LSHTM Tavistock Place

Energy Statement

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Executive Summary

This report has been produced to present the proposed energy strategy for the London School for Hygiene and Tropical Medicine's new 3,661m^2 medical research facility at Tavistock Place. This will necessitate the demolition of an existing main storage shed, the two storey wing of the LSHTM main accommodation block and the smaller storage accommodation at 15-17 Tavistock Place, to facilitate the provision of high quality dry laboratory and write up space, forming a new medical research facility consistent with the Class D1 (non-residential institution) use.

The laboratory space will be housed in a new energy efficient structure that Camden have (through approving the extant planning permission) agreed preserves the setting of Designated Heritage Assets, such as Listed Buildings and the Conservation Area.

A reduction in emissions for the site has been demonstrated via 'Lean', 'Clean', 'Green' measures, in line with the GLA guidance on preparing energy statements, the Camden Local Plan and Camden Planning Guidance 3.

The development optimises envelope performance to reduce mechanical system loads by pursuing a mixed-mode strategy that incorporates natural ventilation where feasible, coupled with high efficiency systems. These 'Lean' measures are predicted to achieve a regulated energy carbon reduction of 29.9%, providing an estimated carbon saving of 20.2 tCO_2.

Whilst no improvement is achieved via 'Clean' measures, as no CHP is proposed for the scheme, an allowance for c.15kWp roof mounted solar photovoltaic panels will contribute to the reduction achieved through 'Green' measures. 'Green' measures are predicted to achieve a reduction in emissions of 7.8%, providing an estimated carbon saving of 5.3 tCO_2.

The combined regulated emissions reduction resulting from proposed 'Lean' and 'Green' interventions associated with the development demonstrate a carbon reduction of 37.8%; an estimated 25.5 tCO_2. This meets London Plan policy 5.2.

Further opportunities to optimise the on-site energy contribution from PV will be explored as the design develops. Specialists will be engaged to assess efficiencies of the system and optimise layouts to maximise yield.

Spatial allowances have also been made within the plantroom for the future installation of a heat exchanger to enable future connection to a local energy network.

Contents

1.0 Policy Summary

The project team are committed to delivering a building that minimises its impact on the environment and resource consumption. The following section outlines the key aspects of National and Local Policy that have influenced design.

1.1 Building Regulations Part L – Conservation of Fuel and Power

Building Regulations are statutory instruments that seek to ensure that the policies set out within any relevant UK legislation are carried out. Building Regulations approval is required for the majority of building work carried out in the UK.

Part L covers the requirements with respect to the conservation of fuel and power in all buildings. It sets performance parameters relating to insulation levels, air permeability, heating efficiency, ventilation and air conditioning systems together with hot water storage and lighting efficiency. It also sets out the requirements for calculating the carbon dioxide emissions and the Carbon Emission Targets for each building type.

The proposed LSHTM Tavistock Place development is seeking compliance with Part L2A.

1.2 The London Plan (2016)

At a regional level, the climate change policies as set out in the London Plan require developments to make the fullest contribution to the mitigation and adaptation to climate change and to minimise carbon dioxide emissions.

1.2.1 Policy 5.2 Minimising Carbon Dioxide Emissions

London Plan Policy 5.2 states that major development proposals should include a detailed energy assessment to demonstrate how the targets of carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

All developments should demonstrate a reduction in carbon emissions in accordance with the following energy hierarchy:

- Use Less Energy (Be Lean)
- Supply Energy Efficiently (Be Clean); and
- Use Renewable Energy (Be Green)

1.2.2 Policy 5.3 Sustainable Design and Construction

Policy 5.3 states that all Major Developments must meet the standards outlined in the Mayor's Supplementary Planning Guidance. This includes consideration of the following issues:

- Minimising carbon dioxide emissions across the site, including the building and services (such as heating and cooling systems)
- Avoiding internal overheating and contributing to the urban heat island effect
- Efficient use of natural resources (including water), including making the most of natural systems both within and around buildings
- Minimising pollution (including noise, air and urban run-off)
- Minimising the generation of waste and maximising reuse or recycling
- Avoiding impacts from natural hazards (including flooding)
- Ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions

- Securing sustainable procurement of materials, using local supplies where feasible, and
- Promoting and protecting biodiversity and green infrastructure.

1.2.3 Policy 5.6 Decentralised energy in development proposals

The London Plan outlines the Mayor's desire to generate a significant proportion of London's heat and power through localised and decentralised energy systems. As such, Policy 5.6 recommends that Major Development proposals should select energy systems in accordance with the following hierarchy, in conjunction with the London Heat Map tool:

1. Connection to existing heating or cooling networks
2. Site wide CHP network
3. Communal heating and cooling

1.2.4 Policy 5.7 Renewable Energy

The promotion and development of renewable energy generation is described in Policy 5.7. Specific requirements are to be set within Borough's Local Development Frameworks. Nonetheless, all systems should have no adverse impacts on environmental assets.

1.2.5 Policy 5.9 Overheating and Cooling

Policy 5.9 outlines the measures that should be considered to minimise overheating and therefore cooling within development. Development should demonstrate this in accordance with the 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)

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.

1.3 Camden Local Plan (2017)

The Camden Local Plan, covering the period from 2016 – 2031, replaces the Council's Core Strategy and Development Policies, adopted in 2010, and sits alongside the London Plan and Camden Planning Guidance 3. Camden's contribution to climate change is minimised and protection and improvements to the local environment are made through policy CLP CC1.

1.3.1 Policy CC1: Climate change mitigation

Development should seek to minimise the effects of climate change and meet the highest feasible environmental standards. This includes following the energy hierarchy towards zero carbon, supporting decentralised energy networks, reducing the need for car travel and optimising resource efficiency.

The council will:

a) Promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps of the energy hierarchy
b) Require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met
c) Ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks, and
d) Expect all developments to optimise resource efficiency
e) Require all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establish a new network
f) Require major developments to install appropriate monitoring equipment so that the effectiveness of renewable and low carbon technologies can be monitored

1.4 Camden Planning Guidance: Sustainability CPG3

CPG3 replaces the Camden Planning Guidance 2006 and provides information on ways to achieve carbon reductions and more sustainable developments. The borough of Camden seeks to minimise its contribution to climate change and ensure development occurs in a way that respects environmental limits and improves quality of life. Developments are required to demonstrate that they have applied the energy hierarchy to make the fullest contribution to CO2 reduction, first through 'lean' energy efficiency measures, before supporting the development of 'clean' decentralised energy networks and Combined Heat and Power where feasible, and finally through use of 'green' renewable energy technologies.

The London Plan, CPG3, and the Camden Local Plan expect all new non-domestic development of 500m^2 or above to be zero carbon from 2019.

2.0 Energy Strategy

Following the guidance set out in CPG3, this energy statement uses London Test Reference Year weather data (TRY) as per the NCM requirement to establish the baseline energy demand and carbon dioxide emissions of the proposed development following the energy hierarchy in a step by step methodology that demonstrates:

- ‘Lean’ measures applied to reduce the demand for energy
- ‘Clean’ measures integrated to supply energy efficiently, and
- ‘Green’ measures to further reduce carbon dioxide emissions through use of renewable energy technologies

2.1 Be Lean

The development will focus on a ‘fabric first’ approach to maximise energy efficiency. The strategy depends on spectrally selective solar control glazing. In comparison to reflective or absorptive solar control, spectrally selective glazing retains a relatively neutral appearance (it’s usually slightly tinted) whilst simultaneously filtering out solar gain and allowing daylight in.

2.1.1 Building Fabric

In accordance with Part L, all elements of the building fabric will exceed performance levels detailed in table 1.

Table 1. Envelope thermal performance for new build elements

Element	***U-Value (W/m^2 K)***	***Description***
Internal Ceilings	-	Suspended lightweight system
External Walls	0.16	Lightweight TECU façade system
Roof	0.15	Lightweight Roof to levels 2,3 and 4
Ground Floor	0.12	Insulated ground slabs. U-values of ground slab calculated in accordance with BS EN ISO 13370
Glazing	1.6	Double-glazed
Basement Floor	0.2	Uninsulated concrete floor calculated in accordance with BS EN ISO 13370.
Internal Partitions	-	Generic lightweight stud partitions.

Air Permeability

Air permeability of 3m^3/m^2/hr@50Pa has been assumed, which roughly equates to an infiltration rate of 0.1ach. This must be verified by onsite testing by the Contractor prior to completion.

Lighting

The scheme will utilise LED luminaires suitable for the purpose and use of the spaces. Luminaires will comply with BS EN 60 598, and be specified for their photometric performance, with suitable distribution, efficiency and appropriate glare control, for effective illumination of a particular task or space.

- Lighting efficacy is higher than the Notional building’s 60 luminaire-lumens per circuit watt
- Photoelectric dimming is used in all areas with a significant amount of external glazing
- External lighting to be automatically controlled for prevention of operation during daylight hours

- Presence and absence sensing controls are used throughout
- Parasitic power from control circuits is set to 1W for every 20m^2
- Scene setting control systems shall be employed where changes in room use necessitate different lighting conditions
- Display lighting efficacy in Reception areas > 35 luminaire lumens per circuit watt
- BMS has capability for Automatic Measurement and Targeting

Ventilation

The current proposal considers a mixed-mode approach to cooling and ventilation. A fully natural ventilation strategy is not viable due to the basements and deep-plan areas (that maximise the efficiency of the site), and the resultant lack of opportunity for cross ventilation. The potential for cross ventilation is further limited by the supply and extract louvers from the retained existing building adjacent, which face directly onto the site of the proposed new building, contaminating the outdoor air. It is expected that natural ventilation, where permitted, will be used for as much of the year as possible to maintain comfort conditions.

Window openings at the perimeter areas above ground level will allow high and low level ventilation where spaces are ventilated from a simple façade, to promote stack ventilation. The design strategy of exposed thermal mass and generous floor to ceiling heights will further improve ventilation effectiveness and thermal comfort in naturally ventilated areas.

A centralised mechanical ventilation system has been assigned to write-up areas/labs, reception, toilets, changing areas and the basement plant room. Ventilation rates will be minimised through the use of active chilled beams rather than air for cooling, reducing Specific Fan Power (SFP) to 1.6 W/l/s or less, thus minimising the energy consumed to ventilate and condition the building. Ventilation will be demand controlled via CO_2 sensors and variable fans.

The central AHUs will include heat recovery (MVHR) with an efficiency of at least 70%.

Cooling

The mixed-mode approach to cooling is based on the seasonal application of active chilled beams. Where applicable (i.e. to write-up areas and offices only), natural ventilation is be provided to limit cooling demand and remove need for mechanical cooling.

The chillers have a Seasonal Energy Efficiency Ratio (SEER) of 5.1.

Heating

Heating is provided to the building via high-efficiency gas boilers. This solution offers efficient and low cost energy generation.

Pumps and Fans

All pumps will be variable speed with multiple pressure sensors, to reduce pumping power.

Building Energy Management Systems

Energy meters will be provided in accordance with the requirements of the Building Regulations: 2013 Approved Document L2A Conservation of Fuel and Power and TM39: Building Energy Metering CIBSE.

Separate meters will be provided for lighting and power installations, with dedicated distribution boards at each floor. Major plant items will also be separately metered, in accordance with the BREEAM requirements for issue Ene 02 – Energy Monitoring. All meters will be interfaced with the Building Energy Management System (BEMS) for remote monitoring, recording and billing.

2.2 Be Clean

The Camden Local Plan requires all new developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible, connecting to an identified future decentralised network or establishing a new network.

Combined Heat and Power (CHP) has shown to be of limited benefit to LSHTM Tavistock Place, due to seasonal variations in the heat demand profile of the building. No local District Energy Networks are presently available, however, a spatial allowance will be made in the plant room for the future installation of a heat exchanger to enable future connection, in compliance with CLP policy CC1 and CPG3.

The development is within 1km of 4 district schemes:

- The potential Camden Town Hall scheme
  Connection will be considered
- The new local DEN originating from Cartwright Court
  Meeting with the Cartwright Halls design team established there does not appear to be any potential to increase the utilisation of the CHP units in the winter (all three units appear to operate at maximum output over a 24 hour period)
- The existing Bloomsbury Heat and Power network
  The LSHTM site is less than 200m from the proposed network expansion. It is suggested that discussions are initiated with the BHP energy manager to determine the potential for including the LSHTM in the network expansion
- The proposed Euston road DEN
  Where LSHTM Tavistock Place does not have its own CHP or connect to the BHP or Camden Town Hall networks, connection to the Euston road DEN should be investigated as and when the network is constructed

2.3 Be Green

The feasibility of effectively and efficiently incorporating renewable technologies into the development has been analysed. An overview of each of the renewable energy technologies assessed in this study are as follows. The technologies have been given a feasibility status of: 'Recommended', 'Considered', or 'Not Recommended' for the described reasons. Wind power has been discounted as there are no viable locations to locate wind turbines and they would likely cause noise nuisance for occupants of the site and surrounding buildings. Biofuel has also been discounted as biomass deliveries by heavy goods vehicles are not feasible due to site constraints and would have associated noise and safety considerations.

Solar Photovoltaics

Overview	Photovoltaic (PV) modules convert sunlight directly to DC electricity. The solar cells consist of a thin piece of semiconductor material, in most cases silicon. When sunlight shines on the cell it creates an electric field causing electricity to flow; the greater the light intensity, the greater the flow of electricity. Individually, PV cells only provide a small amount of electricity and they are generally grouped together into a module for convenience and higher output.
Status	**Recommended**
Reasons	- Solar Photovoltaics are generally a feasible technology due to their flexibility in urban environments. - The large unobstructed flat roof area of the adjacent building being retained provides a good opportunity for a PV array to contribute to the energy demand on the new building.

Solar Hot Water

Overview	Solar Water Heating systems use radiant energy from the sun to heat water for Domestic Hot Water systems or heating systems pre-heat. Solar hot water systems are most effective when utilised on buildings with year-round demand. There is a risk of these systems overheating when demand is low. Appropriate management strategies, heat dumps, and/or covers to Block the sun must be included to mitigate the risk of the system breaking. Associated additional capital expenditure and maintenance risk must be considered in the feasibility.
Status	**Not recommended**
Reasons	- Hot water demand for the building is minimal - Roof area is prioritised for solar PV array for greater carbon savings

Combined Heat and Power

Overview	A CHP engine maximises fuel and converts it into electricity, increasing the efficiency of a power generation system. Waste heat is recovered from the engine by removal from the exhaust, water jacket and oil cooling circuits, and is redirected as useful heat energy. This reduces energy consumption and resulting carbon dioxide emissions.
Status	**Not recommended**
Reasons	- The demand for heat will be lower in the summer - A high initial investment is required - Usually used with a fossil fuel input source

Ground Source Heat Pump

Overview	Space heating and cooling can be provided by circulating water through the ground or via subterranean water. Ground water cooling and heating makes use of the relatively stable ground/water temperatures throughout the year, typically ranging between 10 – 14°C. The heat pump extracts or dumps heat to the ground via a ground contacting heat exchanger. Ground source heat pumps require no flues, and have no acoustic issues.
Status	**Not recommended**
Reasons	- High capital cost associated with installation ground works

Air Source Heat Pumps

Overview:	An air source heat pump extracts heat from the outside air in the same way that a fridge extracts heat from its inside. It can extract heat from the air even when the outside temperature is as low as minus 15°C. The cycle can be reversed to also provide cooling. The heat pump extracts or dumps heat to the air via a heat exchanger.
Status	**Not recommended**
Reasons	- Low heat supply compared to efficient gas boilers - High carbon factor with grid supplied energy - Roof space prioritised for ventilation and cooling plant and PV

2.1 Selected Renewable Energy

In addition to the requirement for a 35% carbon reduction over Part L 2013, London Borough of Camden also requires a saving from renewable energy technologies alone.

CPG3 and CLP policy CC1 state that developments will be expected to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy), unless it can be demonstrated that such provision is not feasible.

The renewable energy technologies selected for the scheme are:

- Photovoltaics

Available roof area for PV is limited due to the profiled roof design of LSHTM Tavistock Place. As a result, the project team has identified an adjacent roof for the installation of the PV array to contribute to the onsite renewable energy generation contribution. It is proposed that a PV array of approximately c.15kWp is located on the flat, accessible roof space of the existing neighbouring building. This will be installed at an inclination of 10° and aligned close to south, to maximise performance. The PV array is assumed to have 17% efficiency, and DC and inverter losses of 9%. Specialists will be engaged to assess efficiencies of the system and optimise layouts to maximise yield.

3.0 Energy Baseline

The following table provides a breakdown of the anticipated energy demand of LSHTM Tavistock Place by end use.

Table 2. Breakdown of projected energy demand and carbon emissions by end use

	kWh/yr	kWh/m²/yr	$kgCO_2$/yr	$kgCO_2/m^2$
Heating	60,631	16.56	11,166	3.05
Cooling	13,034	3.56	4,582	1.25
Auxiliary (pumps and fans)	40,970	11.19	14,403	3.93
Lighting	38,261	10.45	13,451	3.67
Domestic Hot Water (DHW)	10,215	2.79	3,591	0.98
Equipment	229,673	62.73	80,744	22.05
Total Regulated	**163,148**	**44.55**	**47,194**	**12.89**

4.0 Emissions Summary

The following section considers how the development performs in accordance with the 'Lean, Clean, Green' energy hierarchy.

4.1.1 Breakdown of emissions associated with final energy use

Table 3. Breakdown of regulated CO_2 emissions by consuming system

	Notional ($kgCO_2/(m^2.yr)$)	Be Lean ($kgCO_2/(m^2.yr)$)	Be Clean ($kgCO_2/(m^2.yr)$)	Be Green ($kgCO_2/(m^2.yr)$)
Heating	2.34	3.05	3.05	3.05
Cooling	2.19	1.25	1.25	1.07
Auxiliary (pumps and fans)	4.94	3.93	3.93	3.36
Lighting	7.96	3.67	3.67	3.13
Domestic Hot Water (DHW)	0.98	0.98	0.98	0.84
Equipment (Unregulated)	22.05	22.05	22.05	22.05
Displaced (renewables)	0.00	0.00	0.00	-1.38
Total Regulated	18.40	12.89	12.89	11.45

Table 4. Regulated CO_2 emissions by step

	Notional	Be Lean	Be Clean	Be Green
Total (regulated) emissions ($kgCO_2$/yr)	67,368	47,194	47,194	41,906
$kgCO_2$ reduction by step ($kgCO_2$/yr)		20,174	20,174	25,462

4.1.2 'Lean', 'Clean', 'Green' Breakdown in accordance with London Plan

Table 5. Regulated CO_2 emissions after each stage of the hierarchy

	Total tCO_2/yr	Ref		
Baseline	67.36	A		
Lean	47.19	B		
Clean	47.19	C		
Green	41.91	D		
	Ref	**Reduction tCO_2**	**Ref**	**% change**
Lean	A-B	20.17	(A-B)/A x 100	29.9
Clean	B-C	0.00	(B-C)/B x 100	0.0
Green	C-D	5.29	(C-D)/A x 100	7.8
Total Cumulative Savings	A-D=E	25.46	(A-D)/A x 100	**37.8**

4.1.3 Regulated and Unregulated Energy Breakdown

Table 6. Total regulated and unregulated CO_2 emissions by step

	Notional	Lean	Clean	Green
Regulated emissions ($kgCO_2/yr$)	67,368	47,194	47,194	41,906
Unregulated emissions ($kgCO_2/yr$)	80,744	80,744	80,744	80,744
Total emissions ($kgCO_2/yr$)	148,112	127,938	127,938	122,650

Table 7. Regulated and unregulated CO_2 emissions after each stage of the hierarchy

	Total tCO_2/yr	Ref		
Baseline	148.11	A		
Lean	127.94	B		
Clean	127.94	C		
Green	122.65	D		
	Ref	**Reduction tCO_2**	**Ref**	**% change**
Lean	A-B	20.17	(A-B)/A x 100	13.6
Clean	B-C	0.00	(B-C)/B x 100	0.0
Green	C-D	5.29	(C-D)/A x 100	3.6
Total Cumulative Savings	A-D=E	25.46	(A-D)/A x 100	**17.2**

The development complies with London Plan Policy 5.2, achieving a 37.8% reduction in regulated emissions against Part L 2013, as demonstrated in Table 5. PV will contribute a total of 3.93kWh/m^2/yr of the building's 44.55kWh/ m^2/yr demand.

PV contributes a carbon reduction of 7.8%. It is acknowledged that this does not comply with the criteria of CPG3 and CLP policy CC1, which requires developments to achieve a 20% reduction in CO2 emissions from on-site renewable energy generation.

Available roof area for PV is limited due to the profiled roof design of LSHTM Tavistock Place. As a result, the project team has identified an adjacent roof for the installation of a c.15kWp PV array to contribute to the onsite renewable energy generation contribution.

Further opportunities to optimise the on-site energy contribution from PV will be explored as the design develops. Specialists will be engaged to assess efficiencies of the system and optimise layouts to maximise yield.

Spatial allowances have also been made within the plantroom for the future installation of a heat exchanger to enable future connection to a local energy network.

5.0 Conclusion

This energy statement presents the predicted energy performance for the London School for Hygiene and Tropical Medicine's new medical research facility at Tavistock Place. This is based on the current design specification and a contribution from low/zero carbon technologies.

Reductions in emissions for the new development have been demonstrated via 'Lean', 'Clean' and 'Green' measures, in line with the Mayor's London Plan and the London Borough of Camden's energy policies.

The development replaces existing poor quality buildings of low architectural value and will comprise of two storeys of basement and four upper levels, accommodating dry laboratories, research/write-up spaces and plant. The laboratory space will be housed in a new energy efficient structure that Camden have (through approving the extant planning permission) agreed preserves the setting of Designated Heritage Assets, such as Listed Buildings and the Conservation Area.

The scheme seeks to optimise fabric performance, natural light and ventilation to reduce mechanical system loads, and incorporates highly efficient systems. These 'Lean' measures are predicted to achieve a regulated energy carbon reduction of 29.9%, providing an estimated carbon saving of 20.2 tCO_2.

Whilst no improvement is achieved via 'Clean' measures for the site as no CHP is proposed for the scheme, and no local District Energy Networks are presently available, an allowance for c.15kWp roof mounted solar photovoltaic panels will contribute to the reduction achieved through 'Green' measures. 'Green' measures are predicted to achieve a reduction in emissions of 7.8%, providing an estimated carbon saving of 5.3 tCO_2.

The combined regulated emissions reduction resulting from proposed 'Lean' and 'Green' interventions associated with the development demonstrate a carbon reduction of 37.8%, an estimated 25.5 tCO_2. This meets London Plan policy 5.2, modelled against Part L 2013.

Further opportunities to optimise the on-site energy contribution from PV will be explored as the design develops. Specialists will be engaged to assess efficiencies of the system and optimise layouts to maximise yield.

Spatial allowances have also been made within the plantroom for the future installation of a heat exchanger to enable future connection to a local energy network.

Appendix A: BRUKL output