

CONTENTS

1.0	INTRODUCTION	1
2.0	INCOMING SERVICES.....	1
2.1	Gas	1
2.2	Water	1
2.3	Electricity	1
3.0	LOW AND ZERO CARBON TECHNOLOGIES	1
3.1	Solar Thermal Water Heating	2
3.2	Solar Photovoltaics	2
3.3	Mini-CHP and Waste Heat	2
3.4	Hot Water-Fired Absorption Chillers	3
3.5	Air Source Heat Pumps	3
3.6	Rainwater Harvesting	3
3.7	Other Low and Zero Carbon Technologies	3
4.0	NATURAL GAS	4
5.0	DOMESTIC WATER SERVICES	4
6.0	HEATING SYSTEMS.....	4
7.0	VENTILATION SYSTEMS.....	5
7.1	General Ventilation	5
7.2	Specialist Ventilation Systems	5
8.0	AIR-CONDITIONING SYSTEMS	5
9.0	BUILDING ENERGY MANAGEMENT SYSTEMS AND CONTROLS	6
10.0	POWER INSTALLATIONS	6
10.1	Electrical Switchgear and Distribution	6
10.2	Small Power	7
11.0	LIGHTING INSTALLATIONS	7
11.1	General Lighting	7
11.2	Emergency Lighting	7
11.3	External Lighting	7
12.0	STRUCTURED WIRING INSTALLATIONS	7
13.0	SECURITY SYSTEMS	8
13.1	Fire Alarm	8
13.2	Intruder Alarm	8
13.3	CCTV	8
14.0	LIGHTNING PROTECTION.....	8

Checked by: Date:

1.0 INTRODUCTION

This document outlines the strategy for the provision of building services installations to serve the new SmartLIFE Low Carbon development in Cambridge.

The intent of this report is to provide a high-level review of the preferred strategies for the provision of building services installations, based on goals and specific requirements set by the Client. These goals and requirements include;

- Provide an overall building services installation that emphasises the efficient use of systems to minimise energy consumption.
- Achieve a BREEAM rating of EXCELLENT, with consideration being given to the possibility of achieving OUTSTANDING.
- Incorporate a diverse selection of low and zero carbon technologies within the building services scheme, with the facility to use these as teaching aids.

2.0 INCOMING SERVICES

2.1 Gas

A new gas supply is to be brought to the site boundary from Kings Hedges Road. A supply will be extended from the boundary meter to serve the new SmartLife Low Carbon building.

The Contractor is to note that the training facilities provided within the building will include a number of boilers and other heat generating appliances, which will be used by students to carry out installation and fault-finding exercises. All such equipment is to be capable of being operated, and will therefore require an adequately sized gas supply.

2.2 Water

A new mains cold water supply is to be brought to the site boundary from Kings Hedges Road. A supply will be extended from the boundary meter to serve the new SmartLife Low Carbon building.

2.3 Electricity

A new mains electricity supply is to be provided to serve the building, and there are a number of possible options for how this would be achieved;

- Provision of a new connection from the Cambridge Regional College site network. This is the preferred option, but is subject to sufficient capacity being available and agreement regarding being able to route services under the guided bus-way.
- Provision of a new connection, by the electricity company, from King's Hedges Road. This is subject to available network capacity. Should capacity not be available then a new on-site sub-station would be required, of a suitable size to serve both the new building and other future development on the site.

3.0 LOW AND ZERO CARBON TECHNOLOGIES

One of the functions that will be accommodated within the SmartLIFE Low Carbon building is to provide teaching facilities for training in the installation and maintenance of low and zero carbon technologies. Therefore, the Client wishes to incorporate a number of different technologies within the building services installations as working demonstration models to show to students.

The Contractor is to note, therefore, that plant areas need to be highly accessible to ensure that all such technologies can be viewed in operation by groups of students in addition to the normal access requirements for maintenance.

A minimum target of 15% energy on site being provided by low or zero carbon technologies has been identified as a requirement in working towards a BREEAM rating of EXCELLENT. This exceeds the requirement of the planning authority for 10% of the development's total predicted energy demand to be provided from on-site renewable sources.

A high-level feasibility study of low and zero carbon technologies has been undertaken, and a number of systems have been identified as offering opportunities for inclusion as part of this scheme;

3.1 **Solar Thermal Water Heating**

The roof of the workshop area has been designed to offer the maximum opportunity for the use of solar technologies, providing a number of pitched south-facing elements on which different types of solar panels could be installed.

Solar thermal water heating offers opportunities for inclusion to serve either one or both of the domestic hot water service and the LTHW heating system, although it needs to be ensured that an adequate year-round base load is available.

In order to offer greater opportunities as a teaching aid, the solar thermal water heating system could be designed to incorporate banks of both the evacuated tube and flat panel collector types.

3.2 **Solar Photovoltaics**

Solar photovoltaics are another technology which could be incorporated to take advantage of the design of the roof of the workshop area and provide a level of on-site electricity generation. This would help to reduce the reliance of the building on electricity generated off-site and thereby reduce the carbon burden associated with the use of electrical energy on site.

On-site electricity generation is to be grid interfaced to take advantage of the new feed-in tariffs which are available for organisations that generate electricity on-site.

Areas of photovoltaic panels could also, potentially, be incorporated within the building façade.

3.3 **Mini-CHP and Waste Heat**

In order to reduce the reliance of the building on electricity generated off-site, which imposes a high carbon burden, consideration is being given to the inclusion of a small-scale gas-fired mini-CHP unit to generate a proportion of the sites electricity demand on-site. The waste heat generated would be utilised to serve the LTHW heating system and/or the domestic hot water service.

On-site electricity generation is to be grid interfaced to take advantage of the new feed-in tariffs which are available for organisations that generate electricity on-site.

The training facilities provided within the building will include a number of boilers and other heat generating appliances, which will be used by students to carry out installation and fault-finding exercises. Such items of equipment will need to be fired

periodically, for up to 30 minutes at a time, to demonstrate that the exercises have been carried out successfully. There will, therefore, need to be a system to dissipate the heat generated, and consideration is being given to a means of incorporating this into the systems providing heating and hot water within the building. While the heat output will be limited and intermittent, it is desirable that the waste heat be made use of rather than being rejected to atmosphere.

3.4 **Hot Water-Fired Absorption Chillers**

Due to the potentially low domestic hot water usage within the building, and having proposed a number of technologies which require a base hot water load throughout the year, consideration is also being given to the provision of cooling by means of a small hot-water fired absorption chiller.

Small commercial systems are currently available with capacities as low as 17.5kW.

Initial thermal modelling indicates potential issues with over-heating in some areas, which could be addressed by means of a cooling system driven by the solar water heating and/or CHP systems.

3.5 **Air Source Heat Pumps**

Consideration has also been given to the use of air-source heat pumps as an alternative means of providing heating, and potentially cooling, within the building, since this is one of the low and zero carbon technologies which will be included within the syllabus of the courses taught.

Consideration would need to be given to how this system might be integrated with other low and zero carbon technologies, due to the differences in heat output generated.

The main potential issue with the use of air-source heat pumps is their use of refrigerant, as it would result in the loss of a number of BREEAM credits which may be required in order to achieve the rating desired.

3.6 **Rainwater Harvesting**

A rainwater harvesting system is to be incorporated within the drainage design, to provide cold water for flushing of WCs and Urinals.

3.7 **Other Low and Zero Carbon Technologies**

Other low and zero carbon technologies have also been considered as part of the high-level feasibility study, but have been determined not to be viable as part of this scheme. These include;

- Biomass Boilers
 - The site has very restricted access for deliveries, and the limited building footprint precludes the inclusion of a plant room at ground floor level.
- Ground Source Heat Pumps
 - The small site does not provide sufficient space for the installation of horizontal 'slinky' ground loops, and the cost of boreholes will be prohibitive.
- Wind Turbines
 - The proximity of an electricity pylon precludes the use of a mast-mounted wind turbine.

4.0 NATURAL GAS

Gas supplies will be required to serve the following areas;

- Plant area
- Science lab / Prep room
- Gas workshop
- Renewables workshop

The gas supply to each of these areas is to be complete with an automatic gas proving system. In teaching spaces, this is to be interlinked with the specialist local fume/exhaust ventilation system to ensure that there is adequate ventilation when gas burning appliances are in use. These automatic gas proving systems are to be capable of modulating the fan speed in response to changes in the volume of gas being consumed.

5.0 DOMESTIC WATER SERVICES

A potable cold water booster set will be provided to serve the domestic cold water system, to ensure that adequate water pressure is available to all areas of the building. This system will incorporate a break tank to provide a nominal level of storage to cover brief periods of peak demand, such as breaks between lessons/seminars.

WC and urinal flushing will be served, via a cold water booster set, from the rain-water harvesting system.

Domestic hot water will be generated by means of a direct gas-fired water heater, incorporating indirect pre-heating by means of one or more of the proposed low or zero carbon technologies which are to be included within the scheme.

In order to maximise the effectiveness of the pre-heating system, the system is to incorporate UV filtration in preference to a high temperature pasteurisation cycle.

6.0 HEATING SYSTEMS

Heating of the building is to be undertaken utilising a low temperature hot water (LTHW) heating system. This system will serve heat emitters throughout the building, which may include one or more of the following;

- Radiators
- Underfloor Heating
- Warm-Air Unit Heaters
- Fan Convectors
- Fan-Coil Units

Low temperature hot water will be generated by means of a high-efficiency gas-fired boiler installation, incorporating indirect pre-heating by means of one or more of the proposed low or zero carbon technologies which are to be included within the scheme.

Air-source heat pumps are also being considered as an alternative means of providing heating within the building, subject to BREEAM credit requirements being agreed.

7.0 VENTILATION SYSTEMS

7.1 General Ventilation

Extensive consideration has been given to the relative benefits and drawbacks associated with both Mechanical and Natural ventilation systems and their application as part of this scheme.

While natural ventilation is typically perceived as the low-carbon option, it presents a number of issues which may result in increased energy consumption over the life of the building due to difficulties in controlling the ventilation rate and achieving any meaningful form of heat recovery.

By providing a tightly sealed and well insulated building, a high efficiency heat recovery ventilation system will provide the correct ventilation rates while ensuring that minimal heat input is required once the building is up to temperature. During the summer, a heat recovery system will also recover cooling energy and thus ensure that minimal additional cooling energy is required once the spaces have been cooled to the correct temperature.

It is therefore proposed to provide mechanical ventilation to meet the ventilation requirements associated with the building occupants, incorporating high-efficiency heat recovery. The system is to incorporate air quality sensing, to enable the ventilation rates to be modulated in response to building usage.

A high efficiency WC extract system will be provided to serve sanitary facilities located adjacent to the stair core on each floor of the building.

7.2 Specialist Ventilation Systems

7.2.1 Flues and Chimneys

Flues and chimneys are to be appropriately sized to suit the appliances served, and positions agreed in conjunction with the architect.

In teaching spaces where there are multiple gas-burning appliances installed, an appropriate fume/exhaust extraction system is to be provided. Such systems are to be interfaced with automatic gas proving systems that are to be capable of modulating the fan speed in response to changes in the volume of gas being consumed. Discharges from common flues and flue dilution systems will be located at roof level.

7.2.2 Fume Cupboards and Extract Hoods

Fume cupboards are to be provided within the laboratory prep room and within the laboratory area itself. It is currently anticipated that these units will have individual discharges at roof level.

8.0 AIR-CONDITIONING SYSTEMS

While air-conditioning is not traditionally associated with low-carbon buildings, this scheme provides an opportunity to explore more innovative approaches to the design of such systems. One such technology is solar cooling, utilising the hot water generated by a solar thermal water heating system to generate chilled water by means of an absorption chiller.

Absorption chillers are typically associated with large-scale industrial applications, but recent developments in the technology have resulted in units with cooling outputs as

low as 17.5kW becoming available. It is, therefore, a viable technology in small commercial applications.

By using solar thermal water heating and electricity from solar photovoltaics, it is therefore possible to achieve a zero-carbon air-conditioning system. However, it is unlikely that sufficient photovoltaics will be installed as part of this scheme to serve all of the pumps and other ancillary devices associated with the system and there will therefore be some carbon emissions attributed to the air conditioning.

One of the important factors of incorporating solar cooling within the building is that the provision of a comms/server room cooling system will ensure a reliable year-round base load for the solar thermal water heating system.

The chilled water generated by this system would be used to provide cooling throughout the building, utilising one or more of the following systems;

- Fan-Coil Units
- Passive chilled beams

An air-source heat pump unit would be utilised to provide comms/server room cooling should a cooling system not be implemented elsewhere in the building.

9.0 BUILDING ENERGY MANAGEMENT SYSTEMS AND CONTROLS

The building is to be operated by means of a central Building Energy Management System (BEMS), linked back to the head-end PC located within the facilities department at Cambridge Regional College. Overall local control of the building will be provided via a touch-screen display interface unit, to be located within the administration office.

The BEMS System shall provide temperature and time schedule control of all mechanical systems. All sensor values, meter readings, plant status and alarm conditions shall be monitored, logged, prioritised and recorded by the BMS System.

Generally the systems will be operated in accordance with an overall time schedule, adjusted to achieve optimum start based on temperature conditions, with the facility to extend the operation of the systems if required to accommodate extended opening for evening events.

10.0 POWER INSTALLATIONS

10.1 Electrical Switchgear and Distribution

A main LV switchboard will be provided in an LV switch room within the Building. The main LV switchboard will be of Form 4 Type 2 construction. Outgoing circuits will be protected by either moulded case circuit breakers or fuse switches. Outgoing devices will provide supplies to distribution equipment, mechanical services equipment, lifts and other loads via steel wire armoured cables.

Power factor correction equipment will be installed in the LV switch rooms to achieve a power factor of 0.95. Surge protection will be provided to the main LV switchboard.

Distribution boards shall be strategically located throughout the building to serve final circuits. They are to be fitted with miniature circuit breakers, shall be wall mounted and, where possible, located within lockable service cupboards.

10.2 **Small Power**

Socket outlets will be provided to all areas, generally mounted on dado trunking around the perimeter of rooms.

The precise requirements for socket outlets and other small power provision is to be determined as part of the room data sheet development process.

Power will be provided to suit equipment layouts within specialist areas such as laboratories and workshops.

11.0 **LIGHTING INSTALLATIONS**

11.1 **General Lighting**

New lighting shall be provided to the building to comply with the requirements of CIBSE Lighting Guides and Codes and BS EN 12464-1:2002.

Generally luminaires will have linear or compact fluorescent lamps, recessed into suspended ceilings or suspended in workshop areas. Tungsten halogen lamps will only be used for display lighting in limited areas and will not be used for general lighting.

11.2 **Emergency Lighting**

Emergency luminaires are to be provided throughout the building to provide safe egress from the building.

An emergency lighting system with battery autonomy of 3 hours shall be provided. This can be provided by either a central battery system or by using self contained integral battery packs. The costs and benefits of both systems will be further investigated during the detailed design phase.

11.3 **External Lighting**

External lighting will be required to provide amenity lighting to the building. Lighting will be provided by bulkhead type luminaires and low level bollard type luminaires.

12.0 **STRUCTURED WIRING INSTALLATIONS**

The systems within the new building are to be interfaced with the Cambridge Regional College network. This is to be investigated further during the detailed design process to determine whether a hard-wired connection can be achieved, or whether some form of wireless transmission will be required. If ducts can be routed under the guided busway, then a fibre connection is probably the preferred option.

It is envisaged that a structured wiring system and associated hardware will be provided to the building. This will be designed as a Category 6 system, which provides a reasonable level of performance where data use is not intensive.

A complete and continuous containment system will be provided for the structured wiring installation, generally comprising open cable basket, trunking and conduits.

13.0 SECURITY SYSTEMS

13.1 Fire Alarm

An automatic fire alarm system will be provided to the building in accordance with BS5839:2002. The precise level of coverage will be determined by a risk assessment during the design process. It is, however, envisaged that a Category L2 system will be provided.

The fire alarm system will be analogue addressable with control panels located within the main entrance area(s).

The system shall be linked to the Cambridge Regional College fire alarm system, subject to there being spare capacity on the system.

13.2 Intruder Alarm

An intruder detection system shall be provided to the building. At this stage it is envisaged it will cover the building using PIR detection in each ground floor room with window and door contacts on external doors and opening windows.

13.3 CCTV

A CCTV system shall be provided to cover the entrance to the building and the car park. The system shall be connected to the existing Cambridge Regional College monitoring station.

14.0 LIGHTNING PROTECTION

A lightning protection system shall be provided to meet the requirements of BS6651. It is envisaged that an externally fixed conductor network tape will be provided at roof levels. Where practical the system will use the building structural elements, such as columns of a steel frame, with test and inspection pits at ground level.

Electronic surge protection will be provided at key points in the electrical distribution system.