for the following reasons:

a) Acoustic separation must be provided between the classrooms and external environment – natural ventilation would not be suitable
b) Reduced ventilation air heating requirement
c) Greater thermal comfort during winter – ventilation air is preheated with heat recovery
d) Accurate control of the ventilation flow rate – even on still days
e) Provision of filtered outside air is preferable.

The heat recovery element will ensure that over 80% of the heat contained within the extract air is transferred to the supply air thereby mitigating occupant discomfort from cold drafts, which naturally ventilated classrooms are prone to during winter.

To minimise energy usage the system will incorporate heat recovery to ensure optimum performance. The MVHR units will feature EC-DC (Electronically Commutated Direct Current) motor technology which now facilitates reduced running costs for an additional capital cost outlay. Such motor



3.2.2 Demand controlled Mechanical Ventilation

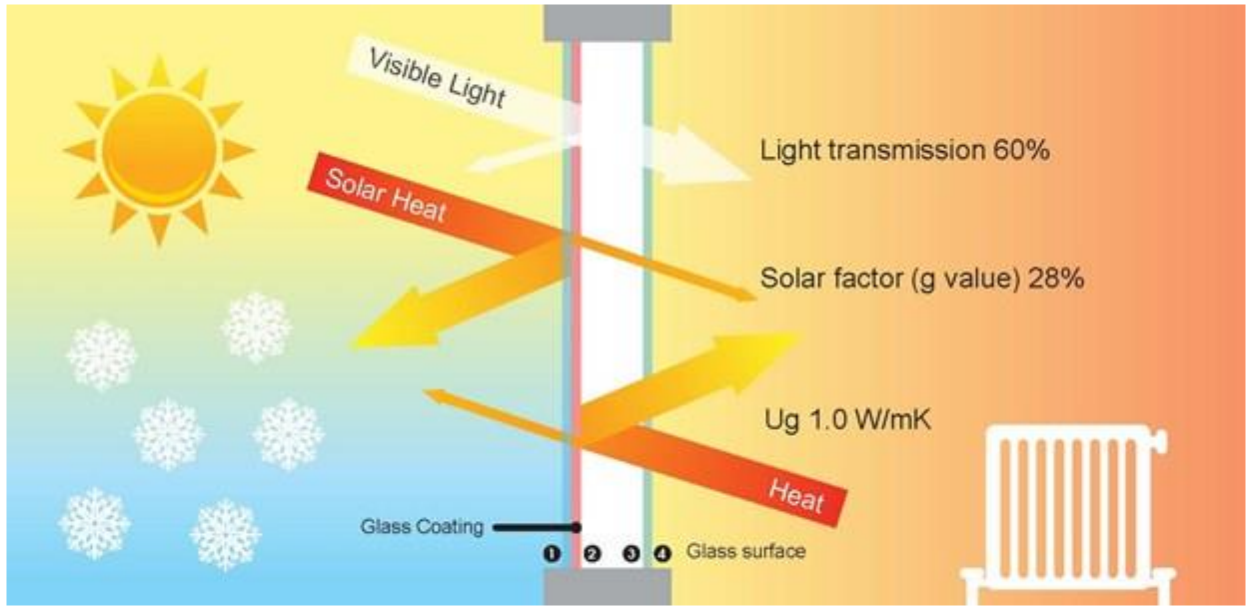
All mechanical ventilation provided to serve occupants which feature 'demand control' which will determine fan speed and hence volume flow rate based upon inputs from temperature sensors, carbon dioxide sensors, presence detection sensors (from lighting controls system) and time and date schedules, depending on the location and use. This will ensure that the correct amount of air is being provided at all times and reducing the volume of outside air which the heating system must raise the temperature of.

3.3 Heat Transfer – Cooling requirement

Highly insulated, airtight construction is an obvious cost-effective measure towards minimising energy demand and is well implemented using Passivhaus techniques. However, there is extensive evidence to suggest that not every aspect of the German Passivhaus standard is suitable for the Southern areas of the UK which typically experiences higher average temperature than Germany. In order to provide a reasonable level of thermal comfort, the primary challenge for designers of highly insulated, airtight buildings for the UK is summer overheating.

3.3.1 Solar Control Glazing

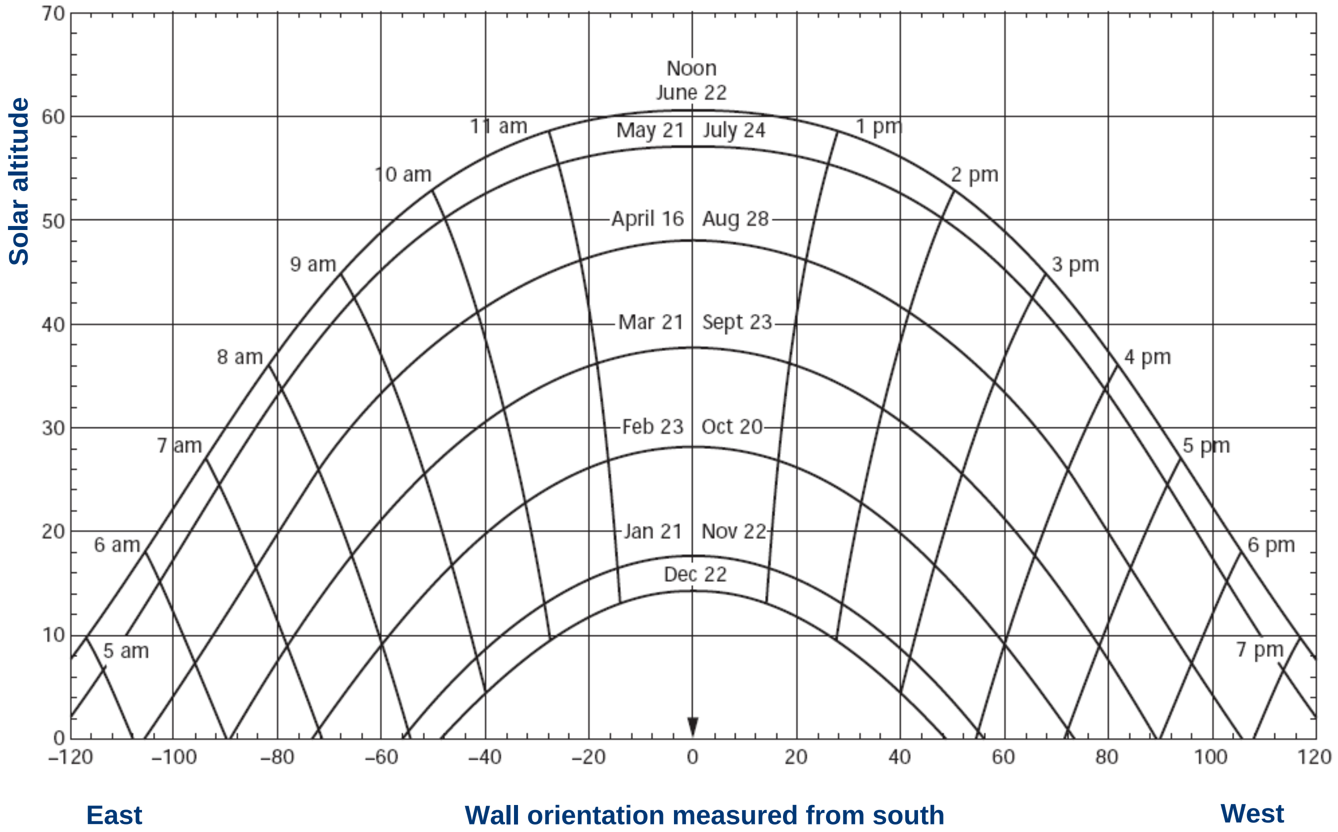
The glazing specification proposed incorporates solar control coatings to limit solar gain and improve occupant comfort. A high performance solar glass will reduce solar gains considerably, but the light transmission is normally reduced and so a compromise is necessary. The latest high performance glass technology has improved this balance significantly with G values as low as 0.28 being achievable yet with light transmittance at up to 55%. The optimisation of solid elements and glazing is important not only for thermal insulation but also to limit solar gain and is a key part of the energy strategy.



3.3.2 Solar Shading

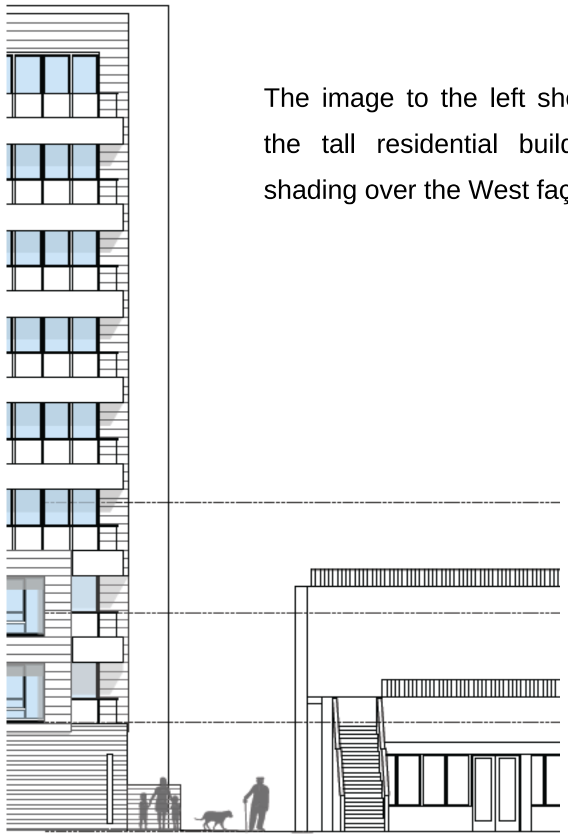
The sun path diagram below shows that during the summer months the South facade experiences a high solar altitude, whereas East and West facades experience much lower solar altitudes:

Sun path diagram



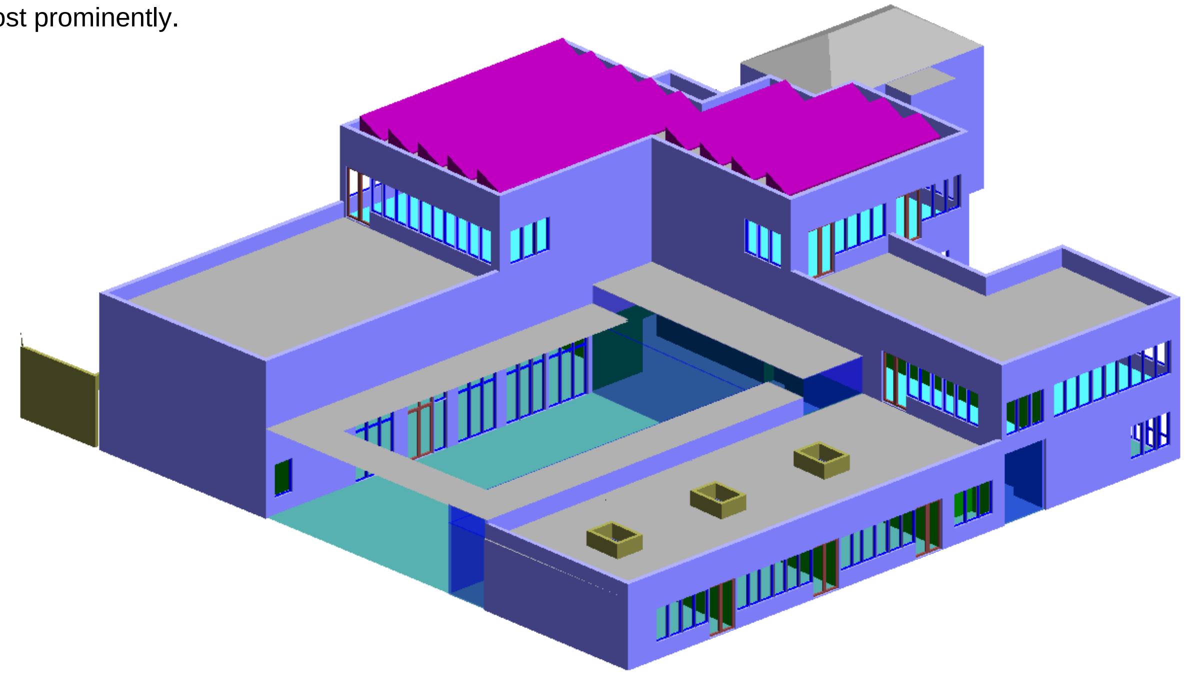
Vertical shading elements offer protection from direct solar radiation along East and West facades. Horizontal elements offer shading from high angle midday sun.

For a clear summer's day, the sun will rise over the terraced housing from 63 to 51 Kentish Town Road onto the Eastern façade. The areas most affected will be the East facing year 4, 5 and 6 classrooms on the first and second floors. Towards midday as the sun rises, the higher angle of the sun will be unshaded by the elevated railway line to the South and the 5 and 6 classrooms on the first and second floors will be most affected. During the afternoon as the sun moves to a lower position in the West, much of the building will be shaded by the proposed 8 storey residential building on West part of 'Area B' and proposed 9 storey mixed use building of 'Area C' to the South West of Hawley School.



The image to the left shows the South elevation with the tall residential building to the West providing shading over the West façade of Hawley School.

The image to the right shows the South West corner of the building most prominently.



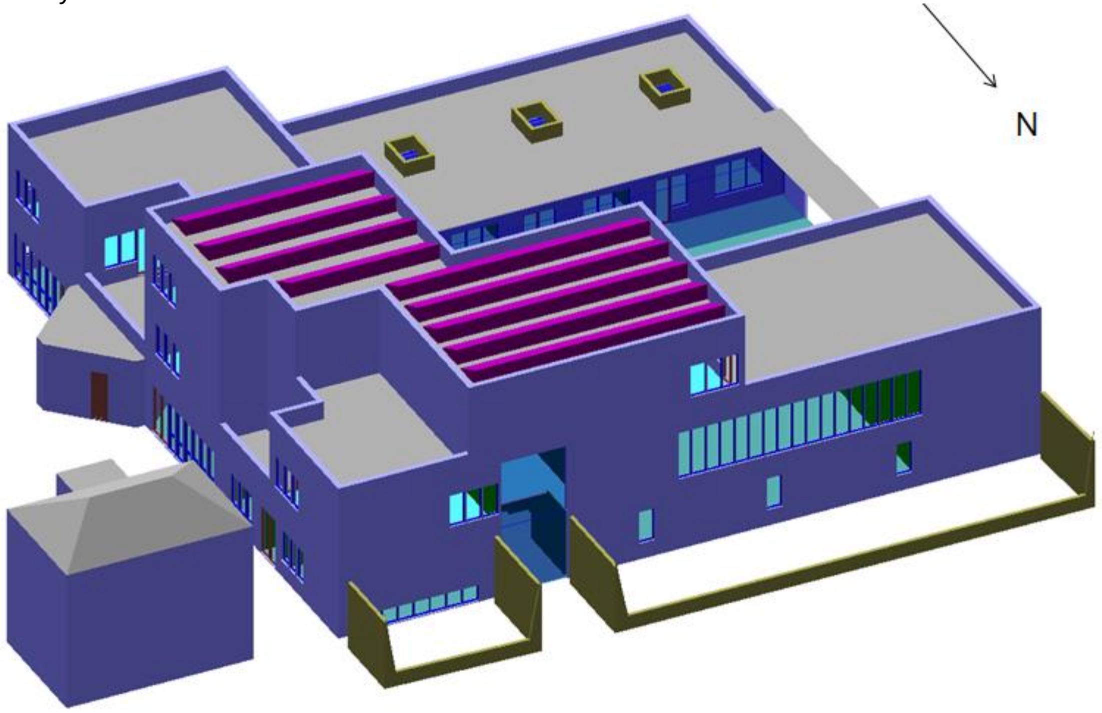
3.3.3 Façade Engineering

The building form is a ‘U’ shape arranged around a central courtyard. The South façade of the courtyard features horizontal shading to offer protection for intense solar irradiance during summer midday sun.

The North façade on Hawley Road features a high proportion of glazing to make best use of diffuse natural daylight whilst avoiding direct solar irradiance with its associated heat gains and occupant discomfort.

The West façade also features extensive glazing. Although the West façade is prone to low angle solar irradiance striking the glass perpendicularly, this occurs during the morning at times of reduced external air temperature, hence the effect on internal temperature is less severe. Also, classrooms are provided with high reflectance internal blinds to protect against glare and excessive solar radiation. The blinds will provide effective solar control during summer morning whilst allowing diffuse natural daylight penetration into the classrooms at other times.

The image to the below shows the North East corner of the building most prominently.



3.3.4 Night Purge

During the summer when there is sufficient variation in diurnal and outdoor temperatures and a good prevailing wind, night-time ventilation can be used to cool down the thermal mass of the building interior, reducing cooling loads. Heat gains generated during the day are absorbed by furnishings, walls, floors, and other building surfaces then released over a period of time in proportion to the thermal capacity of the material. Removal of these accumulated heat loads will be achieved by operating the mechanical ventilation system at low velocity.

Heavy-weight thermal mass is strategically located in internal walls and exposed soffits. This mass is "activated" or cooled at night using outdoor air directed to flow over its unobstructed surface. During the day, occupants exposed to this chilled thermal mass perceive a cooler environment due to a radiative exchange with the low surface temperature of this thermal mass.

Thermal storage techniques absorb heat during peak periods of excess gain and store it until it can be discharged later, thereby reducing internal temperatures. Using the building fabric as a thermal store with night cooling takes advantage of the added benefit of cooler night temperatures to enhance both the resultant radiant and convective cooling effect. A building's thermal mass is key to its thermal response. A room of lightweight thermal capacity is less capable of absorbing room heat gains, and so the resulting room conditions fluctuate more quickly in response to excess heat. The natural cooling capacity of a thermally lightweight room is perhaps 50% that of a heavyweight room (without night ventilation). In addition, compared with the inherent damping effect of a heavyweight room, a lightweight room needs more frequent and faster-response cooling adjustment.

In an unventilated room the thermal capacity has limited scope for discharging its stored heat in readiness for accepting further heat the following day. Ventilating at night can double the benefits of a heavyweight room over a lightweight room. Night ventilation or purge will be achieved automatic control of mechanical ventilation subject to a start time delay to take account of the temperature offset due to heat gain from the supply fan.

The use of night purge via the mechanical ventilation system will allow a more predictable ventilation rate but with the slight penalty of fan energy use and some heat gain from the fan. While night cooling fan heat gain may be marginal only, it will undermine the potential benefit.

An appropriate control regime will be implemented when employing night ventilation to avoid over-cooling as this causes discomfort or results in unnecessary operation of the heating system. Night ventilation will be terminated at an appropriate time using predictive control to allow the warmth being drawn from the thermal mass to raise the surface temperatures prior to occupancy. The rate of fan assisted night ventilation will be varied to suit non-peak temperature days.

3.3.5 Internal heat gains

Over recent years, evidence has emerged that Part L minimum requirements for insulation of pipework is insufficient when considering large communal heating systems. Such heating systems would still have heating medium flowing through them during summer to satisfy the domestic hot water requirement.

We intend to highly insulate such pipework, with the final spec to be determined with rigorous heat gain calculation. However, the minimum insulation specification for communal heating pipework and fittings including hydraulic interface units within buildings will be greater than the performance requirements of Part L 2010. The other benefit is that greater heat energy will be retained within the pipework furthering efficiency aspirations.

In addition, the heating and domestic hot water systems have been largely separated so that the heating system may be turned off during summer. This means that during periods when overheating may occur, the heating distribution pipework is not in operation and not emitting heat. The domestic hot water for the main kitchen, shower, hall kitchenette and listed satellite building will be heated from the main heating system minimising pipework which must operate year-round to a single run of pipework to the satellite building with very short branches. Wash hand basins for toilets will be served by small electric water heaters, possibly with storage. Therefore, during summer months the heating system will shut down and there will be no heat pipework emission except for the pipework serving the listed satellite building.

The class rooms will feature high ceilings which will allow buoyant warm air to rise and stratify to create a temperature gradient with lower temperatures at the level of seated occupants.

waterman

3.3.6 Electrical Energy – Lighting

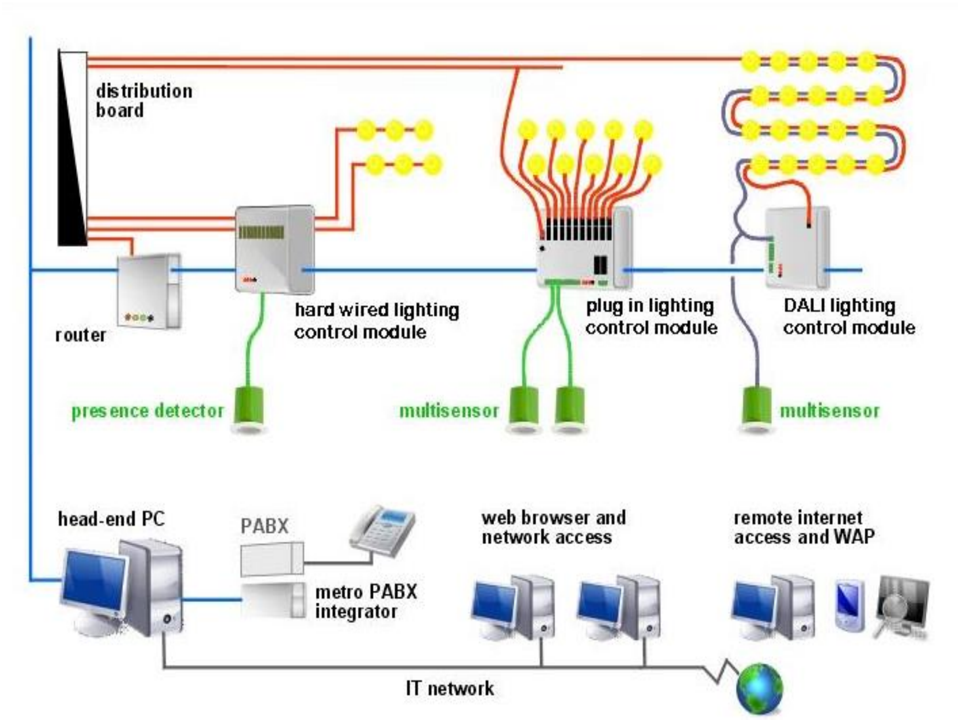
Low energy lighting has become an essential feature of building design in recent years. New concepts of lamp and ballast design have led to higher efficiency fluorescent and LED lamps and higher frequency control gear becoming standard in most new retail installations. It is proposed to incorporate LED lamps where required to meet the targets lighting efficacies shown on the adjacent table.

Changes to standards such as Part L Building Regulations, have pushed the standards for efficiency in lighting installations and promoted the use of lighting controls systems.

Lighting controls can comprise simple presence detection, which when combined with daylight control can switch luminaires on/off automatically, or regulate the lighting levels to suit the outside conditions. These systems should be used in conjunction with each other, for the most energy efficient installation. Daylight control can only be utilised in perimeter zones where daylight is received and this will depend upon the internal building layout.

The more functions a lighting control system has, the more costly the system becomes. However, the payback periods on lighting controls systems are very good so the investment is beneficial.

The interior lighting scheme design will recognise the need to provide good lighting in an energy conscious and cost effective manner. The proposed development will incorporate extensive LED lighting with daylight sensing and presence/absence detection lighting controls.



Energy performance will be the prominent criteria for luminaire selection. Target mean lighting efficacies are listed below:

Zone	Description	Efficacy (Lumens/circuit Watt)	Light Output Ratio	Occupancy sensing	Daylight Control
1	Circulation	80	1.0	auto on / dimmed	auto dimming
2	Toilets / Shower	80	1.0	auto on/off	manual
3	Offices	95	1.0	auto on/off	auto dimming
4	Classroom	95	1.0	auto on/off	auto dimming
5	Plant	80	1.0	none	manual
6	Store	80	1.0	auto on/off	manual
7	Kitchen	80	1.0	auto on/off	auto dimming

3.4 Electrical energy – Pumps

Some 40% of industrial electricity consumption is utilised as the motive power for pumps and fans. The vast majority of these motors are driven at constant speed by squirrel cage machines, and any variation in system output is generally achieved by throttling or damping in the system. However, a substantial amount of this energy is wasted. This is because most fan and pump systems are oversized, usually because of too much contingency planning in the system design, and then rounding up to the next standard motor size. Consequently, significant amounts of energy are expended unnecessarily, and the operating cost of the system is as much as 50% more than it should be.

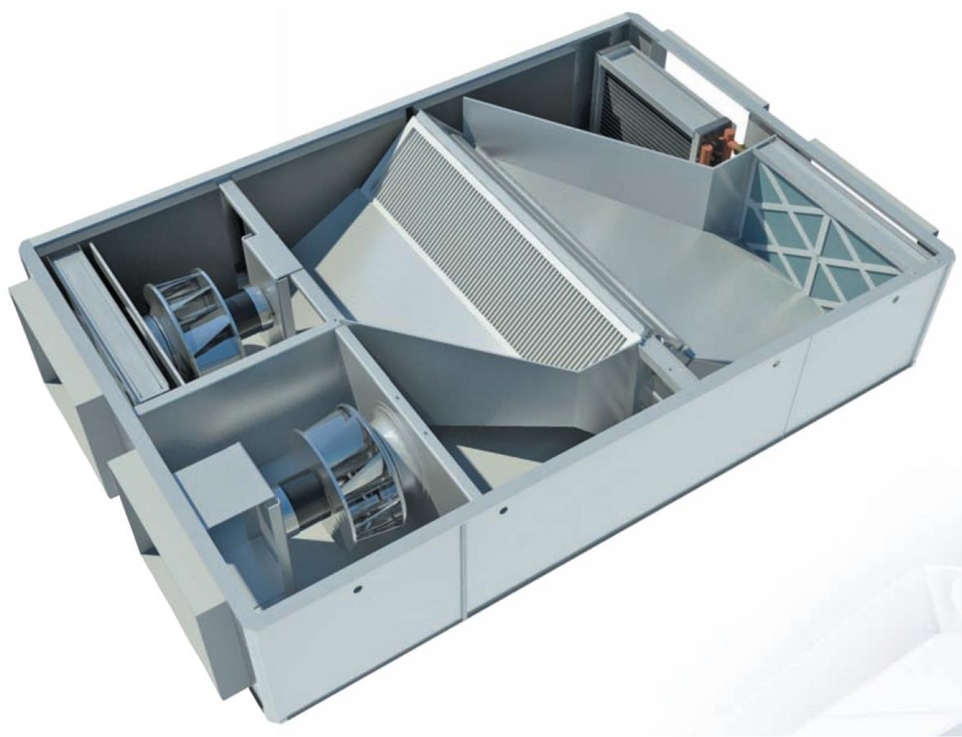
The overall savings to be made in energy and indirect costs rely upon the effective application of variable speed AC inverter drives; for example, a 15% reduction in fan or motor speed will, based on The Affinity Laws, achieve a 40% energy saving. Substantial overall savings in energy and indirect costs can be realised relatively simply with the effective application of variable speed AC inverter drives. There are also significant indirect cost savings available by extending motor life, reducing maintenance time and cutting overall noise levels.

The development will incorporate inverter driven pumps with 2-port control for the major plant where possible at the development so that pump energy consumption matches the varying building load.
Where possible high efficiency class of electric motors EFF1 (ISO 12759:2010) will be selected.

To reduce heating pumping energy demand further, a greater temperature differential between flow and return temperatures for heating pipework has been selected to reduce mass flow rates.

3.5 Electrical energy – Fans

Mechanical Ventilation with Heat Recovery (MVHR) units will be installed in classrooms to suit air quality and acoustic considerations. Careful ductwork design will ensure that air flows with reduced resistance through the system. The fan speed will be modulated to respond to demand as indicated by air quality sensors. With a conventional non-demand controlled system the motor always runs at the same speed irrespective of air quality. Whilst constant air volume results in simpler controls and less capital it has a major disadvantage of consuming more energy than is required. If the air volume for each fan was reduced from 100% to 80% the motor energy would, based on The Affinity Laws, be reduced by 50% - a significant saving in power. If the air volume was reduced from 100% to 60% there would be an 80% reduction in motor energy.



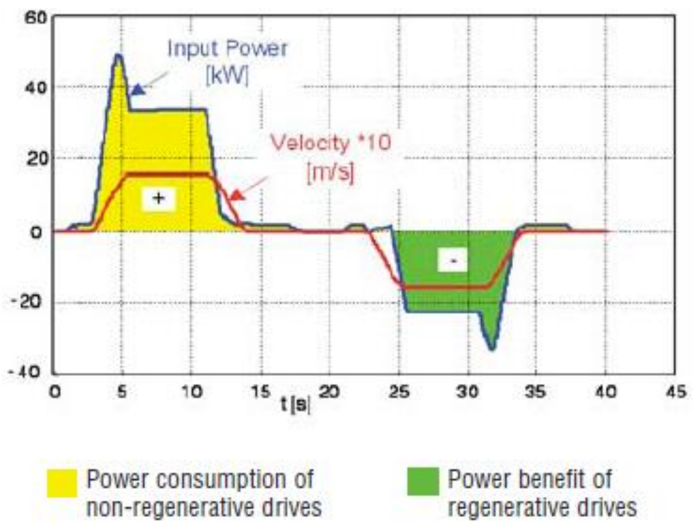
The air handling units serving toilets, showers and changing rooms will have low system resistances and will be carefully controlled to ensure that excessive energy is not consumed by the run around coil heat exchanger system. These areas will also use demand controlled ventilation with sensors activating the system.

3.6 Electrical Energy – Lifts

In a typical non-regenerative drive, energy is dissipated as heat in a set of resistors when braking occurs, resulting in reduced efficiency and creating additional waste-heat loads in the building. Regenerative drives feed this energy back into the building's internal electrical grid where it can be used by other loads or users connected to the same network. Regenerative drives reduce energy usage by up to 75 per cent compared to non-regenerative drives. The drives are so efficient that their power factor is close to unity.

Regenerative drives lower overall building operating costs, delivering significant annual savings to building owners and tenant's year-after-year during the life of the lift. The drives help reduce the two key factors that influence energy costs, peak power demand and energy consumption. As a result, both the fixed costs based on peak power demand (kVA) and variable costs based on energy consumption (kWh) decrease.

Electrical power is generated when the lift travels up with a light load, travels down with a heavy load and during the lift system deceleration. In effect, a fully loaded, descending lift can now provide a significant portion of the power for an adjacent ascending lift. The amount of energy savings due to regeneration depends on various system parameters and configurations such as car load, speed, length of run, traffic pattern and system efficiency. Modelling and simulation results show that regenerative drives use substantially less energy than non-regenerative drives for equivalent lift motion and it is proposed that this technology will be included in the development. Variable frequency drive control and standby mode for idle periods will further reduce energy demand. The benefit of reduced carbon emissions falls under the category of unregulated emission.



4. DELIVERING ENERGY EFFICIENTLY

4.1 Site-wide Heating Network

The use of site-wide heating systems enables the benefits of low carbon technologies to be optimised. A heat network can match and manage flows, whilst maximising the utilisation of the central plant providing the heat. Site-wide heating networks provide the following direct benefits:

- enabling the efficient transportation and use of heat for a wide variety of users
- allowing a broad range of energy generation technologies to work together to meet demand for heat
- enabling fuel flexibility
- helping to efficiently manage supply and demand of energy
- lowering costs of energy generation
- dramatically increasing fuel efficiency through use of CHP
- reducing labour and maintenance cost as compared to individual systems

The school-wide heating system will service each of the heated spaces in each school. Highly insulated heat distribution pipework will reduce pipe losses. System design based upon variable flow concept combined with high temperature differentials to reduce pumping energy. Optimising the number of hydraulic separation stages (heat exchangers in series) to reduce the flow and hence return temperatures. Lower return temperature will enable greater flue gas heat recovery and greater efficiency from heating plant.

The school-wide heating network complies with London Plan policy 5.6B

The site-wide heating network will be designed in accordance with the guidance of the GLA's District Heating Manual for London to ensure compatibility.

4.2 Camden Lock Village District Heating Network

Hawley School is part of the wider Camden Lock Village development (outline consent 2012/4628/P). Camden Lock Village will establish a district heating network with a central energy centre incorporating CHP.

The Grontmij Energy Statement for planning of 28th Aug 2012 contained the results of their CCHP feasibility study. They concluded that the central energy centre for the district heating network will contain a 300kW CHP unit and an 80kW absorption chiller.

However, as this network will not be available when the school is first occupied the school will incorporate on site CHP. The CHP, buffer, boilers etc will be accommodated in the first floor plant room. Should future connection to the wider district heating network be required, it is assumed that the CHP unit, buffer vessel and CHP primary pumps and circuit would be removed and replaced with a DH substation and associated pumps and pipework.

4.3 On site CHP Energy Centre

A feasibility study was carried out to assess suitability of CHP at the proposed development. Biogas CHP could be a renewable alternative to fossil based natural gas fired CHP in the future. However there are currently no commercial providers available which may be recognised as 'Accredited External Renewables' and hence acceptable for BREEAM. There is currently a Green Gas Certification Scheme operated by the Renewable Energy Association. Similar to 'green electricity', the scheme tracks the contractual flows of biogas rather than the physical flows of biogas.

CHP could also be implemented via fuel cells however the capital cost, the absence of a 'hydrogen infrastructure' (no hydrogen commercially available) and the market immaturity make this a high risk option and currently untenable.

The economic justification for Combined Heat and Power (CHP) is largely dependent on the value of electricity it generates. Electricity prices are generally highest between 5.00pm and midnight, so savings are highest if all electricity produced during these times can be put to use.

If conditions are right, CHP offers unique benefits to consumers in that it improves the efficiency at which energy is used in power generation. With regard to waste minimisation, the opportunities are considerable. The average efficiency of thermal power stations in the UK in terms of converting primary energy into electrical is between 38% and 52%. The rest of the energy input is rejected as low-grade heat. There are further losses in the transmission and distribution system so that by the time it arrives at the workplace or home only between 33% and 47% of the primary energy is actually available for use. CHP installations can typically convert around 80% of the energy in the fuel into electrical power and useful heat.

By generating the electricity in an on-site CHP unit, and utilising the heat, electricity from conventional power stations is displaced and the substantial conversion, transmission and distribution losses are avoided. The resulting efficiency gives typical small-scale CHP installations, with the right load conditions, a simple payback period of between 3 and 5 years, beyond which the units continue to save energy right up until the end of the life of the plant.

Fuel is the largest operating expense in the production of power. In typical power applications, fuel costs over a ten-year cycle can range from 75-85% of total operating costs. Thus, in installations where heat can be recovered and used, it is possible to increase total energy output per unit cost and yield attractive savings.

The value of the electricity and heat produced by a CHP unit is greater than that of the fuel consumed. In particular, the value of a unit of electricity can be up to five times that of a unit of heat. As long as the difference offsets the capital and maintenance costs, savings are made. In order to maximise savings from the initial capital investment, running hours should be as long as possible. Guide figures from the CHPQA (Combined Heat and Power Quality Assurance) standards suggest in excess of 4500 hours per annum is required to ensure a good quality installation. According to the London Renewable Toolkit and CIBSE AM12, for CHP systems to be economically viable they need to run for at least 4,000 hours per year.

CHP schemes should be seen as an adjunct to the conventional provision of heat and power, and not an alternative. Conventional arrangements for importing power and running boilers will still be required to cover CHP planned and unplanned downtime and peak demands. A CHP scheme should be considered when any of the following are sought:

- Energy & CO_2 savings;
- Reduced dependency on an electrical supplier; and/or
- Environmental performance improvements.

In comparison with other heat raising methods, CHP schemes are relatively high cost. It is important that all other energy saving and energy efficiency measures are fully considered and incorporated into a building before the viability of a CHP scheme is evaluated. Failure to do so may result in the benefit of the CHP scheme being undermined by the later application of the energy saving measures.

The economic and environmental benefits of CHP schemes are determined from four fundamental parameters:

- Building load profiles;
- Fuel and electricity tariffs;
- CHP plant rating, efficiency and heat to power ratio; and
- CHP plant running hours.

Although these are shown above to be distinct items, in reality they are all interlinked. For any successful application of CHP, all the parameters must be considered together, and an optimised solution sought for the proposed development.

The proposed CHP unit is an SAV XRGI6:

Power unit	XRGI 6
Noise level	49 dB(A)
Dimensions (L x W x H)	92 x 64 x 96 cm
Weight	440 kg
Service interval	10,000 hours
Power output (modulating)	2.5 - 6 kW
Electrical efficiency	28%
Thermal output	8 – 13.5 kW
Thermal efficiency	64%
Overall efficiency	92%
Fuel	natural gas, propane, butane
Natural gas consumption	max. 2.14 m³/h
Flow temperature (constant)	80°C
Return temperature (variable)	5 – 75°C
Emission levels	CO < 150 mg/Nm³ NO_x < 350 mg/Nm³

5. RENEWABLE ENERGY

A cogeneration system using combined heat and power (CHP) plant is consented as the low carbon technology for the Camden Lock Village district heating network. The CHP will provide for the heating requirements for the development. Based on this, biomass heating has been discounted. Moreover, biomass installations are not acceptable in the central London because biomass fired boilers will generate high levels of particulate matter (PM10) and NOx emissions which are both detrimental to air quality.

CHP complimentary systems include wind turbines, solar photovoltaic cells and ground source cooling. These systems are described and further analysed in the following sections. After investigation, solar photovoltaic has been selected as the most suitable technology for the development. All of the potential systems are described and further analysed in the following sections:

5.1 Wind Power

Wind power is conversion of wind energy into more useful forms. Common contemporary wind power is generated in the form of electricity by converting the rotation of turbine blades into electrical current by means of an electrical generator. Wind energy is renewable, widely distributed, clean, and reduces toxic atmospheric and greenhouse gas emissions if used to replace fossil-fuel-derived electricity. Horizontal or vertical axis wind turbines could be used to assist in the power requirements for a building. Not as a single solution, but part of renewable energy strategy, a turbine could be integrated into a building profile.

It is essential that turbines should be sited away from obstructions, with a clear exposure or fetch for the prevailing wind. The most feasible location for wind turbines on Hawley Primary School would be the roof areas. However, the noise generated by wind turbines (typically 60 to 65 dBA) is not favourable for site which includes terraced areas and outside amenity spaces. Aside from this issue, the fact that the Hawley Primary School development is in a dense urban location, it is not ideal for wind turbines as there is a lot of interference with wind flows causing turbulence which decreases the efficiency of wind turbines and yields insufficient wind velocities to make them viable.

5.1.1 Proposed approach for Hawley Primary School

Following review, the negative impact for building occupants, the limited usable unturbulent wind resource available and building height limits makes wind turbines an unfeasible proposition for Hawley Primary School.

5.2 Ground Source Cooling

A closed loop ground source cooling system circulates a fluid, usually water, through the buried loop field pipes. In a closed loop system there is no direct interaction between the fluid and the earth; only heat transfer across the pipe. Horizontal closed loops require a high site footprint to net internal ratio which is not available at the development and for this reason vertical loops would be required. The cooling available from the vertical loops required is a function of the ground formation thermal conductivity, deep earth temperature, and also depends on the balance between the amount of heat rejected to and absorbed from the ground during the course of the year. As a guide, the surrounding soil temperature is the average annual temperature for the region. For London, this is approximately 14°C.

A vertical closed loop field is composed of pipes that run vertically in the ground. A hole is bored in the ground, typically, 50 to 150m deep. Pipe pairs are installed in the hole and are joined with a U-shaped cross connector at the bottom of the hole. The borehole is commonly filled with a bentonite grout surrounding the pipe to provide a good thermal connection to the surrounding soil or rock. Vertical loop fields are typically used when there is a limited square footage of land available. Bore holes are spaced 5–6 m apart and are generally 15m deep per kW_{th} of capacity. Typically, high capital costs are associated with vertical ground source cooling systems due to the complications associated with the drilling of deep boreholes.

5.2.1 Proposed Approach for the Hawley Primary School

The closed loop system would also require use in heating mode to maintain energy balance. The GLA have expressed dissatisfaction for such a strategy as potential heat load for the CHP heating network would reduce. There is greater carbon performance available from high efficiency CHP than ground source heat pump. The cooling load is very low as only an ICT server may require cooling. On this basis, we do not propose the use of closed loops ground source heat pumps at Hawley Primary School.

5.3 Photovoltaics

Solar energy is the energy force that sustains life on the earth for all plants, animals, and people. The earth receives this radiant energy from the sun in the form of electromagnetic waves, which the sun continually emits into space. The earth is essentially a huge solar energy collector receiving large quantities of this energy which manifests itself in various forms, such as direct sunlight used through photosynthesis by plants, heated air masses causing wind, and evaporation of the oceans resulting as rain which can form rivers.

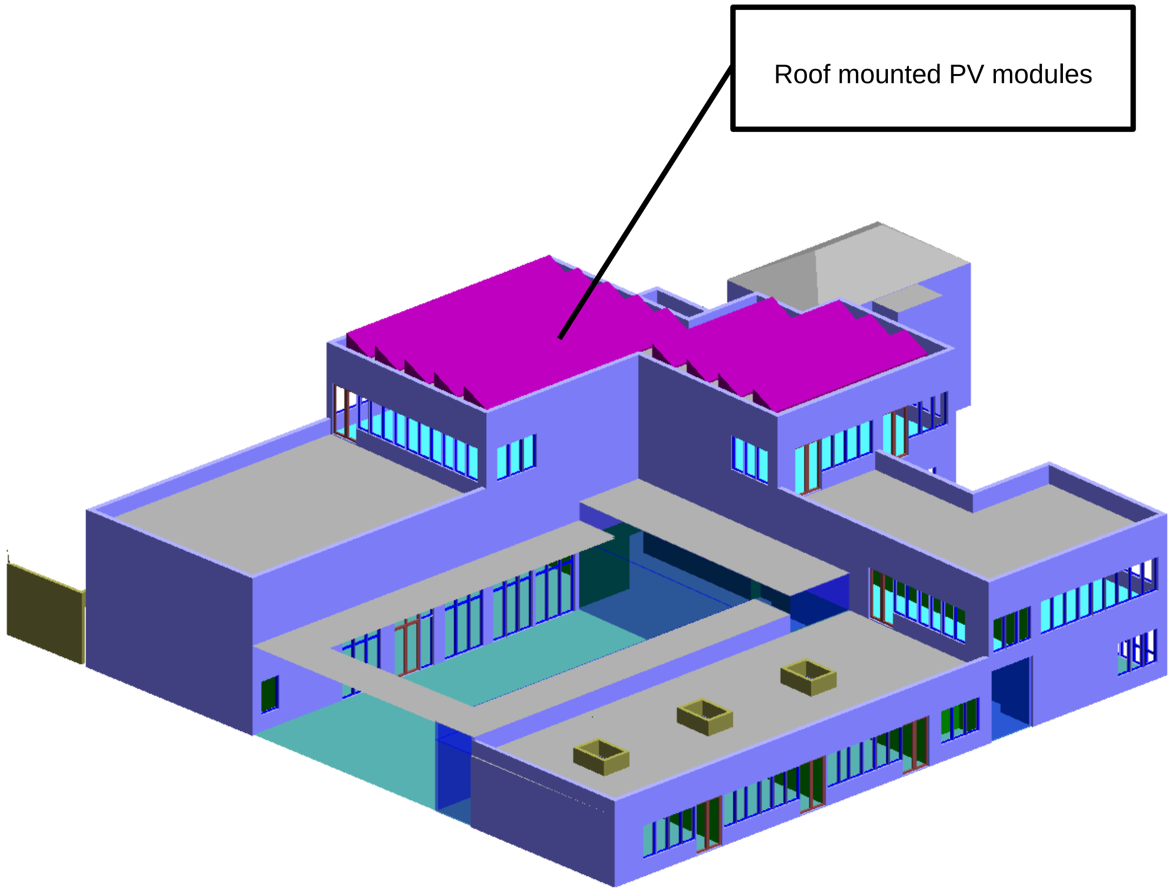
Solar energy is therefore a renewable resource that is inexhaustible and is locally available. It is a clean energy source that allows for local energy independence. The sun's power flow reaching the earth is typically about 1,000 W/m^2, although availability varies with location and time of year. Capturing solar energy typically requires equipment with a relatively high initial capital cost. However, over the lifetime of the solar equipment, these systems can prove to be cost-competitive, as compared to conventional energy technologies. The key to successful solar energy installation is to use quality components that have long lifetimes and require minimal maintenance.

Electricity can be produced from sunlight through a process called photovoltaics (PV), which can be applied, in either a centralized or decentralized fashion. "Photo" refers to light and "voltaic" to voltage. The term describes a solid-state electronic cell that produces direct current electrical energy from the radiant energy of the sun. Solar cells are made of semi-conducting material, most commonly silicon, coated with special additives. A typical silicon PV cell is composed of a thin wafer consisting of an ultra-thin layer of phosphorus-doped (N-type) silicon on top of a thicker layer of boron-doped (P-type) silicon. An electrical field is created near the top surface of the cell where these two materials are in contact, called the P-N junction. When sunlight strikes the surface of a PV cell, this electrical field provides momentum and direction to light-stimulated electrons, resulting in a flow of current when the solar cell is connected to an electrical load.

5.3.1 Proposed Approach for Hawley Primary School

The amount of roof space for PV has been carefully considered and optimised as it forms a balance with plant requirements, amenity, living roof areas. The location of the PV has also considered the varying roof profiles that shade some elements of the roof scape and thus limit the areas where PV can be effectively applied.

The PVs will be roof mounted and inverters will be located close to the PV modules. Up to 140m^2 of PV module area will be installed at Hawley School depending on the final type of PV module selected and considering appropriate module spacing on the roof so as to avoid modules shading each other at low sun angles.



6. ENERGY DEMAND ASSESSMENT

This section of the report demonstrates that the proposed building complies with Approved Document L 2010 and exceeds the London Plan 2011 requirements for reductions in carbon dioxide (CO_2) and energy generation from renewables. London Plan 2011 Policy 5.2 Minimising Carbon Dioxide Emissions advises that the baseline standard for major new developments should exceed the carbon reduction requirements of ADL2A 2010 by 25%.

The CO_2 emissions were calculated for new build element of the development using EDSL Tas version 9.2.1 dynamic thermal modelling software suite.

This method of calculation compares the total energy consumption of Hawley Primary School and its services, expressed as CO_2 emissions of the building being assessed (its "Building Emissions Rate" or BER) with a target value (its "Target Emissions Rate" or TER) derived from similar calculations for a "notional building".

The notional building has:

- The same geometry, orientation and usage as the assessed building;
- It is exposed to the same weather conditions as the assessed building;
- Standard operating patterns (to allow consistent comparison between buildings in the same sector)
- Standardised assumptions for building fabric, glazing and HVAC plant efficiencies;
- Any service not covered by Part L (e.g. emergency lighting, specialist process lighting) is ignored in both the actual and notional building.

The results of the CO_2 emissions calculations are expressed as defined in GLA Energy Team Guidance on Planning Energy Assessments (September 2011) sections 4.2 and 4.3 in the executive summary of this report. From results provided in Section 1 'Table of Total Carbon Emissions' of this report, CHP provides a carbon dioxide saving of circa 24%. Likewise, PV system provides circa 54% carbon dioxide emissions savings respectively.

7. CONCLUSIONS

The proposed redevelopment at Hawley Primary School has been assessed using approved software to demonstrate the potential energy usage and CO_2 emissions.

The strategic design approach follows the London Plan energy hierarchy outlined below:

1) Use less energy
"Be Lean"

e.g.

- Improve insulation
- Incorporate passive heating and cooling
- Install energy efficient lighting and appliances

2) Supply energy efficiently
"Be Clean"

e.g.

- Use combined heat and power, and community heating
- Cut transmission losses through local generation

3) Use renewable energy
"Be Green"

e.g.

- Install renewable energy technologies, such as photovoltaics.

From the charts in Section 1 it can be seen that the proposed new build development with the inclusion of renewable technologies as well as the other measures proposed, has the potential to better the ADL2A 2010 maximum requirements for CO_2 emissions by ~74%. This potential reduction is achieved by the inclusion of a carefully considered façade design, energy efficient LED lighting system, combined heat and power unit connected to a district heating system and roof mounted high efficiency photovoltaic modules.

The change in GLA policy since the implementation of the London Plan 2011 has focused the energy strategy on carbon emission reductions be it by efficiency measures, or with the inclusion of renewable technologies. This has allowed further investment in aspects of energy efficient design, seeking greater energy savings from low energy lighting systems, high light transmittance glazing optimised with solar shading.

The energy strategy if this development achieves all the carbon performance objectives of adopted policy including National Planning Policy Framework, London Plan and the London Borough of Camden Local Development Framework.

8. APPENDICIES

ADI-NOx

ADI Premix Combustion Gas Fired Boilers

Ultra low emission, compact gas fired boilers in condensing and non-condensing versions with outputs from 68 to 905kW

MHS BOILERS
Part of elco heating solutions

Kinder to the environment

High efficiency accords reduced carbon emissions, and extremely low NOx concentration in the flue gases reduces the potential for damage to the environment through acid rain.

Utilising a radiant premix burner fed with precisely premixed gas and air, the ADI-NOx ADI range of boilers have extremely low harmful emissions with NOx as low as 4.0mg/kWh at 0% O^2.

The ADI boilers are available in three different forms, condensing versions for highest efficiency, low temperature versions for higher output and standard versions which are designed with the replacement boiler market in mind where compact dimensions and the ability to operate at 11°C Δt system design conditions are key features.

ADI boilers are designed to operate with a Δt between 10 to 15K, however for installations where a wider system load circuit temperature drop is desired, this is simply achieved via temperature modification through blending in the low loss header. For rationale see page 14.

The compact dimensions of the ADI boilers allow important space to be liberated for other purposes in new build projects. And when used as replacement appliances in existing buildings, the space saving nature of these boilers makes for ease of application, with even the possibility to make an almost complete installation of the boilers as replacements, before the original units are taken out of service. Thus reducing the time needed to bring the system back to operation and thereby reducing inconvenience in a building that remains occupied during the works.

Boiler replacement can pose extreme difficulties, particularly when attempting to retrofit for some of the very narrow dimensioned gas fired atmospheric appliances which were very popular during the period from the 1970's to the early 2000's. Some appliances with outputs up to 100kW were just 376mm wide. The ADI boilers provide the solution with models of up to 110kW output which are only 350mm wide.

Modulating burner output with turndown to 30% of maximum output and the ability to create cascade/modular installations of up to 15 boilers gives the potential for extremely high seasonal efficiency.

Standard features

Durability

Through the use of corrosion resistant stainless steel as a heat exchanger material in the CD and LT models. The HT models being non-condensing appliances are fabricated from high quality carbon steel.

Compact dimensions

Mindful that space is at a premium in commercial buildings, the ADI has been designed to be space-saving and with dimensions as small as 350mm wide for outputs up to 105kW and just 1040mm width for a boiler of 905kW output, the appliances are ideal first time or replacement units.

Controls

Communication between the user and the boiler's in-built comprehensive control centre is via LCD interface with soft touch membrane switches and which provides at-a-glance information about the operation of the appliance. Programming is via menu based format. As standard the boiler can control an attached heating circuit (which may be with direct-on-boiler weather compensation for the CD and LT versions) plus a domestic hot water cylinder.

Extreme efficiency

Up to 99.3% net at full load is achievable utilising the condensing version (CD).

Multiple boiler installations

With the use of an RVA47 cascade manager, up to 12 boilers may be controlled with optimum power to load matching for good seasonal efficiency. Alternatively, the use of an RVS 63 controller provides for cascade installations of up to 15 boilers.

Analog input

If required, a single boiler or a cascade arrangement may be set up to respond to variable voltage inputs. Alternatively, boilers may be enabled by an external volt free switch.

Warranty

As standard the warranty period is 2 years. All guarantees are against manufacturing or material defects only (see terms and conditions of sale).

For details on prefabricated skid mounted sets or roof-top packages, please contact MHS Boilers

Technical data ADI CD Models

Model		CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD	CD
ADI-NOx ADI		**70**	**85**	**105**	**120**	**175**	**200**	**250**	**325**	**375**	**450**	**550**	**650**	**750**	**850**	**950**
Nominal heat output max @ mean water temp 70°C	kW	68	85	104	120	161.8	197.5	241	294	354	440	530	598	675	792.7	892.3
Nominal heat output min @ mean water temp 70°C	kW	20.4	25.5	31.2	36	48.5	59.25	72.3	88.2	106.2	132	212	239.2	270	317	356.9
Nominal heat output max @ mean water temp 40°C	kW	68.7	86.1	105.6	121.3	167.1	204.5	244.7	302.6	358.7	443.5	542.1	610.3	686.8	802.1	904.1
Nominal heat output min @ mean water temp 40°C	kW	22	27.5	34	39	52.3	63.1	77.4	94.4	113.6	141	230	259	292	338.2	380.9
Nominal heat input max (net)	kW	70	87.7	107.1	123.4	166	202.2	246.5	300.5	361.2	448.2	548.1	619	695.8	818.5	924.5
Nominal heat input min (net)	kW	21	26.3	32.2	37	49.8	60.7	74	90.2	108.4	134.5	219.2	247.6	278.3	332	377
Gross seasonal efficiency*	%	93.08	92.86	93.16	93.32	92.59	92.63	93.11	93.16	93.28	93.27	92.9	92.88	92.95	92.95	92.95
Modulation range	%	100% - 30%														100% - 40%
Maximum flow temperature	°C	90														
Water content	litres	30	33	34	34	35	86	90	112	118	118	160	160	160	188	188
Nominal water flow Δt 10K	l/s	1.61	2.02	2.47	2.85	3.85	4.7	5.73	7	8.42	10.47	12.61	14.23	16.07	19.04	21.54
Nominal water flow Δt 11K	l/s	1.46	1.84	2.24	2.59	3.5	4.28	5.21	6.37	7.67	9.53	11.48	12.96	14.63	17.31	19.58
Nominal water flow Δt 15K (min flow)	l/s	1.07	1.35	1.64	1.9	2.56	3.13	3.82	4.67	5.62	6.98	8.41	9.5	10.72	12.69	14.36
Hydraulic resistance @ Δt 10K	kPa	8.5	9	9.7	10.3	8.4	9.4	11	12.5	14.8	18.2	11.7	13.7	15	18.0	24.0
Hydraulic resistance @ Δt 11K	kPa	7.04	7.45	8.04	8.53	6.96	7.8	9.11	10.36	12.26	15.08	9.7	11.35	12.43	16.0	20.0
Hydraulic resistance @ Δt 15K	kPa	3.2	3.39	3.66	3.88	3.17	3.55	4.15	4.72	5.58	6.87	4.42	5.17	5.66	8.0	10.5
Min/max water pressure	bar	1.0 / 5.0										1.0 / 6.0				
Gas consumption NG (G20)	m³/h	6.5	8.2	10	11.5	15.4	18.8	22.9	27.9	33.6	41.7	51	57.5	64.7	77.1	87.6
Nom gas inlet pressure NG (min/max)	mbar	20 (17/45)														
Gas consumption LPG (G31)	kg/h	1.7	2.2	2.7	3.1	4.1	5.0	6.1	7.4	8.9	11.1	18.0	-	-	-	-
Nom gas inlet pressure LPG	mbar	37.0														
Approx flue gas volume	m³/h	152	190	233	269	377	459	560	683	821	1018	1170	1321	1491	1771	2014
Residual pressure @ flue outlet	Pa	43.2	37.8	90	64.8	54	64.8	64.8	90	64.8	90	180	132	108	177.5	266.2
NOx emission @ 0% O^2	mg/kWh	<12.0														
Approx flue gas temperature @ mean water temp 40/70°C	°C	45/75														
Gas connection	BSP-F	¾″	¾″	¾″	1″	1″	1¼″	1¼″	1¼″	1¼″	1¼″	1¼″	1¼″	1¼″	1¼″	1¼″
Flow/return connections (•BSP-M)	DN	•2″	•2″	•2″	•2″	•2″	65 PN6	65 PN6	65 PN6	65 PN6	65 PN6	100 PN6	100 PN6	100 PN10	100 PN10	100 PN10
Flue connection	Ø mm	150	150	150	150	150	175	175	250	250	250	350	350	350	350	350
Nominal weight (dry)	kg	110	116	120	135	138	330	350	440	445	490	510	510	510	585	585
Noise level @ 1m distance	dB(A)	62.8	64.7	68.8	65.5	59.2	66.7	61.4	62.0	67.6	70.4	65.9	67.7	69.2	74.1	78.0
Electrical supply	v/ph	230V single phase 50Hz														400V 3ph
Power consumption (max)	W	236	240	255	245	267	261	290	334	301	768	77	789	1003	1325	1850

* Calculated using "Equation 2[9]" as listed in the Non-Domestic Building Services Compliance Guide

- Models 650 to 950 not available for use with LPG

LoadTracker CHP
XRGI 6 and XRGI 9

Power unit	XRGI 6	XRGI 9
Noise level	49 dB(A)	49 dB(A)
Dimensions (L x W x H)	92 x 64 x 96 cm	92 x 64 x 96 cm
Weight	440 kg	440 kg
Service interval	10,000 hours	10,000 hours
Power output (modulating)	2.5 - 6 kW	4 - 9 kW
Electrical efficiency	28%	29%
Thermal output	8 – 13.5 kW	14 - 20 kW
Thermal efficiency	64%	65%
Overall efficiency	92%	94%
Fuel	natural gas, propane, butane	natural gas, propane, butane
Natural gas consumption	max. 2.14 m^3/h	max. 3.1 m^3/h
Flow temperature (constant)	80°C	80°C
Return temperature (variable)	5 – 75°C	5 – 75°C
Emission levels	CO < 150 mg/Nm^3 NO_x < 350 mg/Nm^3	CO < 50 mg/Nm^3 NO_x < 100 mg/Nm^3