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energy in building

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The Energy Efficiency and Renewable Energy Plan

(Project team responses to S106 item 2.20)

Issue 2- June 2014

This report is a summary of energy efficiency and renewable energy strategies incorporated in the design of Cartwright Halls student accommodation. The Energy Efficiency and Renewable Energy plan is in line with the submitted Energy Statement (March 2013), as detailed in sections **a** to **h** below. A brief response is provided for each item separately and the details are provided in drawing and specification format in the appendices.

The Energy Efficiency and Renewable Energy Plan means a plan substantially in accordance with the draft appended at the tenth schedule which sets out a package of measures to be adopted by the Owner in the management of the Development with a view to reducing carbon energy emissions through (but not limited to) the following:

a) The incorporation of the measures set out in the submission document entitled Energy Strategy Report and dated March 2013;

Response: The following explains how the measures set out in the Energy Strategy Report dated March 2013 are incorporated into the design. There are minor changes in the Energy strategy as a result of progress in design, but these have no major changes on the total carbon reduction from the site. These minor updates are now included in our original energy statement. Please see <u>Appendix G</u>.

- **Passive Design:** the strategies listed under section 4.1 of the Energy Statement are being followed:
  - The design and layout has not changed; the solar gain and daylight gain strategies is consistent with the report.
  - The fabric construction details are currently being finalised; the targeted U values have not changed and are going to be achieved in accordance with the Energy Statement.
  - Air permeability target has not changed and is included in the specifications.

- **Energy Efficiency Strategies:** The efficiency measures listed in section 4.2 of the Energy Statement are being followed
  - The HVAC standards are in line with those in section 4.2
  - The lighting efficiencies are in line with this section
  - The controls (for both HVAC and Lighting) are in line with detailed description in section 4.2

- **The Combined Heat and Power (CHP):** The target in section 5.2 in regards to site wide CHP is going to be achieved. The model and the number of CHP units are now changed to one larger unit instead of three smaller units. This is because the efficiencies of larger units are higher and also to ensure ease of maintenance during operation. Replacing the three CHP with one has been studied and modelled in our software programme and bespoke CHP spreadsheet tools and the results were very close.
  Please refer to Appendix A for detailed information on the proposed CHP unit, provided by Cundall.

- **The Photovoltaic Panels (PV):** The target emission rate from PV panels is going to be achieved, however, during the detailed design the layout and the output per PV panel is changed. Please see Appendix B for the latest drawings and Specification of PV panels provided by Cundall & TP Bennet.

b) ***further details of how the Owner will reduce the Development's carbon emissions from renewable energy technologies located on the Property ensuring the Owner will target a reduction of at least 25% in carbon emissions in relation to the Property using a combination of complementary low and zero carbon technologies;***

Response: University of London has an agreement and contract with the operator of the student accommodation, University Partnership Programme (UPP), to operate and maintain the equipment as intended in the energy strategy. All passive and efficiency strategies, together with Low and Zero Carbon technologies (LZC) will be incorporated in the building and will be running in accordance to this contract. Please refer to Appendix F to see confirmation on this from UPP.

c) *separate metering of all low and zero carbon technologies to enable the monitoring of energy and carbon emissions and savings;*

Response: Low and Zero Carbon technologies, i.e. CHP and PV panels, will be sub-metered to enable the monitoring and savings during operation. For details on the proposed sub-metering strategy for LZC technologies, please refer to Appendix C.

d) *a building management system being an electronic system to monitor the Development's heating cooling and the hours of use of plant;*

Response: A building management system will be in place to monitor the energy consumption and carbon emission of the building, broken down into different components, as described in the specifications provided by Cundall. Please see Appendix D.

e) *measures to enable future connection to a local energy network at the boundary of the Property;*

Response: As part of the M&E design, Cundall have provided measures to enable connection to future district heating network. As shown on the drawings, the potential local energy network will enter the building on the basement level along the Leigh Street – a route of pipework is then identified from the connection point to the main plant room area, where the required space for header is allowed for. Please refer to Cundall's drawings in Appendix E.

f) *include a pre-Implementation review by Licensed Assessors of the Building Research Establishment (BRE) certifying that the measures incorporated in the Energy Efficiency and Renewable Energy Plan are achievable in the Development and satisfy the aims and objectives of the Council's strategic policies on the reduction of carbon emissions contained within its Development Plan;*

Response: In accordance with our recent correspondence with the council, we are assuming here the council means reviewed by Licenced Energy Assessor – Mecserve licenced Energy Assessor (Nazli Dabidian LCEA119469) has reviewed the strategy and modelled the building using accredited software programme. We believe that the measures incorporated in Energy Efficiency and Renewable Energy Plan will be achievable and will satisfy the requirements of the council in terms of reduction in carbon emission based on our theoretical calculations. Details of our calculations output is summarised in our Energy Statement report.

It should be noted that both the London Plan and the council requirements for estimating carbon emissions at the design are on the basis of theoretical Part L Calculations (based on National Calculation Methodology). As has been shown in numerous research studies the actual energy consumption and carbon emissions will differ from these theoretical figures calculated at the design stage. This is mainly because the building's operational regime will be different from the National Calculation Methodology assumptions for different zones. The calculated figures demonstrate the theoretical relative performance of the proposed measures against the accepted benchmarks rather than absolute predictions of carbon emissions.

As accredited Energy Assessors, we can confirm that the incorporated Energy efficiency and renewable options are completely feasible and practical for this site and would work well. Based on our calculations and in line with the council requirements, a combination of energy efficiency and Low and Zero Carbon technologies will deliver more than 25% reduction in carbon emission of the site.

g) measures to secure a post construction review of the Development by Licensed Assessors of the BRE certifying that the measures incorporated in the Energy Efficiency and Renewable Energy Plan have been achieved in the Development and will be maintainable in the Development's future management and Occupation; and

Response: In accordance with our recent correspondence with the council, we are assuming here the council means reviewed by Licenced Energy Assessor. The building will be reviewed post construction and the Energy Performance Certification on construction (EPC) will be provided for the building by the Accredited Energy Assessors (Mecserve). The development's future management team (UPP) has also confirmed that according to their contract with the University of London, they are obliged to run the building in accordance with the proposed Energy Strategy and therefore the CHP systems will be running and the PV panels shall be operational. We confirm that the post construction review will be undertaken approximately 2 weeks after Practical Completion which is anticipated to be in September 2016 (based on programme reference 29 May 2014).

h) identifying means of ensuring the provision of information to the Council and provision of a mechanism for review and update as required from time to time

Response: The future building managers (UPP) have confirmed that subject to data protection, a mechanism will be in place to provide the operational information to the council. The mechanism would involve monitoring the results of sub-metering of CHP and PV panels to enable UPP and the council to review the performances of these technologies. UPP will monitor the energy performance on a monthly basis, the results would then be analysed and discussed with the council on an annual basis. This analysis will include comparing the results of the real energy performance of both the PV and CHP with the predicted energy performance of these items. Moreover, any significant underperformance will be reviewed with the manufacturers, the FM team and the M&E designers and where appropriate the contractor, with the required remedial actions being taken to address any issues of underperformance within 6 months of the annual review.

Appendix A – Proposed CHP unit

110 EXISTING SITE AND SERVICES

- Description: For details of the existing site arrangement and layouts refer to Main Contract Preliminaries.

Electricity

Currently there is 1No network sub-station and 2No switch rooms located on the site, all belonging to UK Power Networks, that provide the site with electricity.

The network sub-station is located in the basement of Commonwealth Hall and serves both Commonwealth Hall and off site customers. As this substation serves off site customers it is a key issue with regard to the phasing of the works. This substation must be retained in its current location and the off-site connections must be maintained. The substation is to be protected during the demolition works and remain operational.

Of the 2No switch rooms, 1No is located in the basement of the Hughes Parry Tower and is to be retained and provided with a new transformer by UKPN in its current location to serve the Hughes Parry Tower. The second switch room is currently located at Ground Floor level and is accessed from Sandwich Street, this switch room will no longer be required as part of the new development.

In addition to the retained Cartwright Gardens substation and Hughes Parry switch room, 1No new substation will be provided to serve the Cartwright Gardens New Build. The location for this substation is on the Ground Floor and accessed from Sandwich Street.. The final location of this substation will depend on UK Power Networks requirements and acceptance.

There will be one CHP unit (230kWe) located in the new build plant area of Hughes Parry Tower; the intention is that the generated power is distributed to both the Hughes Parry Tower and the Cartwright Building with surplus electricity exported back to the grid via UKPN; the electrical contractor shall provide a low voltage distribution switchboard to facilitate the electrical distribution of the power supplies to both buildings as required. The system is to meet all requirements of G59/1 and UKPN requirements.

As a requirement of the Building Regulations Part L SBEM and BREEAM Pollution section is to provide a Photovoltaic (PV) installation to each building to offset the carbon usage. Refer to the Architects drawings and Mecserve sustainability report for size and locations of PV arrays.

The contractor shall be responsible for the design, supply & installation of a photovoltaic (PV) roof mounted array to be provided on each building including all wiring, containment, supports, fixings, isolators, inverters, surge arrestors, G59 / G83 synchronisation and mains fail protection relays, control and distribution equipment.

The PV installations are to be grid connected and set in the areas allocated on the roof of each building.

The PV panels shall be located at rooftop level in the areas indicated on the architects drawings, orientated to maximise efficiency of the PV Array.

The electrical contractor shall allow for employing the services of a specialist MCS accredited PV system installer to develop the design, supply, install, commission and set to work the PV system in accordance with BS EN 61194 and BS7671 current edition IET Wiring Regulations.

Notes

PERFORMANCE DESIGN DRAWING ISSUE

CUNDALL HAVE USED THEIR REASONABLE ENDEAVOURS TO ESTABLISH THE REQUIREMENTS OF THE CLIENT DURING THE DESIGN STAGES.

THE DESIGN STAGES REPRESENT AN ITERATIVE PROCESS WHEREBY THE LEVEL OF DETAIL AND THE DEGREE OF PRECISION INCLUDED IN THE DESIGN INCREASES FROM ONE STAGE TO THE NEXT.

WE SUGGEST THE FOLLOWING LEVELS OF ACCURACY COULD REASONABLY BE ACHIEVED BY THE END THIS DESIGN STAGE:

PERFORMANCE DESIGN: ± 15%

THE CONTRACTOR SHALL TAKE INTO ACCOUNT THE LEVEL OF UNCERTAINTY AT THE DESIGNATED DESIGN STAGE OF THE PROJECT, AND THE CONTRACTOR SHALL REFLECT THE ASSOCIATED RISK AND UNCERTAINTY IN ITS PRICING.

THE ABOVE PRECISION FIGURES DO NOT INCLUDE THE EFFECTS OF FUNDAMENTAL VARIATIONS TO THE SCALE OR NATURE OF THE PROJECT, HOWEVER, THEY WILL REASONABLY BE APPLIED TO QUANTITIES OF MATERIALS, ASSOCIATED LABOUR COSTS AND SERVICE OUTLETS OR THE FINAL LOCATIONS FOR EQUIPMENT.

True scale at 1:1

Issue	Date	Description	By	Chkd	Verfd
D	18.03.14	CONTRACT ISSUE SINGLE CHP INDICATED	NC	AS	KA
C	23.12.13	GAS TO HP KITCHEN REMOVED	NC	AS	KA
B	30.09.13	GAS TO LAUNDRY ADDED	NC	AS	KA
A	19.06.13	DISTRICT HEATING SCHEME PROVISION ADDED	NC	AS	KA

Project: CARTWRIGHT GARDENS

Client: UPP

Architect: TP BENNETT

Title: PLANT ROOM SCHEMATIC (HP)

Drawing No.: BS XX (50) 0001 | Issue: D

Job No.: 1004327 | Scale: NTS

Drawing Status: CONTRACT

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Notes

PERFORMANCE DESIGN DRAWING ISSUE

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THE ABOVE PRECISION FIGURES DO NOT INCLUDE THE EFFECTS OF FUNDAMENTAL VARIATIONS TO THE SCALE OR NATURE OF THE PROJECT, HOWEVER, THEY WILL REASONABLY BE APPLIED TO QUANTITIES OF MATERIALS, ASSOCIATED LABOUR COSTS AND SERVICE OUTLETS OR THE FINAL LOCATIONS FOR EQUIPMENT.

Issue	Date	Description	By	Chkd	Verfd
C	18/03/14	CONTRACT ISSUE, SINGLE CHP	NC	AS	KA
B	25/11/13	PLANT LOCATION AMENDED	NC	AS	KA
A	31/07/13	CHP UNIT RE-SIZED	NC	AS	KA

Project: CARTWRIGHT GARDENS

Client: UPP

Architect: TP BENNETT

Title: PLANT ROOM LAYOUT (HP) BLOCK PLAN

Drawing No.: BS -1 (50) 3001

Issue: C

Job No.: 1004327

Scale: 1:50

Drawing Status: CONTRACT

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True scale at 1:1

Appendix B – Photovoltaic Panels: Specifications & Drawings

V14 Photovoltaic systems

To be read with Preliminaries/ General conditions:

GENERAL

110 GRID CONNECTED PHOTOVOLTAIC SYSTEM A requirement of the Building Regulations Part L SBEM and BREEAM Pollution section is to provide a Photovoltaic (PV) installation to each building to offset the carbon usage. Refer to the Architects drawings, Mecserve report and additional correspondences with GLA for size and locations of PV arrays. A total 261 square meters of panel will be required with a 200 Watt peak/m2 output. Panel efficiency should be no less than 20.1% (measured at Standard Test Conditions). The total output of the system should be no less than 53.3 kWp (at STC)

The contractor shall be responsible for the design, supply & installation of a photovoltaic (PV) roof mounted array to be provided on each building including all wiring, containment, supports, fixings, isolators, inverters, surge arrestors, G59 / G83 synchronisation and mains fail protection relays, control and distribution equipment.

The PV installations are to be grid connected and set in the areas allocated on the roof of each building.

The PV panels shall be located at rooftop level in the areas indicated on the architects drawings, orientated to maximise efficiency of the PV Array.

The electrical contractor shall allow for employing the services of a specialist MCS accredited PV system installer to develop the design, supply, install, commission and set to work the PV system in accordance with BS EN 61194 and BS7671 current edition IET Wiring Regulations.

All "warning - dual supply" labelling in accordance with the requirements of BS7671 current edition IET Wiring Regulations shall be provided at all points of isolation as required to indicate two sources of supply are present and that both the mains supply and on-site generation (PV array) supply are required to be isolated before carrying out any work.

A PV system information display panel shall be provided as part of the PV installation. This panel shall be mounted in the main entrance/reception area and shall provide a live numerical read out of current energy generation, total energy generated and CO2 Emissions saved.

The sizes of panels are to be dictated by the area available and the power output required in the installed position.

All PV panels are to be Monocrystalline and are to be provided with a 5 year contractor warranty and a 20-Year Limited Power Output Warranty from Practical Completion, such that each and every complete PV module is replaced by the contractor should they fail for any reason.

The PV panels are to be certified under MCS: 005 and meet the requirements of BS EN 61215 _Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval_

Or

BS EN 61646 "Thin film terrestrial photovoltaic (PV) modules – Design qualification and type approval"

Evidence of compliance must be provided as independent third party testing by a UKAS accredited test laboratory.

PV panels must have a specified peak output of > 200Watts/m² with a maximum current of ~5.0Amps and a Voltage <36Volts; maximum weight of 13kg/ m².

Power capacity should be measured at the inverter AC output using the following test conditions:

1,000 Watts/m 220 degree C ambient temperature and wind speed of 1 m/s.

The contractor shall liaise fully with the Architect and structural engineer to agree the methods of fixings and integration into the building fabric with respect to exact location, weights, weatherproofing of the building and ventilation of the PV panels

Fixings must make allowance for thermal expansion of the PV panels, electrolytic corrosion and wind loading.

The electrical energy generated shall be connected into the main low voltage switchboard in each building. Inverters, circuit protection etc are to be housed within the building electrical services switchrooms.

Each PV array shall be provided with pulsed output metering for current, KW and KWH measurements via the BMS to measure the PV output against the 20-Year Limited Power Output Warranty.

All Metering installed to both Main LV Panel and PV installation shall fully comply with the metering requirements detailed in OFGEM Guidance Note Ref 61/10 for the Government Feed In Tariff (FIT), and all PV equipment shall be MCS certified.

The contractor will be responsible for all liaison and negotiation with the REC respect to registration, application FIT's and G59/G83 protection requirements (as applicable) to suit the requirements of each system on each building.

- System manufacturer: Submit proposals.
- PV modules: Required.
  - Mounting: Roof (stand-off) with framework.
- By-pass diodes: Required.
- String fuses: Required.
- Blocking diodes: Required.
- d.c. switchboard: As section V31.
- d.c. isolation switches: As section V31.
- Junction boxes to connect parallel arrays: Submit design and cost proposals.
- Power conditioning units (PCUs): Required.
- a.c. switchboards: As section V31.
- a.c. isolation switches: As section V31.
- Energy meters: Required.
- Cable type: Multi-core XLPE/ SWA/ LSZH, as section V32.
  - Sizes: Submit design and cost proposals.
- Rewireable installation: Submit design and cost proposals.
- Concealed installation: Submit design and cost proposals.
- Cable containment: Submit design and cost proposals.
- Lightning protection: As section W60.
- Transient over-voltage surge suppression devices: As section Y67.
- Accessories: Submit design and cost proposals.

SYSTEM PERFORMANCE

210 DESIGN

- Design: Complete the design of the photovoltaic system.
- Standards: To IEC 60364-7-712, to BS 7671, to BS EN 62124 and in accordance with BS 6399-2, ER G59/2-1 and ER G83/1-1.
- Testing and commissioning: Incorporate adequate measures to allow full testing and commissioning of the completed system.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.
- Approvals: Obtain written approval of the Electricity Distributor and Obtain planning approval from the relevant authorities.

220 WIND UPLIFT LOADS OF PV ROOFING TILES

- Standard: To BS 5534.

820 LABELLING

- Dual supply warning notices (grid connected systems only): Provide danger warning notices stating that the system has a dual supply and is energized from more than one source.
  - Location: Main grid interconnection point.
  - Electricity Distributor's approval of text: Obtain.
- PV modules: Label with warning notices describing the presence of live terminals.
- a.c. isolation switches: Label with notices stating "PV system - Point of emergency switching".
- Circuit diagram: Provide at point of interconnection.
- Details of protective settings incorporated in the PCU: Provide at point of interconnection.
- Contact telephone number for the maintainer of the system: Provide at point of interconnection.
- Fuses, terminal blocks and other assembly components: Label describing their purpose.
- Spare fuses: Label, describe their rating and purpose.

NOTES:

DO NOT SCALE. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING. CHECK DIMENSIONS ON SITE AND REPORT DISCREPANCIES TO THE ARCHITECT.

THIS DRAWING IS PROTECTED BY COPYRIGHT.

ALL AREAS HAVE BEEN MEASURED FROM CURRENT DRAWINGS. THEY MAY VARY BECAUSE OF (EG) SURVEY, DESIGN DEVELOPMENT, CONSTRUCTION TOLERANCES, STATUTORY REQUIREMENTS OR RE-DEFINITION OF THE AREAS TO BE MEASURED.

AERIALS OMITTED. WILL BE SUBJECT TO COORDINATION WITH THIRD PARTY PROVIDER.

Hatch Legend

- Indicates Extent of Green Roof
- Davit System Zone
- Area requiring Man Safe System
- Extent of handrail for planning
- Extent of new handrail / guarding

No.	Date	Comment	Drawn	Chk'd
T6	.07.03.14	CONTRACT ISSUE - no change	EB	RM
T5	17.01.14	Mansafe area added to Leigh Street wing roof	RCR	RM
T4	05.12.13	Handrails / guard rails added, green roof hatch updated, mansafe hatch added, Davit system zone hatch updated.	AR	RM
T3	23.0913	Structural grid added; Inner parapet shown on Roof; Mechanical Vent shown onLleigh St Roof;	SM	RM
T2	01.08.13	Coordinated with M&E services and structure. Green roof areas, AOV's, access hatches, lift overrun, Solar panels and Davit system zone shown.	SM/JN	RM
T1	12.04.13	ISSUED FOR STAGE 1 TENDER	SM	RM

Revisions

Issue Status

TENDER

tp bennett

architecture
interiors
planning

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London Moscow Abu Dhabi New York

Project

Proposed
University of London
Cartwright Gardens, London

Drawing Title

Proposed Plans
Roof Plan

Drawn	Date	Scale @ A1/A3	Alt. Ref.
SM	apr 2013	1:200/1:400	--

tp bennett Project No.	Drawing Number	Rev
A10417	G 0115	T6

Appendix C – Sub-metering strategy for LZC technologies

indicated on the supervisory graphics.
Each unit is complete with its own automatic changeover panel where applicable.

DRAINAGE
The lower ground floor is served by 2 number pumped drainage systems which are to be monitored by the BMS for a common fault with any fault being indicated on the supervisory graphics.

ELECTRICITY
GENERAL
The building can receive an electrical supply generated from an array of photovoltaic cells on the roof in addition to that provided by the electrical utility provider. Both of these incoming supplies are to be monitored by the BMS together with the kWh of energy used for primary plant via the main switchboard and for lighting and small power via the various

distribution boards throughout the building.
. .

- Equipment interconnectivity: Wired .
- Link to building monitoring and management system: As section Y41 .
- Systems to be controlled:
  - Water supply systems:
  - Cold water, as section S10;
  - Pumped water, as section S10; and - Indirect hot water storage, as section S10 .
  - Fuel supply systems: None .
  - Steam and condensate systems: Not applicable .
  - Heating systems:
  - Direct gas fired, as section T10;
  - Low temperature hot water, as section T10; and - Medium temperature hot water, as section T10 .
  - Cooling systems Not applicable .
  - Ventilation systems:
  - Mechanical supply, as section U10;
  - Mechanical extract, as section U10; and - Kitchen extract, as section U10 .
  - Air conditioning systems: Local, as section U60 .
- System control strategies:
  - Water supply system;
  - Heating system;
  - Cooling system;
  - Mechanical ventilation system; and - Mechanical extract system .
- Data logging:
  - Actuator;
  - Alarm;
  - Motorized valve;
  - Sensor; and - Thermostat .
- Monitoring:
  - Cooling plant;
  - Fan;
  - Heating plant;
  - Pump; and - Water treatment plant .
- Equipment:
  - Control panel;
  - Actuators;
  - Alarms; and - Motorized valves .
  - Sensors:
  - Flow in duct;
  - Flow in pipe;

200 HEATING SYSTEMS

- Description:

The accommodation will utilise a central wet LTHW heating systems via panel-convector radiators in bedrooms with local thermostatic control.
Radiators within disabled toilets and accessible flats and rooms are to be low surface temperature type.

The townhouses in the Cartwright buildings will also be heated from the central LTHW heating system via panel-convector radiators with local thermostatic control in lounge, kitchen and bathrooms and towel rails in the bathroom/wc.

The heat emitter type for the general area's will be as indicated on the heating strategy drawings.

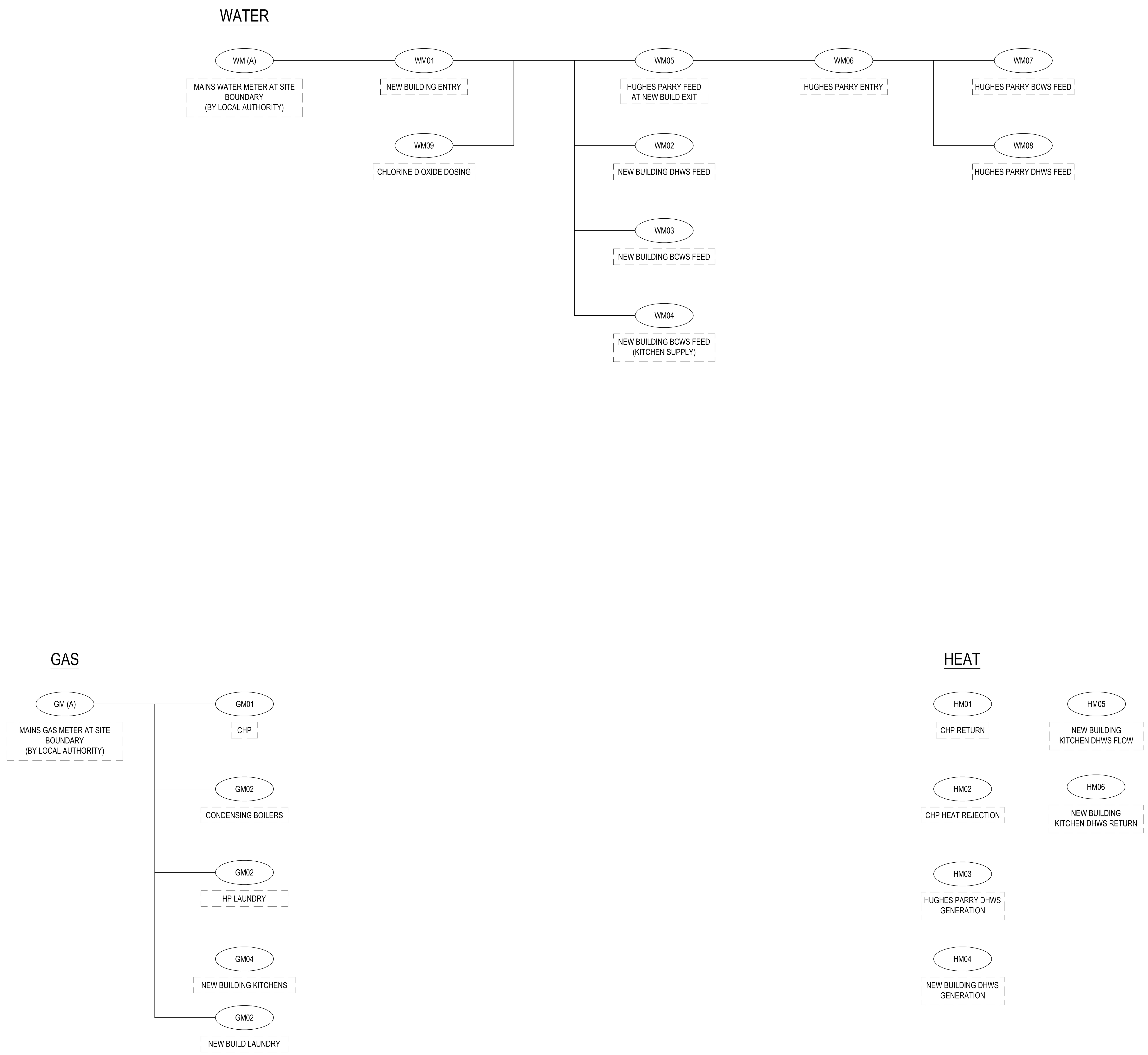
The heating system will operate under normal conditions 24 hours a day, 7 days a week with add in adjustable time schedules unless the facility is in shut down mode.
The LTHW heating system will comprise of: 1no gas fired CHP unit with heat sink facility and 6no gas high efficiency, Ultra Low NOx modulating condensing modular boilers (BLR 01 - 06).
The CHP unit is located in the Hughes Parry New basement plant room.
The 6no gas high efficiency, Ultra Low NOx modulating condensing modular boilers are located in the existing Hughes Parry basement plant room.
The CHP unit shall always act as the buildings primary heat source and is sized to serve approx. 10% of the peak heating load and approximately 65% of the total annual heating/hot water requirement of the site, the unit is backed up by 6no modular gas boilers sized to serve 100% of the peak load.
The high efficiency gas boilers operate as secondary boilers should the system requirement be greater than the combined CHP output.
The system will have a low loss header with 4no of circuits.

1 No Hughes Parry variable temperature circuit. (PMP07)
1no Hughes Parry constant temperature circuit. (PMP08)
1no Hughes Parry HWS constant temperature circuit. (PMP15)
1 No Cartwright New Build constant temperature circuit.

The Cartwright New Build constant temperature circuit from the Hughes Parry plant area will enter the New Build Plant area and split to serve the New Build constant temperature circuit, new build HWS constant temp circuit and the New Build variable temperature circuit.
The LTHW will be circulated through each boiler via single head variable speed pumps (PMP 01 -06)and will be enabled/disabled in conjunction with the boiler firing sequence via the BMS. All return LTHW from the low loss header to the gas fired boilers will pass through the single head variable speed pump set (PMP 14).
The CHP will have its own integral pump set which is part of the CHP package to provide the minimum water flow rate to the unit, a CHP shunt pump (PMP12) is required to provide adequate flow through the CHP shunt circuit and will be enabled/disabled via the BMS.
A CHP heat rejection circuit will be incorporated with a 3 port diverting valve and frost pump (PMP13), the BMS will co-ordinate the heat rejection cycle to ensure in the first instance all gas boilers are disabled prior to heat rejection.
The CHP unit will be complete with an integral control panel, each CHP panel will have a BMS interface.

A heat meter (HM 01) is incorporated into the CHP pumped circulation circuit which will be monitored by the BMS control panel and indicate the amount of heat generated by the CHP unit, a second CHP heat meter will be installed on the CHP heat rejection circuit to illustrate the total useful heat provided by the CHP unit.
The BMS will be linked to the CHP control panels for monitoring and fault signals.

Constant Temperature LTHW will be provided for Hughes Parry domestic hot water



1004327 A1

Based on Architects Drg No. Rev
Structural Drg No. Rev
Survey Drg No. Rev
Other Drg No. Rev
Other Drg No. Rev

DO NOT SCALE FROM THIS DRAWING

Notes

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WE SUGGEST THE FOLLOWING LEVELS OF ACCURACY COULD REASONABLY BE ACHIEVED BY THE END THIS DESIGN STAGE:

PERFORMANCE DESIGN: ± 15%

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Issue	Date	Description	By	Chkd	Verfd
A	18.03.14	CONTRACT ISSUE HP KITCHEN METER REMOVED	NC	AS	KA

Project: CARTWRIGHT GARDENS

Client: UPP

Architect: TP BENNETT

Title: MECHANICAL METERING STRATEGY

Drawing No.: BS XX (50) 5005 — Issue: A

Job No.: 1004327 — Scale: NTS

Drawing Status: CONTRACT

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Website: www.cundall.com

True scale at 1:1

HUGHES PARRY ALTERNATIVE SUPPLY SUB MAIN CABLE SCHEDULE

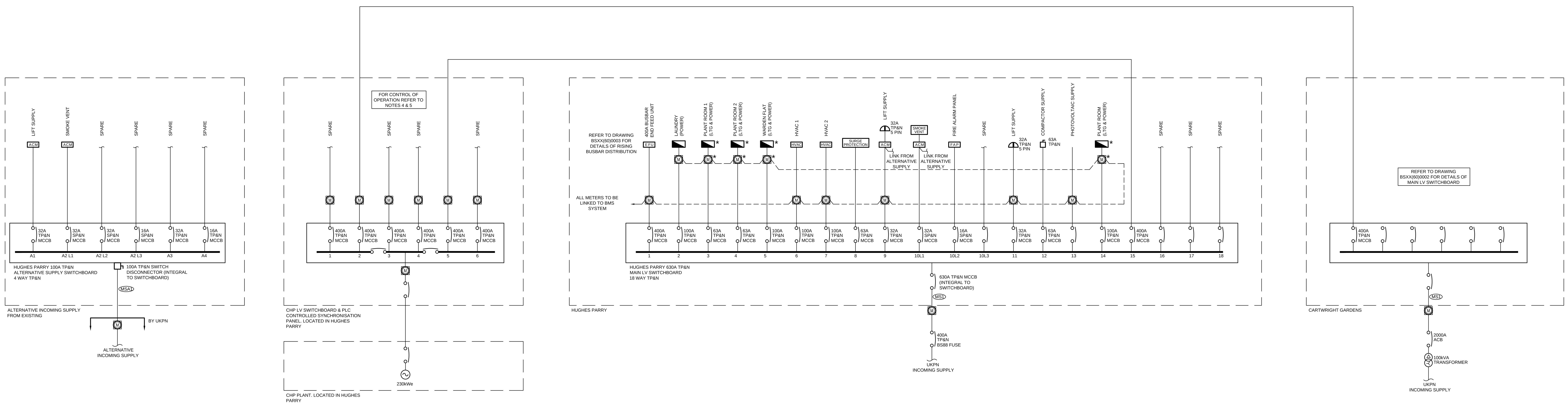
REF.	CABLE SIZE	CABLE TYPE	CORES	CPC
TAILS				
MSA1	35mm²	XLPE/SWA/LSF (TO PH120)	4C	ARMOUR & ANCILLARY
SUB MAINS				
A1	10mm²	XLPE/SWA/LSF (TO PH120)	4C	ARMOUR & ANCILLARY
A2 L1	10mm²	XLPE/SWA/LSF (TO PH120)	2C	ARMOUR & ANCILLARY
A2 L2	-	SPARE	-	-
A2 L3	-	SPARE	-	-
A3	-	SPARE	-	-
A4	-	SPARE	-	-

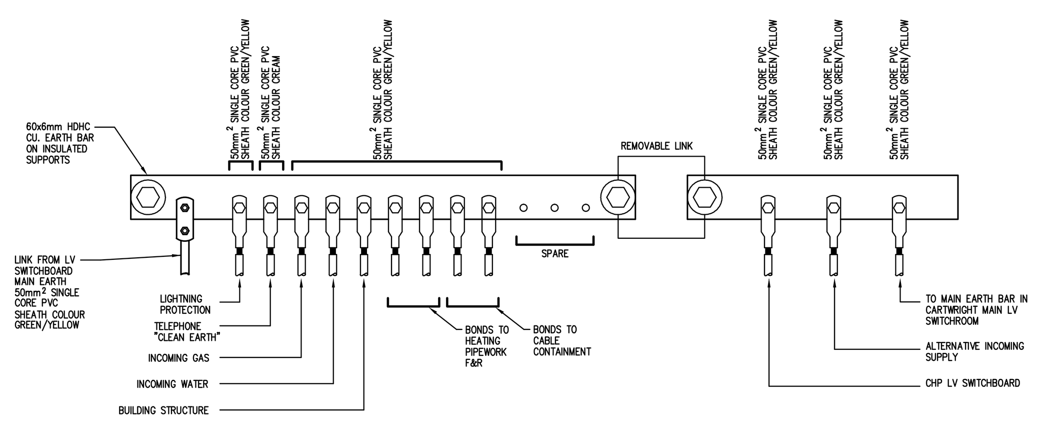
CHP SECTION BOARD SUB MAIN CABLE SCHEDULE

REF.	CABLE SIZE	CABLE TYPE	CORES	CPC
1	-	SPARE	-	-
2	120mm²	XLPE/SWA/LSF	2x4C	ARMOUR & ANCILLARY
3	-	SPARE	-	-
4	-	SPARE	-	-
5	120mm²	XLPE/SWA/LSF	2x4C	ARMOUR & ANCILLARY
6	-	SPARE	-	-

HUGHES PARRY SUB MAIN CABLE SCHEDULE

REF.	CABLE SIZE	CABLE TYPE	CORES	CPC
TAILS				
MS1	185mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
SUB MAINS				
1	150mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
2	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
3	25mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
4	25mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
5	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
6	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
7	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
8	25mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
9	10mm²	XLPE/SWA/LSF (TO PH120)	4C	ARMOUR & ANCILLARY
10L1	10mm²	XLPE/SWA/LSF (TO PH120)	2C	ARMOUR & ANCILLARY
10L2	4mm²	ENHANCED SOFTSKIN	3C	INTEGRAL CORE OF CABLE
10L3	-	SPARE	-	-
11	10mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
12	25mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
13	TBC	TBC	TBC	TBC
14	-	SPARE	-	-
15	-	SPARE	-	-
16	-	SPARE	-	-
17	-	SPARE	-	-
18	-	SPARE	-	-





TYPICAL EARTH BAR SCHEMATIC (N.T.S.)

1004327 | **A0**

Based on Architects Drg No. Rev
Structural Drg No. Rev
Survey Drg No. Rev
Other Drg No. Rev
Other Drg No. Rev

DO NOT SCALE FROM THIS DRAWING

Notes

1. ALL OUTGOING WAYS TO HAVE A MINIMUM FRAME SIZE OF 160A.
2. '*' DENOTES COMBINED LTG & POWER DB C/W INTEGRATED METERING. PROVIDE 2No. METERS, 1No. FOR LTG & 1No. FOR POWER.
3. WHERE ANCILLARY CPC IS IDENTIFIED, CPC IS TO MATCH PHASE CONDUCTOR SIZE.
4. ALL CIRCUIT BREAKERS IN CHP LV SWITCHBOARD TO BE PLC CONTROLLED TO PROVIDE FULLY FLEXIBLE OPERATION AND CONTROL FACILITATING OPERATION/SWITCHING OF CHP ELECTRICAL SUPPLY IN SINGLE OR PARALLEL OPERATION TO EITHER OR BOTH BUILDINGS AS LOAD DICTATES.
5. CIRCUIT BREAKERS TO BE ELECTRICALLY INTERLOCKED TO MEET G59/1 REQUIREMENT FOR SAFE OPERATION.

PERFORMANCE DESIGN DRAWING ISSUE

CUNDALL HAVE USED THEIR REASONABLE ENDEAVOURS TO ESTABLISH THE REQUIREMENTS OF THE CLIENT DURING THE DESIGN STAGES.

THE DESIGN STAGES REPRESENT AN ITERATIVE PROCESS WHEREBY THE LEVEL OF DETAIL AND THE DEGREE OF PRECISION INCLUDED IN THE DESIGN INCREASES FROM ONE STAGE TO THE NEXT.

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PERFORMANCE DESIGN: ± 15%

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THE ABOVE PRECISION FIGURES DO NOT INCLUDE THE EFFECTS OF FUNDAMENTAL VARIATIONS TO THE SCALE OR NATURE OF THE PROJECT, HOWEVER, THEY WILL REASONABLY BE APPLIED TO QUANTITIES OF MATERIALS, ASSOCIATED LABOUR COSTS AND SERVICE OUTLETS OR THE FINAL LOCATIONS FOR EQUIPMENT.

Issue	Date	Description	By	Chkd	Verfd
A	18.03.14	CONTRACT ISSUE CHP SECTION BOARD SUB MAIN SCHEDULE AMENDED. CHP PLANT AMENDED. WAY 1-6 AMENDED FROM 250A MCCB TO 400A MCCB ON CHP LV SWITCHBOARD. WAY 1 AMENDED FROM 800A MCCB TO 400A MCCB ON MAIN LV SWITCHBOARD METER ADDED TO PHOTOVOLTAIC SUPPLY	MCB	GW	KA

Project: CARTWRIGHT GARDENS

Client: UPP

Architect: TP BENNETT

Title: HUGHES PARRY ELECTRICAL DISTRIBUTION SCHEMATIC

Drawing No.: BSXX(60)0001 | Issue.: A

Job No.: 1004327 | Scale: NTS

Drawing Status: CONTRACT

CUNDALL
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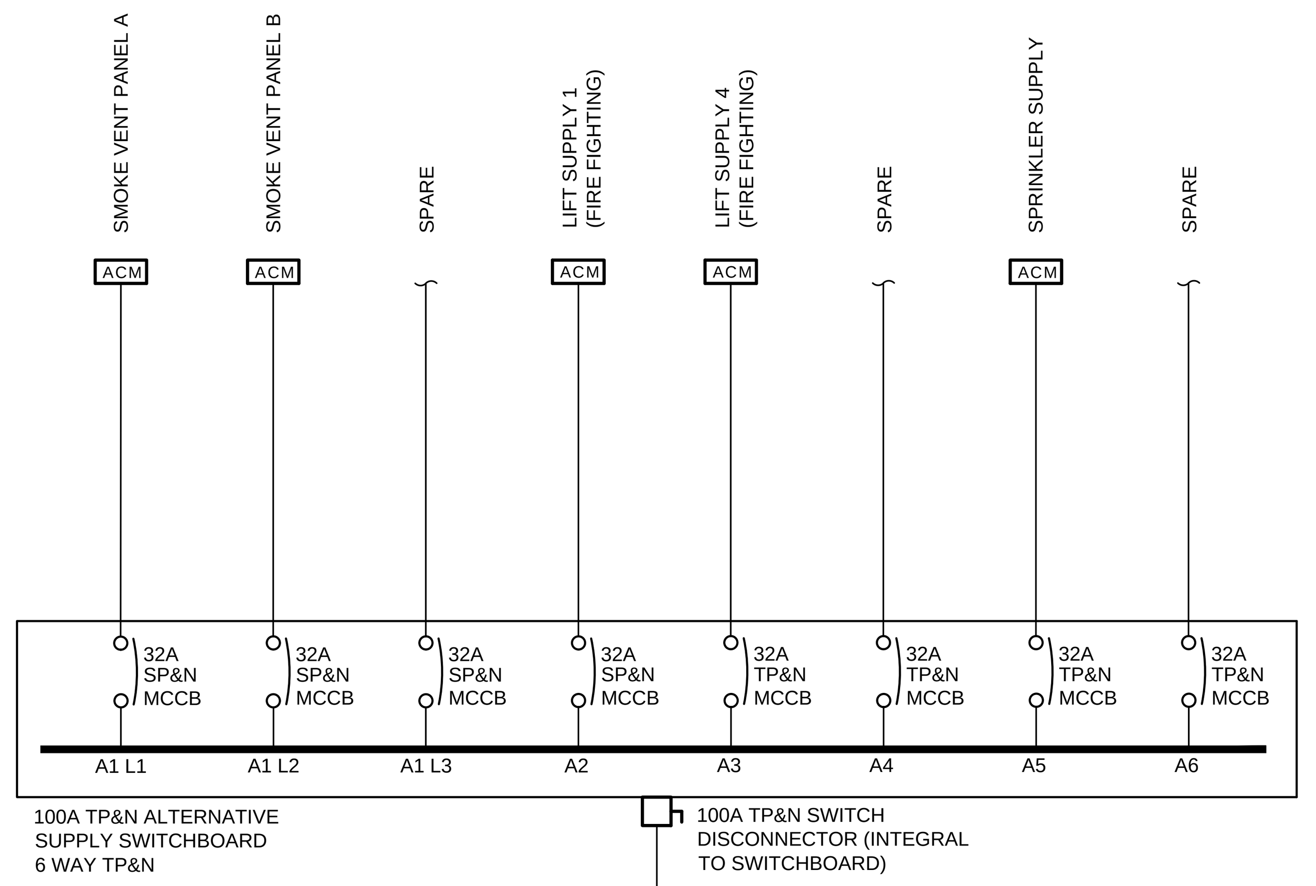
Horsley House, Regent Centre,
Gosforth,
Newcastle NE3 3LU
Telephone: (0191) 213 1515 Facsimile: (0191) 213 1701
Website: www.cundall.com

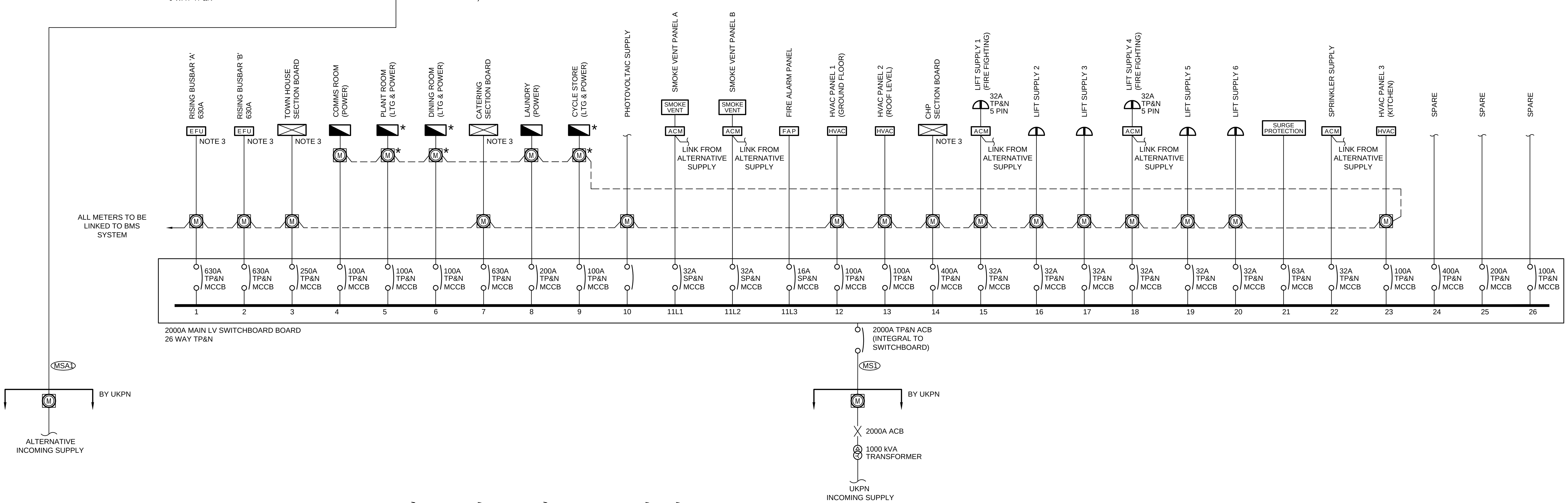


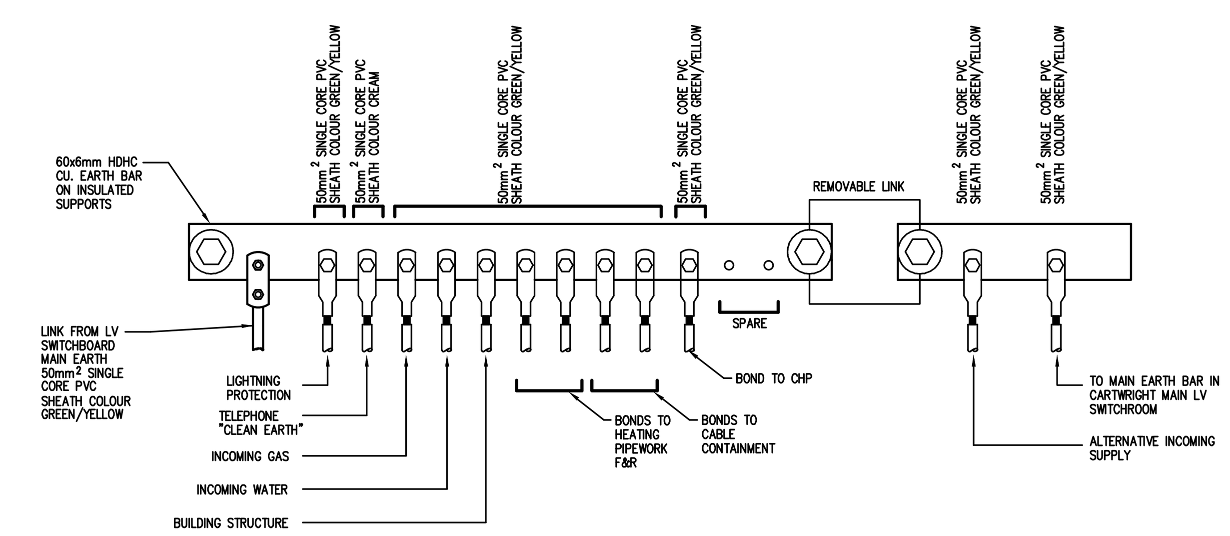
CARTWRIGHT GARDENS SUB MAIN CABLE SCHEDULE

REF.	CABLE SIZE	CABLE TYPE	CORES	CPC
		TAILS		
MS1	300mm²	XLPE/LSF DOUBLE INSULATED	3 x 1C PER PHASE	ARMOUR & ANCILLARY
		SUB MAINS		
1	150mm²	XLPE/SWA/LSF	2 x 4C	ARMOUR & ANCILLARY
2	150mm²	XLPE/SWA/LSF	2 x 4C	ARMOUR & ANCILLARY
3	70mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
4	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
5	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
6	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
7	150mm²	XLPE/SWA/LSF	2 x 4C	ARMOUR & ANCILLARY
8	95mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
9	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
10	TBC	TBC	TBC	TBC
11L1	10mm²	XLPE/SWA/LSF (TO PH120)	2C	ARMOUR & ANCILLARY
11L2	10mm²	XLPE/SWA/LSF (TO PH120)	2C	ARMOUR & ANCILLARY
11L3	4mm²	ENHANCED SOFTSKIN	3C	INTEGRAL CORE OF CABLE
12	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
13	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
14	150mm²	XLPE/SWA/LSF	3 x 4C	ARMOUR & ANCILLARY
15	10mm²	XLPE/SWA/LSF (TO PH120)	4C	ARMOUR & ANCILLARY
16	10mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
17	10mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
18	10mm²	XLPE/SWA/LSF (TO PH120)	4C	ARMOUR & ANCILLARY
19	10mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
20	10mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
21	25mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
22	10mm²	XLPE/SWA/LSF (TO PH120)	4C	ARMOUR & ANCILLARY
23	35mm²	XLPE/SWA/LSF	4C	ARMOUR & ANCILLARY
24	-	SPARE	-	-
25	-	SPARE	-	-
26	-	SPARE	-	-

CARTWRIGHT GARDENS ALTERNATIVE SUPPLY SUB MAIN CABLE SCHEDULE

REF.	CABLE SIZE	CABLE TYPE	CORES	CPC
		TAILS		
MSA1	35mm²	XLPE/SWA/LSF (TO PH120)	4C	ARMOUR & ANCILLARY
		SUB MAINS		
A1 L1	10mm²	XLPE/SWA/LSF (TO PH120)	2C	ARMOUR & ANCILLARY
A1 L2	10mm²	XLPE/SWA/LSF (TO PH120)	2C	ARMOUR & ANCILLARY
A1 L3	-	SPARE	-	-
A2	10mm²	XLPE/SWA/LSF (TO PH120)	4C	ARMOUR & ANCILLARY
A3	10mm²	XLPE/SWA/LSF (TO PH120)	4C	ARMOUR & ANCILLARY
A4	-	SPARE	-	-
A5	10mm²	XLPE/SWA/LSF (TO PH120)	4C	ARMOUR & ANCILLARY
A6	-	SPARE	-	-





TYPICAL EARTH BAR SCHEMATIC (N.T.S.)

1004327 A1

Based on Architects Drg No. Rev
Structural Drg No. Rev
Survey Drg No. Rev
Other Drg No. Rev
Other Drg No. Rev

DO NOT SCALE FROM THIS DRAWING

Notes

1. ALL OUTGOING WAYS TO HAVE A MINIMUM FRAME SIZE OF 160A.
2. '*' DENOTES COMBINED LTG & POWER DB C/W INTEGRATED METERING. PROVIDE 2No. METERS, 1No. FOR LTG & 1No. FOR POWER.
3. REFER TO DRAWING BSXX(60)0003 FOR DETAILS OF RISING BUSBAR & SECTION BOARD DISTRIBUTION.
4. RISING BUSBAR TO HAVE TAP OFFS POINTS AT 500mm INTERVALS.
5. WHERE ANCILLARY CPC IS IDENTIFIED, CPC IS TO MATCH PHASE CONDUCTOR SIZE.

PERFORMANCE DESIGN DRAWING ISSUE

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Issue	Date	Description	By	Chkd	Verfd
A	18.03.14	CONTRACT ISSUE WAY 22 OF SUB MAIN CABLE SCHEDULE AMENDED. WAY A5 OF ALTERNATIVE SUB MAIN CABLE SCHEDULE AMENDED WAY 14 AMENDED FROM 800A MCCB TO 400A MCCB ON MAIN LV SWITCHBOARD METER ADDED TO PHOTOVOLTAIC SUPPLY	MCB	GW	KA

Project: CARTWRIGHT GARDENS

Client: UPP

Architect: TP BENNETT

Title: CARTWRIGHT GARDENS ELECTRICAL DISTRIBUTION SCHEMATIC SHEET 1 OF 2

Drawing No.: BSXX(60)0002 Issue: A

Job No.: 1004327 Scale: NTS

Drawing Status: CONTRACT

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Newcastle NE3 3LU
Telephone: (0191) 213 1515 Facsimile: (0191) 213 1701

Website: www.cundall.com

Appendix D – Building Management System

confirmed), linked to the Building Automation Network.
It is to include an alarm printer and a colour ink-jet report printer. It is to be configured to display interactive graphical representations of all the systems, plants, instruments and actuators monitored and controlled by the BMS.
We anticipate the system will be accessible from any computer connected to the Building Automation Network.
The system is also to be connected to the access control, security, CCTV and fire systems to form an integrated system providing a common interface for the operator.
Internet access is to be provided for up to 4 users,

A wall-mounted screen will be provided by the controls specialist in the main entrance foyer on which environmental and energy usage statistics and analyses are to be able to be displayed and explained in the form of charts, graphs and tables through purpose configured proprietary display software using real-time and historic data provided by the BMS.

This proprietary display software shall be selected and provided by the Controls Specialist and approved by the project administrator.
It shall be able to be user configurable to display pre-configured daily, weekly, monthly and yearly energy usage over up to four comparative back-to-back periods in overlaid bar chart or graphical forms from historic data drawn from the BMS.
Such data shall include:
" Carbon footprint;
" Electrical energy drawn from the grid;
" Electrical energy from photovoltaic cells;
" Energy generated from the CHP;
" Electrical Energy supplied to the grid;
" Electrical energy consumptions throughout the building;
" Gas and water consumed; in component parts.
" External weather conditions – temperature, relative humidity, barometric pressure, wind speed and direction, rainfall;
" Degree days.

Graphics
The interactive graphical display screens listed below are to be provided for display through the BMS supervisory software. There are to be two types of graphics provided: simple non-technical graphics (NTGs) to allow the staff, visitors and facility management staff to view the conditions of the services and the environments within the building; and more detailed technical engineering graphics (TEGs) to enable service engineers to check and adjust the services.
The following interactive graphical display screens are to be provided for display through the BMS supervisory software:
" Introductory page (showing picture of building) - NTG
" Top menu page – NTG -TEG
" Overall floor plans (Split by building) - NTG
" Detail floor plans (1 page per floor Hughes Parry – 2 page per floor Cartwright) – NTG.
" Room data per room – NTG.
" Heating systems overview (2No) – NTG - TEG.
" CHP system over view – NTG – TEG.
" Primary heating system - TEG
" Boiler plants (6 total) – TEG.
" CHP units (3 total) – TEG.
" Secondary heating systems – TEG.
" Public health systems – NTG.
" Cartwright Building Kitchen supply and extract - NTG – TEG.
" Cartwright Building Kitchen supply and extract over-run NTG – TEG.

Appendix E – Connection to future district heating network

1004327 A1

Based on Architects Drg No.
Structural Drg No.
Survey Drg No.
Other Drg No.
Other Drg No.

DO NOT SCALE FROM THIS DRAWING

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Gosforth,
Newcastle NE3 3LU
Telephone: (0191) 213 1515 Facsimile: (0191) 213 1701
Website: www.cundall.com

Title: PLANT ROOM LAYOUT (NB)
BLOCK PLAN

Drawing No.: BS -1 (50) 3002
Issue.: B
Job No.: 1004327
Scale: 1:50
Drawing Status: CONTRACT

Project: CARTWRIGHT GARDENS
Client: UPP
Architect: TP BENNETT

Issue	Date	Description	By	Chkd	Verfd
B	18/03/14	CONTRACT ISSUE	NC	AS	KA
A	31/07/13	UPDATED IN LINE WITH ARCHITECTS TRANSMITTAL 29/07/13	NC	AS	KA

True scale at 1:1

THE CONTRACTOR SHALL TAKE INTO ACCOUNT THE LEVEL OF UNCERTAINTY AT THE DESIGNATED DESIGN STAGE OF THE PROJECT, AND THE CONTRACTOR SHALL REFLECT THE ASSOCIATED RISK AND UNCERTAINTY IN ITS PRICING.

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PERFORMANCE DESIGN: ± 15%

1004327 A1

Based on Architects Drg No. Rev
Structural Drg No. Rev
Survey Drg No. Rev
Other Drg No. Rev
Other Drg No. Rev

DO NOT SCALE FROM THIS DRAWING

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Notes

PERFORMANCE DESIGN DRAWING ISSUE

CUNDALL HAVE USED THEIR REASONABLE ENDEAVOURS TO ESTABLISH THE REQUIREMENTS OF THE CLIENT DURING THE DESIGN STAGES.

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Issue	Date	Description	By	Chkd	Verfd
D	18/03/14	CONTRACT ISSUE	MCB	AS	KA
C	26/09/13	UPDATED TO STAGE E SUBMISSION	MCB	AS	KA
B	31/07/13	RISING PIPEWORK POSITION CHANGED TO SUIT CURRENT ARCHITECTURAL LAYOUT	NC	AS	KA
A	19/06/13	DISTRICT HEATING SCHEME PROVISION ADDED	NC	AS	KA

Project: CARTWRIGHT GARDENS

Client: UPP

Architect: TP BENNETT

Title: PIPED SERVICES DISTRIBUTION LOWER GROUND FLOOR (NB1)

Drawing No.: BS -1 (53-56) 1002

Issue: D

Job No.: 1004327

Scale: 1:100

Drawing Status: CONTRACT

CUNDALL
Consulting Engineers
Horsley House, Regent Centre,
Gosforth,
Newcastle NE3 3LU
Telephone: (0191) 213 1515 Facsimile: (0191) 213 1701
Website: www.cundall.com

True scale at 1:1

Appendix F – UPP Statement

University Partnerships Programme

40 Gracechurch Street
London EC3V OBT
T +44 (0)20 7398 7200
F +44 (0)20 7398 7201
www.upp-ltd.com

University of London, Cartwright Gardens – Energy efficiency statement

Following is a brief summary of measures that we have in place to ensure the building will operate in accordance with the proposed Energy Strategy.

Our energy efficient design proposals achieve the following;

1) Carbon emissions reduction of the building is in excess of 25%, compared to the Part L 2010 standards for new buildings;

2) A site wide Combined Heat and Power system is proposed to meet the base heating and hot water demand of the development; and

3) The scheme also incorporates renewable energy systems in the form of photovoltaic panels to provide electricity.

Our agreement with the University requires us to operate and maintain the equipment and buildings to an agreed standard. Our performance is monitored against this pre-defined standard through Service Level Agreements where we report to the University on a regular basis.

In addition, the operation, maintenance and management of the building and its systems will be delivered against the Service Level Agreements. This in turn will allow UPP and the University to deliver the proposed strategy and achieve the energy targets.

UPP has an expert maintenance team and there will be a training plan and procedure in place for the FM team so they understand how the building is intended to work according to the design strategy and how it saves energy and carbon emission. The FM team, will have target energy consumption set for them and the operational energy performance of the building will be monitored regularly by UPP.

Comprehensive sub-metering will be in place for the development and subject to data protection and the University's agreement a mechanism to report the energy consumption of the CHP and PV panels to the council can be developed to suit all parties.

Appendix G – Updated Energy Statement

UNIVERSITY OF LONDON

GARDEN HALLS, UNIVERSITY OF LONDON

Energy Statement

April 2014

Table of Contents

Executive Summary

This Energy Statement will outline the key features and strategies adopted by the development team to reduce energy use in the proposed redevelopment of Cartwright Gardens Student Accommodation. The strategy for reducing energy use and associated carbon emissions through the design of the scheme follows the London Plan energy hierarchy, namely:

- Reducing the energy demand through passive design strategies and provision of high quality building envelope
- Reducing the energy consumption through best practice design of building services, lighting and control
- Installation of on-site Renewable Energy Technologies

Passive and active energy efficiency features include:

- High performance building fabric
- Excellent air tightness
- Highly efficient building services design
- High efficiency lighting

This energy efficient design proposals achieve the following:

- Carbon emissions reduction of the building is in excess of 28%, compared to the Part L 2010 standards for new buildings.
- A site wide Combined Heat and Power system is proposed to meet the base heating and hot water demand of the development.
- The scheme also incorporates renewable energy systems in the form of photovoltaic panels to provide electricity.

Table 1 demonstrates the reduction in the regulated carbon emission of the development as a result of implementing the abovementioned strategies. The total non-regulated carbon dioxide emission of the development according to NCM guidelines is around 400 tonnes per year. Estimating reductions in non-regulated carbon dioxide emissions is challenging as reductions will generally be based on the operational regime of the site and users behaviour. The building will be operated by UPP (University Partnerships Programme) who have extensive experience of operating student accommodation. Based on other developments they manage we would estimate that the suggested strategies could reduce operational carbon emissions by 10-20%.

Table 1 Carbon Dioxide emissions reduction for the development

Carbon Dioxide emissions (Tonnes CO_2 per annum)	
Building Regulations 2010 Part L Compliant Development	1,452
After Energy demand reduction	1,330
After CHP	1,064
After Renewable energy	1,041

Table 2 demonstrates the calculated CO_2 savings, which will be realised from each proposed technology. As demonstrated below overall 28.3% reduction in carbon emission can be achieved applying the proposed strategies.

Table 2 Regulated carbon dioxide savings from each stage of the Energy Hierarchy

Regulated carbon dioxide savings	Tonnes CO_2 per annum	%
Savings from energy demand reductions	123	8.4
Savings from CHP	266	20.0
Savings from Renewable Systems	22	2.1
Total Cumulative Savings	411	28.3

Figure 1 is a graphical representation of the total carbon emission saved using the proposed efficiency, low and zero carbon strategies.

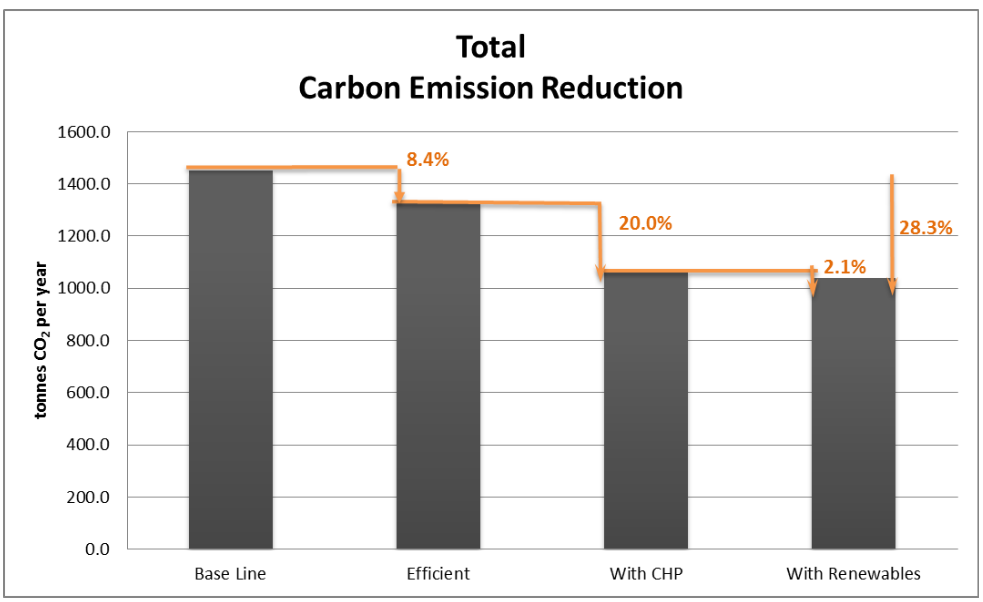


Figure 1 CO_2 reduction achievable from proposed strategies

1 Introduction

This Energy Statement provides an outline of the energy strategy that has been developed and will be implemented in the detailed design of the proposed development.

Over recent years, global public opinion has been increasingly concerned with the state of the environment and the impact of climate change. Buildings account for almost half of the energy consumption and carbon emissions in the UK[1]. This highlights the need for building owners, developers and designers to design environmentally sustainable buildings.

1.1 The Development

The Garden Halls are located on Cartwright Gardens to the south of Euston Road in the London Borough of Camden (see Figure 2). The application is for the redevelopment of the existing student accommodation, comprising the demolition of Canterbury (including York) and Commonwealth Halls, partial-demolition and refurbishment of Hughes Parry Hall and provision of new student accommodation (Sui Generis) to provide a net increase of 187 units (from 1,013 to 1,200 student bedspaces); associated ancillary uses (including Communal areas); two external courtyards; together with public realm improvements to Cartwright Gardens and the surrounding area

This Report outlines the proposed energy and sustainability strategy for the proposed refurbishment and new build development at Cartwright Gardens, Camden.

For a detailed description of the proposed development please refer to the Design and Access statement produced by TP Bennett architects and Maccreanor Lavington Architects.

Figure 2 Existing Situation- Plan

Table 3 is a schedule of proposed student accommodation blocks with a breakdown of areas and the total Net Internal Area per block. As demonstrated, the total Net Internal Area of student accommodation units is circa 21,913 m^2 and the total number of rooms is 1,200.

[1] DCLG (Department for Communities and Local Government), 2007, A guide for businesses: Reducing the energy usage and carbon emissions from your heating and hot water systems,

Table 3 Schedule of Proposed Student Accommodation Blocks

	NIA	GIA	GEA
floor	sqm	sqm	sqm
lower ground	3,521	4,101	4,434
ground	2,607	3,795	4,080
1st	2,210	3,447	3,756
2nd	2,314	3,554	3,866
3rd	2,314	3,554	3,866
4th	2,291	3,533	3,846
5th	2,012	2,969	3,236
6th	1,609	2,548	2,796
7th	845	1,419	1,559
8th	805	1,371	1,517
9th	233	380	420
10th	233	380	420
11th	233	380	420
12th	233	380	420
13th	233	380	420
14th	220	366	423
15th	-	-	-
16th	-	-	-
Total	21,913	32,557	35,479

En suite [C]	706
Mini clusters [SC]	15
Dis en suite [C]	48
Dis studio [SC]	12
HP en suite [SC]	245
Wardenial flat [SC]	2
Town House rooms [SC]	172
Total rooms	1,200

2 Overview of Environmental Standards, Targets and Policies

This section provides an overview of the environmental rating schemes, mandatory regulations and policy documents applicable to the development.

Key national policy documents consulted in the development of this report and environmental strategies include:

- The European Directive on the Energy Performance of Buildings (EPBD)
- The National Planning Policy Framework (March 2012)
- Energy White Paper, "Creating a Low Carbon Economy"[2]

In addition to the standards, targets and policies discussed above, the relevant British Standards; and CIBSE Guidelines were used to assist in determining the most appropriate Ecologically Sustainable Design (ESD) initiatives for the development.

Key regional environmental policy and guidance documents consulted in the development of this

- The London Plan – Spatial Development Strategy for Greater London[3], July 2011.
- Sustainable Design and Construction - London Plan Supplementary Planning Guidance (SPG)[4], May 2006

Key local environmental policy and guidance documents consulted in the development of this

- The Camden Council - Core Strategy – adopted 2010
- Camden Development Policies 2010-2025, Local Development Framework
- Camden Planning Guidance, Sustainability (CPG3)

Finally, Part L of the Building Regulations – 2010 is the basis of the calculations and methodology used in this document.

2 Energy White Paper, "Creating a Low Carbon Economy", http://www.berr.gov.uk/files/file10719.pdf

3 The London plan – Spatial Development Strategy for Greater London, http://www.london.gov.uk/mayor/strategies/sds/london_plan/lon_plan_all.pdf

4 Sustainable Design and Construction – Supplementary Planning Guidance (SPG), http://www.london.gov.uk/mayor/strategies/sds/docs/spg-sustainable-design.pdf

2.1 London Plan Requirements

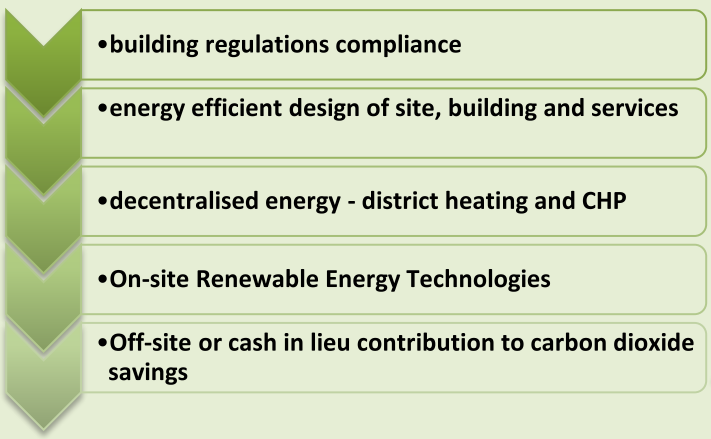
In July 2011 the Mayor published the replacement spatial development strategy for Greater London: The London Plan (2011). This part of the report summarises the relevant energy policies and the project response to each policy.

2.1.1 Carbon Dioxide Emission (Policy 5.2)

POLICY 5.2 Carbon Dioxide Emission

The new London Plan:

- Follows the energy hierarchy (Figure 3) in order to minimise the carbon dioxide emission.
- Requires total carbon emission reduction of 25% in comparison to a Part L compliant building.
- Explicitly asks that the calculation of the energy demand and carbon dioxide emissions from unregulated energy use to be carried out.
- Asks for the energy statements to follow energy assessment methodology (Figure 4)



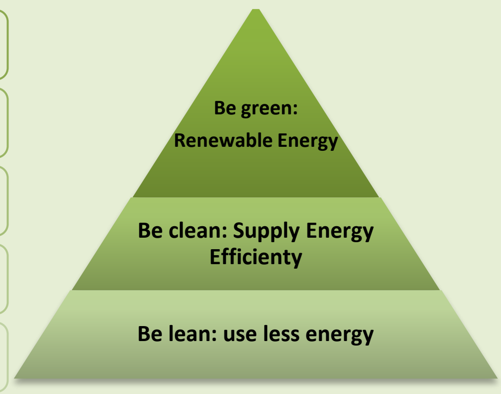


Figure 3 Energy Hierarchy

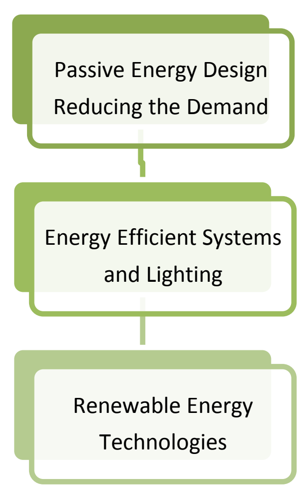
Figure 4 Energy Assessment Methodology

In order to design an energy efficient development, the design team has followed this hierarchy; i.e.

a. The development is designed to have highly efficient envelope and passive strategies have been incorporated in the design where possible.

b. Efficient building services and lighting are chosen for the development for reducing the energy consumption

c. Renewable Energy options are explored and the most feasible options are used in the development.



This report also covers the non-regulated energy use of the development based on a typical usage of the buildings category and lists a number of strategies in order to reduce this.

The report structure and content is organised based on the London Plan required Energy Assessment Methodology.

2.1.2 Decentralised Energy in development proposals (Policy 5.6)

POLICY 5.6 Decentralised Energy in Development Proposals

- 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.
- The London plan requires all major developments to follow a decentralised energy hierarchy when selecting the energy system for the development.

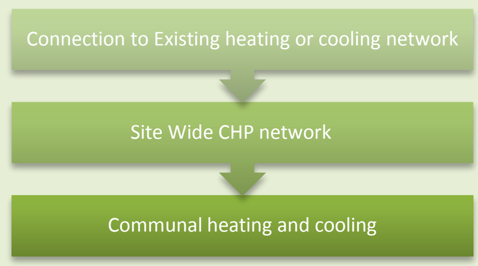


Figure 6 Decentralised Energy Hierarchy

The design team has explored opportunities for installation of decentralised energy system including CHP system. This report includes a summary of the findings.

2.1.3 Renewable Energy (Policy 5.7)

POLICY 5.7 Renewable Energy

- The London Plan Asks that within the energy hierarchy, part of the carbon emission reduction of the development, should come from on-site renewable energy generation where feasible.
- There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation wherever feasible.
- Development proposals should seek to utilise renewable energy technologies such as: biomass heating; cooling and electricity; renewable energy from waste; photovoltaic; solar water heating; wind and heat pumps.

This report summarises the feasibility of different renewable systems and explains the output of the options that were chosen as a result of the feasibility studies.

2.1.4 Overheating and cooling (policy 5.9)

POLICY 5.9 Overheating and Cooling Policy

- Major Developments should reduce potential overheating and reliance on air conditioning systems in accordance with the cooling hierarchy (Figure 7)
- Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise the overheating and also meet its cooling needs.

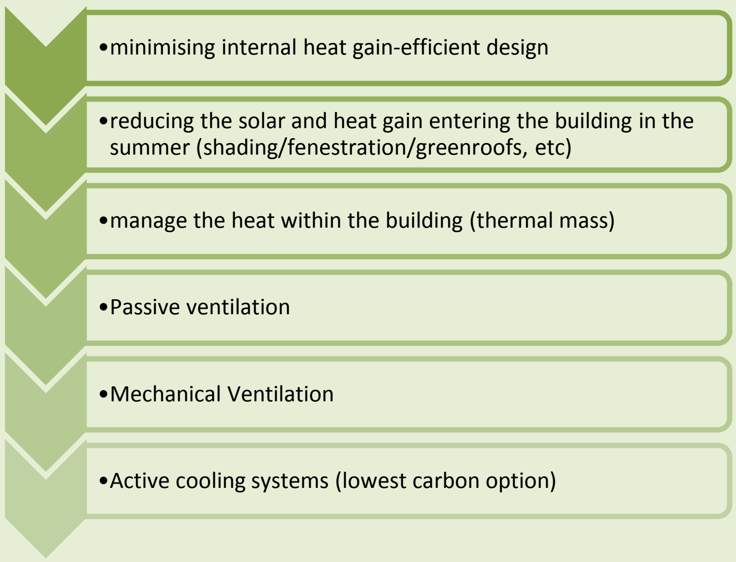


Figure 7 Cooling Hierarchy

Where appropriate, these strategies, which are implemented in order to reduce the overheating risk in the buildings, are covered in this report under passive strategies.

2.2 Camden Core Strategy

Camden Council adopted their Core Strategy in 2010 and subsequently released a set of planning guidance adopted in April 2011.

Camden POLICY CS 13 Tackling climate change through promoting higher environmental standards

- Policy CS13 – Tackling Climate Change though promoting higher environmental standards

Reducing the effects of and adapting to climate change

The council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

a. ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;
b. promoting the efficient use of land and buildings;
c. minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:
   1. ensuring developments use less energy,
   2. making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;
   3. generating renewable energy on-site;
d. Ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions

Local energy generation

The Council will promote local energy generation and networks by:

e. working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:

– housing estates with community heating or the potential for community heating and other uses with large heating loads;
– the growth areas of King's Cross; Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;
– schools to be redeveloped as part of Building Schools for the Future programme;
– existing or approved combined heat and power/local energy networks and other locations where land ownership would facilitate their implementation.

f. protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road);

Camden's carbon reduction measures

The Council will take a lead in tackling climate change by:

j. taking measures to reduce its own carbon emissions;
k. trialling new energy efficient technologies, where feasible; and
l. raising awareness on mitigation and adaptation measures.

2.3 Camden Development Policies

Camden Development Policies forms part of the council's Local Development Framework (LDF), the group of document that sets out Camden Planning strategy and policies.

DP22 . Promoting Sustainable Design and Construction

Under DP22, one of the main requirements to do with Energy Efficiency and LZC technology, is following:

e) expecting non-domestic developments of 500sqm of floor space or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019

Sustainable design and construction measures

The Council will require all schemes to consider these general sustainable development principles, along with the detailed elements identified in the table below, from the start of the design process. Developments of 5 or more dwellings or 500sqm of any floor space should address sustainable development principles in their Design and Access statements or in a separate Energy Efficiency Statement, including how these principles have contributed to reductions in carbon dioxide emissions. When justifying the chosen design with regards to sustainability the following appropriate points must be considered:

Design	Fabric/Services
• the layout of uses • floor plates size/depth • floor to ceiling heights • location, size and depth of windows • limiting excessive solar gain • reducing the need for artificial lighting • shading methods, both on or around the building • optimising natural ventilation • design for and inclusion of renewable • energy technology • impact on existing renewable and low carbon technologies in the area • sustainable urban drainage, including • provision of a green or brown roof • adequate storage space for recyclable material, composting where possible • bicycle storage • measures to adapt to climate change • impact on microclimate	• level of insulation • choice of materials, including - responsible • sourcing, re-use and recycled content • air tightness • efficient heating, cooling and lighting systems • effective building management system • the source of energy used • metering • counteracting the heat expelled from plant equipment • enhancement of/provision for biodiversity • efficient water use • re-use of water • educational elements, for example visible • meters • on-going management and review

This document lists the energy efficiency strategies adopted for the development and demonstrates how above issues are addressed in Cartwright Gardens Student Accommodation.

3 Building Regulation Compliance

The proposal includes refurbishment of Hughes Parry Hall and redevelopment of the Garden Halls student accommodation. The refurbishment of the existing buildings requires compliance with Building Regulations Approved PartL1B. The new student accommodation buildings must comply with Building Regulations Approved Part L1A.

Meeting the requirements of Part L1A 2010 for the new development will be achieved through:

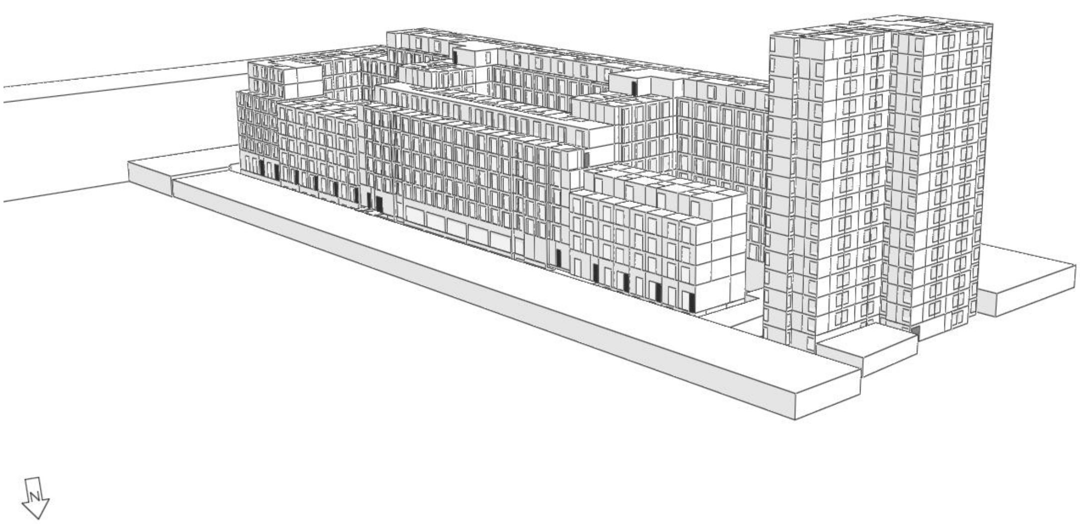
- **Efficient Thermal Elements and Controlled fittings:** the building fabric will be designed to improve on minimum Part L 2010 requirements.
- **Building Services and Lighting:** The new building services will be designed and specified to perform better than the minimum requirements detailed in Non-Domestic Building Services Compliance Guide, 2010 edition.

Meeting the requirements of Part L1B 2010 for the existing building will be achieved through:

- **Efficient Thermal Elements and Controlled fittings:** where feasible, the building fabric will be improved to reduce the energy demand of the building.
- **Building Services and Lighting:** The building services will be replaced and specified to meet current standards.

3.1 Building Energy Model

For the purpose of this study, the buildings are modelled IES-VE software- Version 6.4.0.11. The modelling and analysis have been completed by Mecserve's energy modelling team who are accredited energy assessors.[5]



[5] Nazli Dabidian; Low Carbon Energy Assessor accredited to work on Level 3, level 4 and level 5 Buildings; accreditation number: LCEA119469

3.2 Baseline Carbon Emission Rate

Although the building is comprised of a new part and a refurbished part (Hughes Parry Hall), both buildings are modelled together and compared against the higher standards of a new building. This is a conservative assumption as the refurbished Hughes Parry Hall is being compared against the targets for a new building. The client and the development team are keen to refurbish the existing building to very high standards in line with the new building. The target emission rate for the combined building based on Part L2A, 2010 is calculated as 1,452 tonnes.

4 Energy Efficient Design of Site, Building and Services

4.1 Passive Design Strategies

The first stage of the energy strategy is to reduce the energy demand as much as possible before considering active and renewable energy technologies. The aspiration is to build a high quality student accommodation scheme with an enhanced energy performance.

This will be achieved through:

- **Building Orientation**- The buildings' orientations are largely dictated by the shape of the site. Having said that, the internal layout of the building has been set out to maximise the number of rooms that can take advantage of solar gain and natural light. This has been achieved by arranging the buildings around a courtyard. This arrangement, also enables a natural ventilation strategy to work effectively.
- **Passive Solar Design and Daylight-** The make-up of the façade balances the proportion of solid wall to glazing in order to seek an optimum amount of daylight and winter solar heating, without excessive solar gain during the summer.
- **Thermal performance of the fabric**- the proposed building fabric exceeds the requirements set in the Part L regulations
- **Thermal bridges** - Appropriate construction details will be used to minimise the impact of thermal bridges within the building envelope in the new development. The refurbishment part of the development will be carried out carefully to reduce the impact of thermal bridging.
- **Air-tightness** - Using enhanced construction skills and rigorous detailing to reduce the air permeability of the buildings

The table below shows the proposed specifications for the fabric of the development including air permeability.

Table 4 Target Specifications

Fabric Specifications		Proposed Specification
Fabric U values [W/m2.K]	**Roofs**	0.2
	New Walls	0.25
	Ground floor	0.20
	Windows /Doors	2 (ground floor curtain walling) 1.4 (All other floors)
Air permeability [m3/m2.hr@50pa]		5

Achieving the above values will reduce the energy demand of the development in advance of adding any active energy efficiency measures or renewable energy systems to the development.

4.2 Energy Efficient Systems

After reducing the energy demand of the development, the next stage would be to use energy efficient building services, lighting and controls for the development. This will include:

- **Heating and Hot Water:** best practice design in the heating including highly efficient condensing boilers and very well insulated pipes is proposed for the development.
- **Cooling:** No cooling is proposed for the bedrooms or studios. Cooling will be limited to communal and function areas generally at ground floor level. Cooling may be installed for the ground floor flexible areas depending on the function. Therefore the thermal model includes cooling these areas
- **Ventilation:** the majority of the building is naturally ventilated with extract ventilation in bathrooms and kitchens.
- **Heat recovery:** where mechanical ventilation is installed, they will include heat recovery and demand control systems to reduce the energy associated with mechanical ventilation
- **Building services insulation:** The hot water tanks, pipes and ducts will be insulated to a high standard.
- **Lighting:** The lighting design will consider how to reduce power density for the required lighting level. Daylight control and occupancy sensors will be installed for lighting system in some areas Inclusion of enhanced controls will help reduce the energy consumption of the building further.

Table 5 Energy Efficient Systems (a summary of the energy efficient systems which will be specified)

System Specifications	Efficient Building			
Boiler Seasonal Efficiency	95%			
Ventilation	Natural Ventilation to bedrooms			
	Extract ventilation to bathrooms (Local Specific Fan Power: 0.5 W/l/s)			
	Common areas provided with central ventilation with 65% Heat Recovery: (Central Specific Fan Power: 1.8)			
Cooling	VRV to front of house areas & DX units in Comms room (SCoP min 3.5; SEER min 4.5)			
Pumps	Variable Speed Pumps			
Hot Water	Boiler fed super insulated tanks			
Controls	BMS control, Temperature and time control within zones, Weather compensation			
Light fittings Efficacy (lm/W)	Efficient lighting design in all areas			
	Bedroom	72	Office	65
	Bathroom	85	Meeting room	65
	Living	60	Comms room	60
	Kitchen	70	Storage	55
	Dining	70	Food preparation	60
	Corridor	60	Eating and drinking	60
	Lounge	55		
	Reception	55	Plantroom	70
Lighting Controls	Occupancy controls in all communal areas and bathrooms, Manual controls in the bedroom (manual override where necessary), daylight sensors in lounge, office, eating and drinking areas			

4.3 Overheating And Cooling policy

The project design has followed the overheating and cooling hierarchy as required by London Plan. (See paragraph 2.1.4)

- **Minimising internal heat gain-efficient design:** where possible the internal gains are minimised. This includes highly efficient design of light fittings and Selecting highly efficient A rate equipments to reduce the small power and internal gain
- **Reducing the solar and heat gain:** the areas of the windows are not excessive; in the rooms with higher solar gain, high performance solar control glazing is specified which prevents excessive solar heating during the summar, but does not reduce daylight/ winter solar gain excessively.
- **Manage the heat within the building (thermal mass):** the internal leaf of the walls has high thermal mass and the area of the light weight windows is not excessive, therefore the internal temperature will benefit from the wall's thermal mass where possible.
- **Passive ventilation**: Openable windows are being used to provide natural ventilation to the building where feasible.
- **Mechanical Ventilation:** Mechanical Ventilation is not proposed for the accomodation as above strategies will be sufficient to remove heat and provide fresh air to the units. Mechanical ventilation will be provided to kitchens and bathroom sin accordance with Approved Document Part F.
- **Active cooling systems (lowest carbon option)**: No Cooling is proposed for the student accomodation. Active cooling systems are provided to front of house areas not suitable for natural ventilation.

4.4 Energy Consumption and Carbon Emission of the Efficient Buildings

4.4.1 Carbon emission savings of the efficient buildings

Implementing all the passive and active energy strategies listed in sections 4.1, 4.1 and 4.3, the carbon dioxide emission of the new student accomodaiton buildings is reduced from 1,452 $kgCO_2/m^2$ to 1330. $kgCO_2/m^2$. Figure 8 demonstrates that the reduction in Carbon Emission of the buildings is 8.4%.

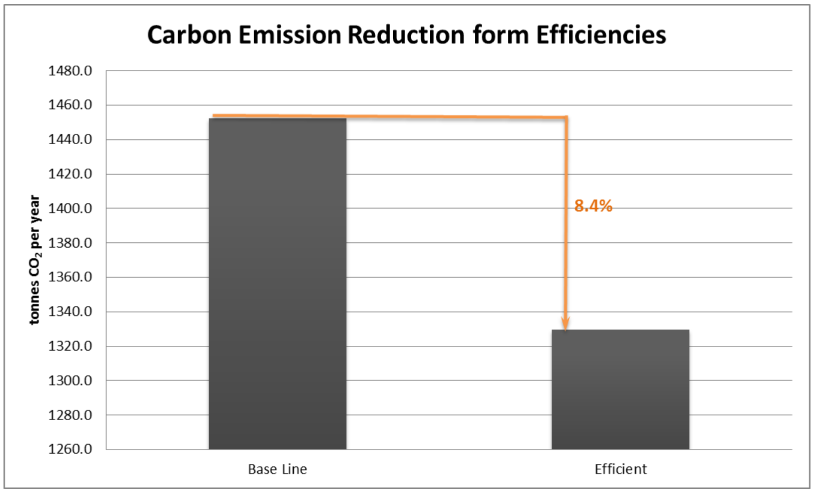


Figure 8 New Development, Carbon reduction due to efficiency measures

4.4.2 Breakdown of the regulated Energy Consumption & Carbon Emission

Based on the energy calculations completed for the development, The graphs below (Figure 9) demonstrate the breakdown of the regulated energy consumption and regulated carbon emission of the development after applying the efficiency measures listed in this report.

The most significant contributions are from Domestic Hot Water and Heating Respectively. Please note that the graphs do not include equipment loads. The non-regulated energy consumption and carbon emission is covered in section 4.5.

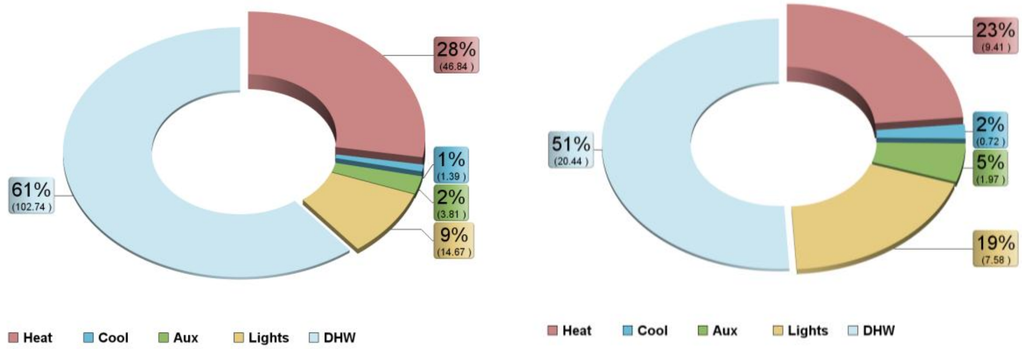


Figure 9 Breakdown of the Energy Consumption and Carbon Emissions for the development

4.5 Non-Regulated Energy Use

The London Plan (2011) requires that the energy demand and carbon dioxide emissions of the non-regulated end uses should also be calculated and reported in the energy assessments.

Based on the National Calculation Methodology, the total Carbon Emission of the non-regulated end users of the buildings is calculated. The total carbon emissions of the development from cooking and equipments is circa 400 tonnes per year.

Following strategies are proposed to reduce the non-regulated energy demand of the development:

- A rated appliance: The kitchens will be fitted out with highly efficient A rated appliances only.
- Installation of energy meters with display monitor for each unit to get the occupants more interested and involved in how energy is being used in their unit.
- Information will be provided to occupants which will explain the operations of energy centre and PV panels and how energy efficient behaviour will reduce the cost/carbon emissions of the development.

5 Decentralised Energy – District Heating

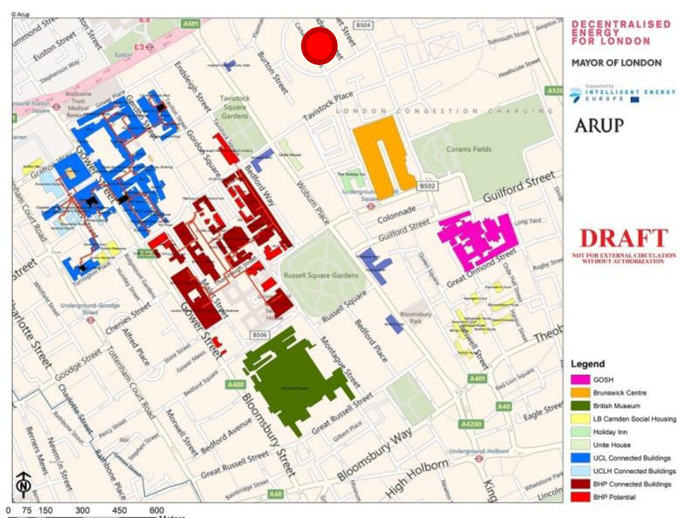
In accordance with the decentralised energy hierarchy, the connection to existing district heat networks, site wide Combined Heat and Power (CHP) and incorporation of CHP in the buildings has been considered for the scheme.

5.1 Existing District heating

There are a number of district heat networks in the local area. The development team have consulted with the parties responsible for these networks to investigate the feasibility of getting the student accommodation to an existing network.

Our discussions are summarised below:

- We initially spoke to Stephen McKinnell, the energy manager at SOAS who is responsible for the SOAS Energy network. He informed us that they are currently concentrating on investment in the central plant serving their existing network rather than expansion. They do have plans to extend the network, these plans are at their early stages and are in general terms aimed at extending the network south towards Great Ormond Street Hospital and the British Museum. Stephen refered us back to Harold Garner at Camden and Stuart Allison at Arup for a wider perspective.
- We spoke to Stuart Allison at Arup who are spearheading the masterplanning of the Bloomsbury heat network on behalf of the Decentralised Energy Body. Stuart confirmed that although the proposal was to extend the Bloomsbury network there is no fixed timescale in which to do this or any firm plan that it would extend towards our site. The Arup team are in dialogue with the operators of the decentralised networks in the area including the Argent, Kings Cross, Euston Road, UCL Gower Street and SOAS networks. We agreed that we would provide our baseline calculations to Arup so that any future considerations could take into account our scheme. Please find below the the map of the proposed Bloomsbury Area DH as it stands.



- Finally, we spoke to Harold Garner at Camden Council. He acknowledged that we had approached the right people in relation to the scheme. We outlined how we were designing the buildings with basement heating and hot water plant which would allow for a technically straightforward change to a district energy network connection at some point in the future should this become available.

Figure 10 below taken from the London Heat Map shows the location of the site and the location of the proposed Euston Road district heating network (red routes). The purple areas on the maps, shows the areas with potential for district heating network and the site is just outside the opportunity area.

Figure 10 London Heat Map and the location of the site

Connection to an expanded Bloomsbury district heating network may be possible in the future. However, currently there is no clear information available on completion date and details of the operation of the district heating. The building therefore, will have its stand-alone communal heating system, but will be designed to technically allow future connection to district heating network when the network becomes operational. Subject to technical and financial feasibility at the time and subject to commercial agreements, the client will connect the building to the district heating network in future.

5.2 Site Wide Combined Heat and Power

The site represents a good opportunity for installation of site wide combined heat and power. This will help in reducing the carbon emission of the site dramatically. The following graphs show the annual heating and hot water demand of the site based on the energy calculations.[6] The hot water demand included in the graph below is based on hourly estimation of hot water demand.[7]

[6] The figures demonstrated on the graphs are based on initial energy calculations only and the real M&E design figures may be slightly different for the development. The CHP will be sized based on the detailed design and heat loss/gain calculations at a later stage.

[7] The graph here (Figure 11) shows the hourly demand and ignores the hot water tank capacity. The next graphs includes the hot water tank capacity as well. The CHP is sized to be able to fill the Hot Water Tank continuously.

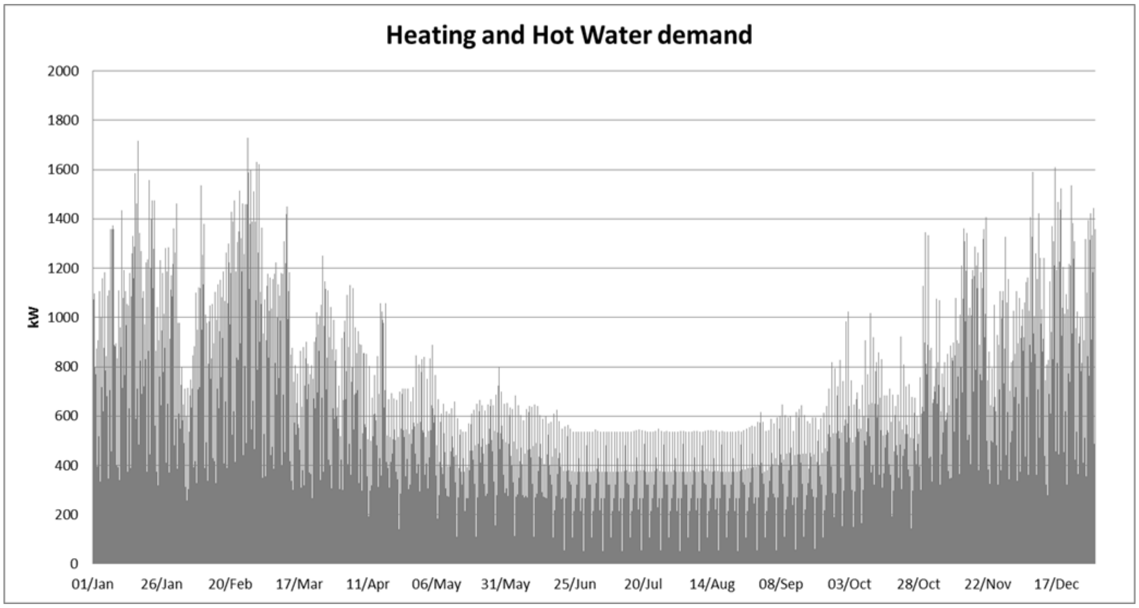


Figure 11 Annual Heating and Hot Water Load

It is proposed that one number CHP unit should be installed for the site for the system to be more efficient and for ease of maintenance. Figure 12 shows the total heating and hot water requirement of the development throughout a year and it demonstrates how the CHP unit, with circa 358 kW heating output, could meet the base demand of the development in winter. Under normal operation the CHP works almost continuously full load or part load with some breaks over the summer period.

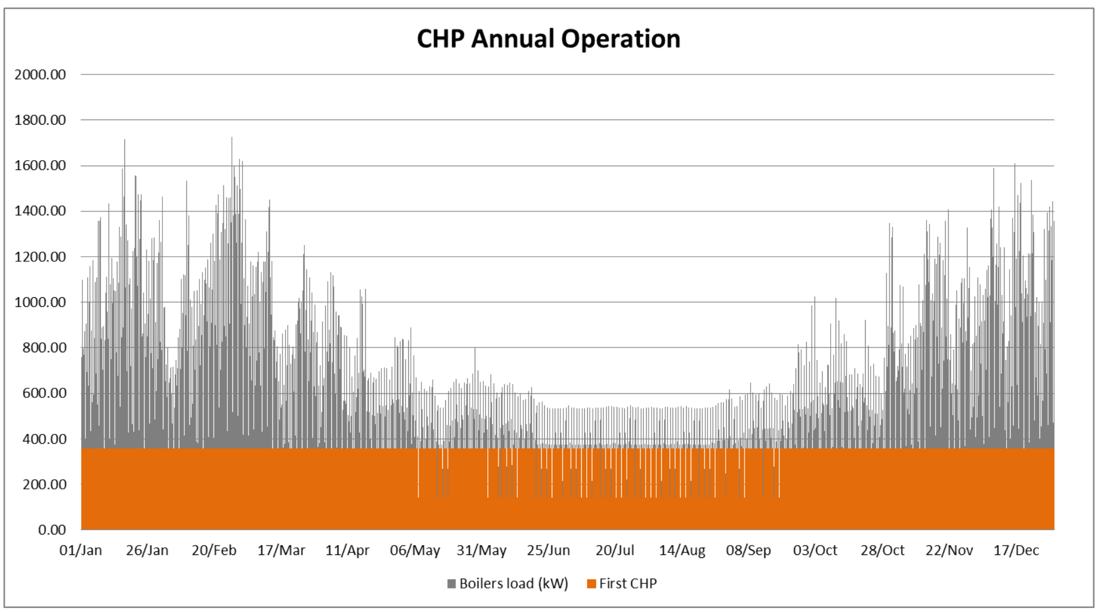


Figure 12 Annual Heating demand met by CHP units

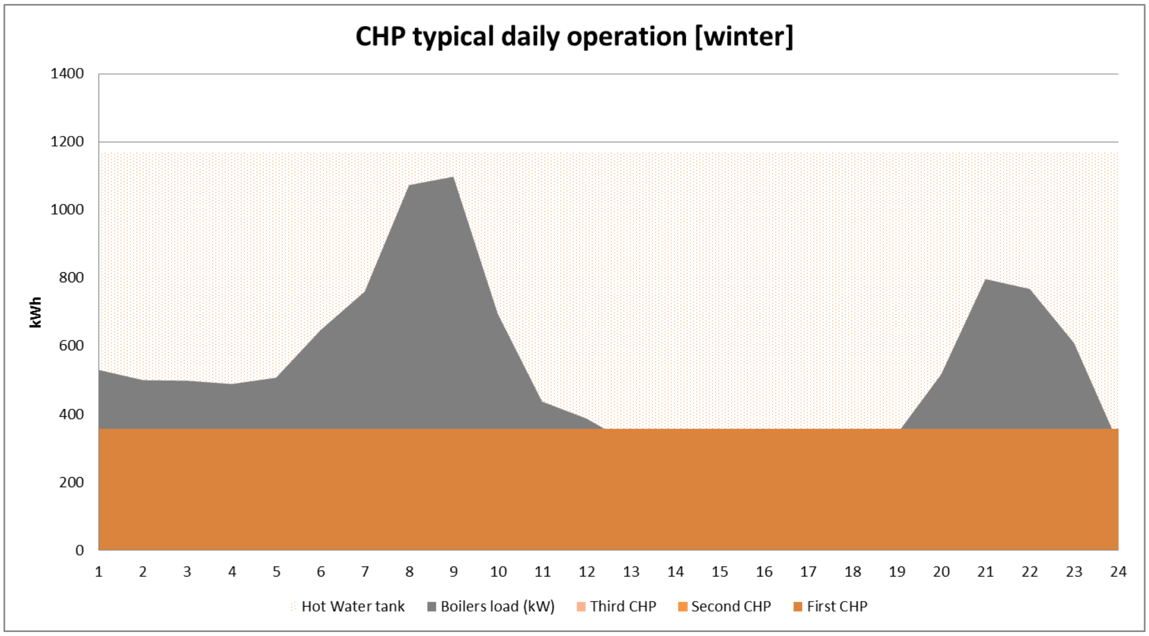


Figure 13 typical winter day CHP operations

Around 65% of the total annual heating/hot water requirement of the site will be provided through communal CHP system. Total CO_2 savings from this is approximately 311 tonnes per year.

Table 6 Total Carbon Emissions saved through CHP system

CHP Carbon Saving	Energy [MWh]	Carbon [Tonnes CO_2]
Heating output	2,099	462
Electricity output	1,348	713
Total Natural gas input (gross)	4,364	864
Saving		**311**

The scheme is designed such that the energy centre will serve the whole site including Hughes Parry Tower and Garden Halls, will be connected to the central network.

5.3 Combined Heat and Power in the Buildings

Since Site Wide CHP is proposed for the site to cover the base line heating demand, small scale CHP will not be considered for the site.

6 On Site Renewable Energy Technologies

In order to further reduce emissions from the development in accordance with the local authority policies it is necessary to consider the introduction of renewable energy systems on site. A high-level assessment has identified the technology most appropriate to this site. This statement provides only brief commentary on technologies not considered appropriate in the appendix A.

6.1 Photovoltaic Panels

Installation of Photovoltaic panels on the roofs of the development is considered and a full shading analysis is completed for the site. Please see Appendix B which shows a summary of our shading analyses graphically.

To mitigate the effect of climate change and reduce the heat island effect and to increase biodiversity at the site, green roof is proposed for some blocks. (for further details of green roof please refer to Sustainability Statement by Mecserve and the Design and Access Statement and Drawings by the Architects). Appendix C shows the *possible locations* for installation of PV panels. The details of the proposed PV panels will be confirmed at the detailed design stage by MCS accredited body responsible for design and installation of PV panels. The current layout is based on 10 degrees inclination and South-West / South-East facing panels.

The energy output of the PV panels will be either used to meet the demand of the development, or will be exported to the grid. Feed in Tariffs will be applicable to the installation according to current legislation and the PV panels will generate revenue each year.

A total of 160 PV panels are proposed to be installed on the roof. Overall, circa 260 m^2 of the roof area will be used for installation of PV panels. The total peak power generated by photovoltaic panels will be around 52.3 kW. The installation will result in a saving approximately 22.5 tonnes of carbon per year. Table 7 is a summary of the contribution of photovoltaic panel installation to the reduction in energy consumption and carbon emissions of the building.

PV panels [number of panels]	Per panel power [kWp]	Total Power [kWp]	Total generated electricity [MWh]	Total Carbon Savings [tonnes CO2/year]
160	327	52.3	42.5	22.48

Table 7 Photovoltaics' Energy generation and Carbon Reduction

6.2 Summary of the recommended Systems

Based on the feasibility study carried out (please refer to Appendix A for the summary of the study), it is recommended that photovoltaic panels would be the most suitable renewable technology for the site.

7 Conclusions

This energy statement outlines the key features and strategies adopted by the development team to reduce energy use and carbon emissions for the scheme. The strategy for reducing energy use and associated carbon emissions through the design of the scheme follows a three-step approach.

- Reducing the energy demand through passive design strategies and provision of high quality building envelope for all the blocks
- Reducing the energy consumption through best practice design of building services, lighting and control
- Installation of on-site Renewable Energy Technologies

Passive and active energy efficiency features include:

- High performance building fabric
- Excellent air tightness
- Efficient building services
- High efficiency lighting

For non-regulated energy use, energy efficiency features that are proposed include:

- A-rated appliances
- Installation of meters with user-friendly display screens for occupants

A site wide Combined Heat and Power system is proposed to meet the base heating and hot water demand of the development.

The scheme also incorporates renewable energy systems in the form of photovoltaic panels to provide electricity.

This energy performance statement has demonstrated that the new development has the carbon emissions reduction in excess of 25% compared to the Part L 2010 standards.

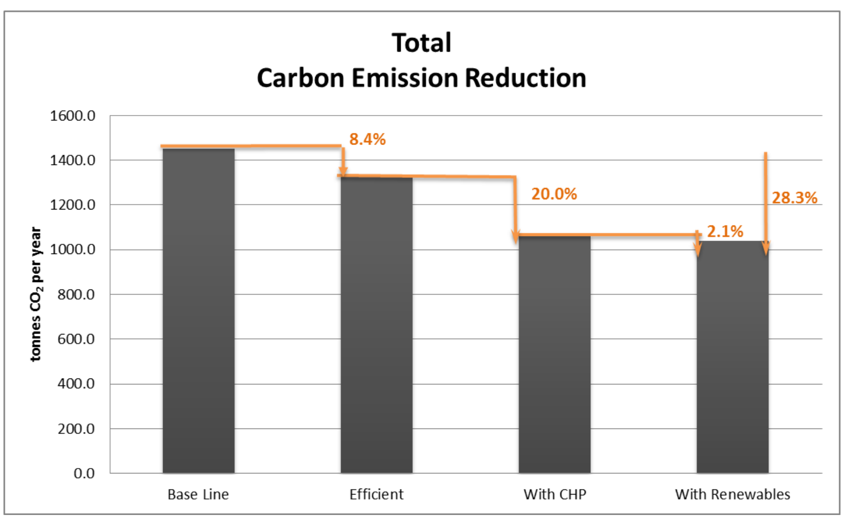


Figure 14 Total Carbon Emission Reduction for the site

A Summary of the carbon savings, that will be realised as a result of implementing the strategies recommended in this report can be found in the following table.

Regulated carbon dioxide savings		
	Tonnes CO_2 per annum	**%**
Savings from energy demand reductions	**123**	**8.4**
Savings from CHP	**266**	**20.0**
Savings from Renewable Systems	**22**	**2.1**
Total Cumulative Savings	**411**	**28.3**

Appendix A – Renewable Energy Systems not feasible for the site:

I. Biomass Heating

The scale of the development is large and it is located in central London, thus there are concerns with the supply chain and the reliability of supply throughout the life of project. The impact of frequent fuel deliveries on local traffic and noise should also be considered. There are also concerns within the local authority over air-quality issues associated with biomass boilers.

The issues outlined above, together with the fact that biomass boilers need very large fuel storages to reduce the frequency of deliveries, especially for this scale of development, means that we would not consider this option to be either appropriate or practical for the development.

II. Heat Pumps (Ground/Water/Air Source)

- **Ground Source Heat Pump**

Ground source heat pumps have been considered for the development. With a closed loop borehole system it would be possible to drop loops beneath the basement of the buildings. However, Ground Source Heat Pumps work best when there is both cooling and heating requirements throughout the year so the stored energy can be recovered in different seasons. If there is no balanced heating/cooling requirement throughout the year, the system life will be short and the system will lose its capacity over time. The majority of the develop requires no cooling and form the energy analysis the demand is driven primarily by domestic hot water and heating requirements. A ground source system would be complex, technically risky, costly and deliver limited carbon emissions savings.We would therefore not recommend this approach for the development.

- **Air Source Heat Pump**

Air-source or aerothermal heat-pumps work on the same principals as a ground-source heating system but extract heat or coolth from the air. The system uses electricity, and although considerable carbon can be saved when comparing with direct electric heating, the carbon reduction realised is not significant when comparing with gas fired system. For this reason, and also to avoid negative noise/visual impacts of the system, installation of air source heat pump is not recommended for this development.

III. Wind Turbines

The urban setting of the development means that the wind speed may not be consistent and reliable to generate the expected energy. Previous studies on wind turbine performance in urban climate have shown that air turbulence in the urban area will usually result in lower energy production than expected. Additionally installation of Wind Turbine might not be acceptable in a dense residential urban environment due to noise issues and aesthetic impacts. We would therefore consider wind turbines inappropriate for the site.

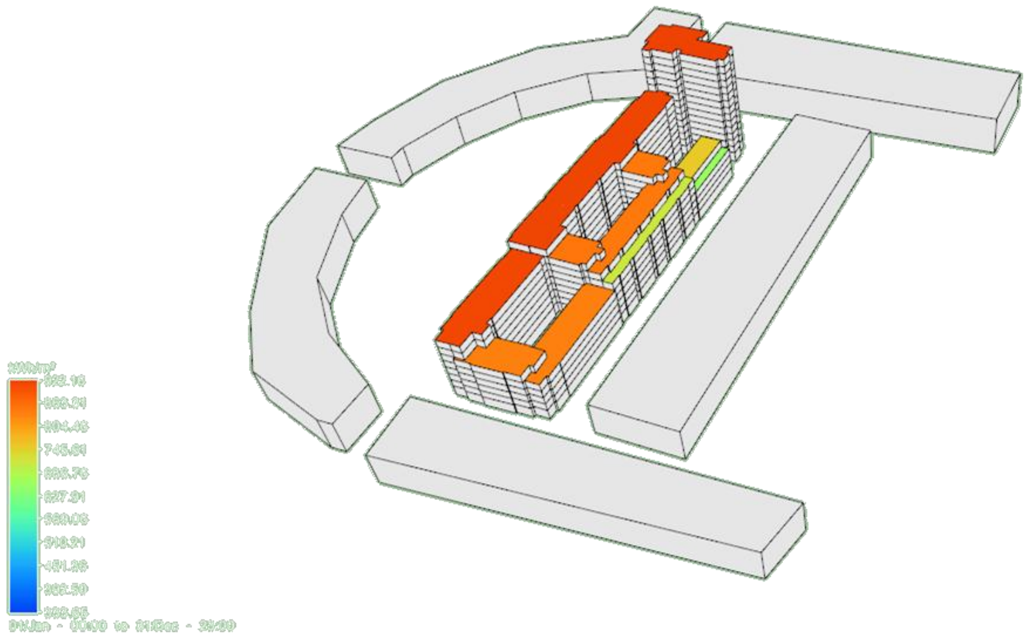
IV. Solar Hot Water System

The development has large hot water demand. However, since site wide Combined Heat and Power is proposed for the development, and since the system is sized to cover the base heating and hot water for the development, it is not possible to take full advantage of solar hot water panels. We do not, therefore, recommend installation of Solar Hot Water system for this development.

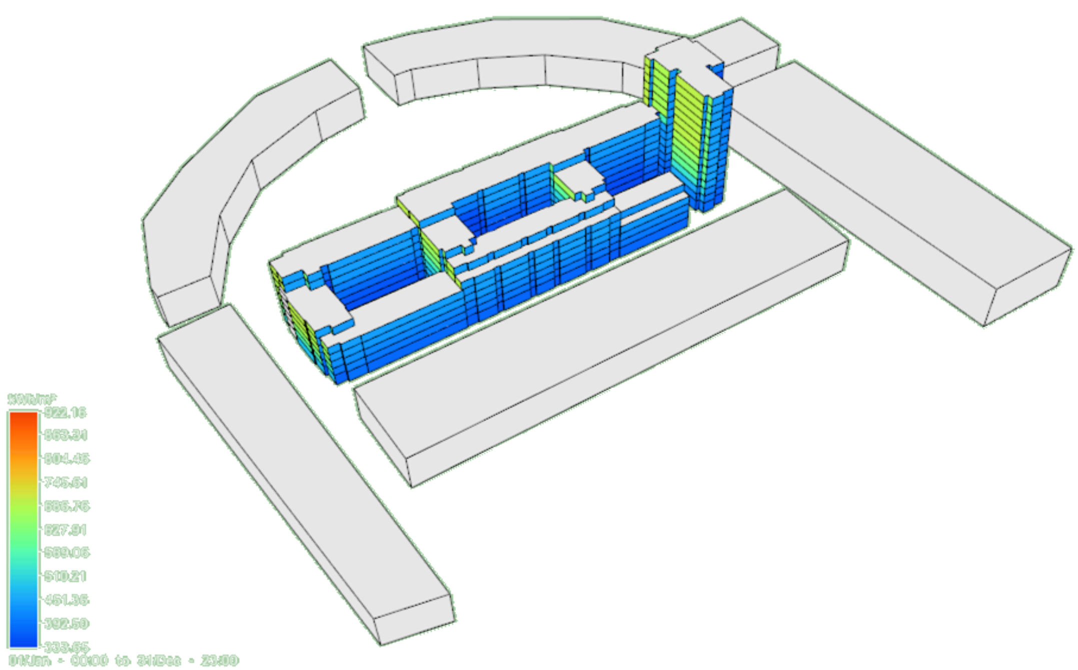
Appendix B – Insolation level on different surfaces

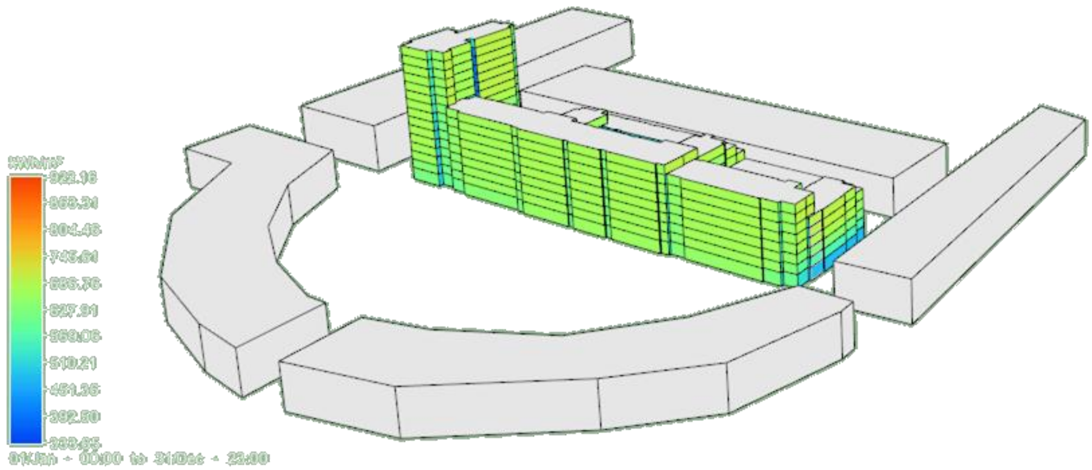
Cartwright Gardens Annual Shading Calculations

Roof: Some surfaces are appropriate for installation of solar panels



North Façade: Not recommended to install solar panels

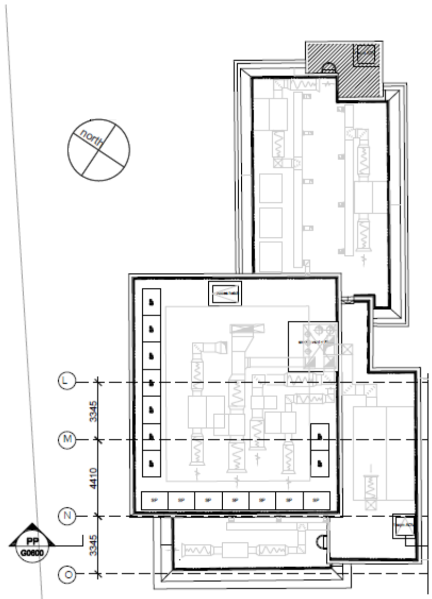


South facing façade: Not recommended to install solar panels


Appendix C – PV panels Layout on the roof

Cartwright Gardens – Potential areas for installation of PV panels

The Tower PV panels Layout



PV panels layout on the main building