Sutton Bonington Campus

Vet school Building

Energy Survey Report

Prepared by: **Martin Oakes**

Carbon Reduction Manager

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Summary of potential energy savings

Opportunity	Description	Estimated annual savings			Estimated Cost (£)	Payback (years)
		KWh	£	CO2 t		
1	Turn CT heating off when outside temp exceeds 18C (Vets)	4,074	£492	0.5 t	none	n/a
2	Cooling set point 23°C instead of 21°C	12,857	£1,856	1.3 t	none	n/a
3	VT heat off as ext'n temp exceeds 15C (Clinical)	680	£98	0.07 t	none	n/a
4	Reinstate operation of AHU 1 (Clinical) heat recovery coils	51,148	£2,295	10 t	none	n/a
5	Turn DHW pump off overnight	15,202	£873	2.8 t	none	n/a
6	Labs temp set p reduced to 17C overnight	83,257	£3,748	17.1 t	none	n/a
7	Cooling valve passing on 2 AHU's	117,906	£8,365	14.3 t	none	n/a
8	Replace lamps with LED using same light fittings	134,960	£19,569	13.5 t	£126,600	6 years
8a	Replace complete fitting with LED	134,960	£19,569	13.5 t	£360,000	18 years
9	Convert 12 fume cupboards to VAV system	164,063	£10,597	28 t	£125,000	12 years
10	Supplementary heat pumps	141,000	£3,158	28 t	£576,000	185 year

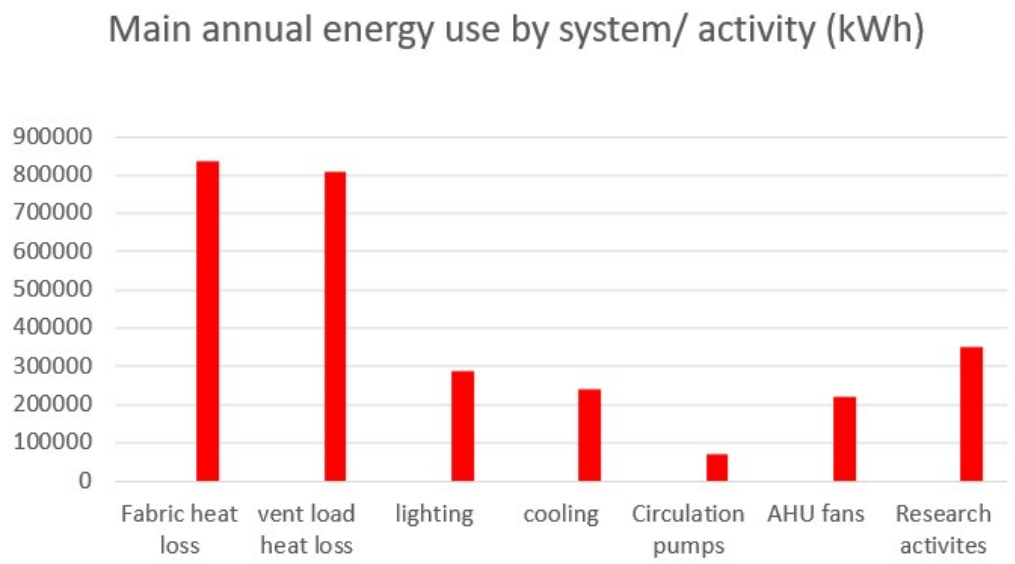
Carbon emissions based on predicated UK average power generation emission factor over the next 12 years
Based on commodity cost of 4.5p/kwh for gas and 14.5p/kWh for Electricity

Background

The Vet School is part of the School of Biosciences and is a heavily serviced, high energy use teaching and research building. Average annual energy and water consumption, current utility cost and scope 1 and 2 carbon emission are shown below and include gas and electricity to the attached glasshouse. Energy use is 157kWh/m2 for electricity and 176kW/m2 for natural gas with typical CIBSE benchmark annual energy use for this type of building of 190kWh/m2 for electricity and 220kWh/m2 for natural gas.

Electricity	1,650,000 kWh, £239,250, 315 t CO2
Natural Gas	1,850,000 kWh, £83,250, 342 t CO2
Water	1,080,000 Lts, £2,484

The main energy consuming systems and activities are shown below, the greatest being the heating energy required for the fabric heat loss and the large ventilation systems that serve the building, followed by research activities and electrical energy consumed by the various building services systems.



Utilities

The electrical supply to the building is from the 11kV substation 5 and consists of 1,250amp 3 phase supply serving a 800amp and 400amp 3ph supplies to the main teaching block, 630amp 3ph to the roof top chilled water plant and a 400amp 3ph supply to the Clinical wing. In addition, there is an independent electrical supply provided by a standby 400Kva generator to serve essential services throughout the building should the site mains fail. The Clinical block also has 1000m2 of roof top solar PV that generates an average of 125,000kWh of electricity each year.

The teaching block is served by a 125mm diameter gas supply from an external meter housing and supplies, heating boilers, water heating boiler and gas use within laboratories.

Mains cold water service is via a 54mm rising main at the rear of the teaching block and a 54mm at the side of the clinical block that serves break tanks in small ground floor plant rooms in each block.

Building Management System

The majority of the building services systems are contolled by BMS panels located in the roof top plant rooms of both the teaching and clinical blocks. The controls include contstant temperature heating (CT) and weather compensated varibale temperature (VT) heating circuits, domestic hot water, chilled water plant and circulation pumps and numerous air hanling plant with assoicated 3 port heating and cooling control valves. The control panels are all networked to provide remote access for adjustment and monitoring along with alarms where approriate.

Building Fabric

The building has a total internal floor area of 10,504m2 with the teaching block covering 6736m3 over 3 story with roof top plant room and the single storey clinical block of 3768m2. There is approx. 2,340m2 of lab area, 2,580m2 of office/ seminar type space, 360m2 of lecture theatre and 430m2 of plant room. Constructed in 2005 with typical U values of 0.6w/m2K for the walls, 0.4 w/m2K for the roof, windows of 3.0 w/m2K and average floor U value of 0.6w/m2K with the Clinical block extended by approximately 230m2 in 2018. The teaching block benefits from external solar shading on the south east and south west elevation glazing to reduced solar gains during the summer months.

Heating

The heating system consists of 4 x 300 kW gas fired Broag Remeha Eco 310 LPHW boilers located in the teaching block roof top plant room and provides constant temperature (CT) heating circuit serving air handling units, reheat coils, fan coil units and radiator circuits via a variable temperature (VT) weather compensated circuit in the clinical block. The circulation is provide by run and standby duty Grundfos LPD65-230-2 inline pumps with motor rating 3kW for both the teaching and Clinical blocks together with dedicated boiler shut pumps Grundfos TP65-60/4 inline pumps with motor rating of 0.55kW. The clinical wing also has separate VT heating circulation pumps. Annual energy consumption for the boilers is estimated to be 1,650,000 kWh together with 68,500 kWh of electrical energy for the circulation pumps.

Gas fired boiler plant locate in the roof top plant room of the teaching block

The boilers are due for replacement this autumn under the capital backlog replacement programme and should save around 30,000 kWh. There was an option to provide additional supplementary heat pumps to provide heating through the mild months of the heating season, however this was ruled out due to the high life time cost per tonne of carbon saved.

Constant temperature heating circulation pumps teaching block

As there are no strict requirements for humidity control from this system and no domestic hot water primary circuits it is recommended the CT pumps serving the teaching block are turned off when outside temperature exceed 18°C. This will save 3,150 kWh of electrical energy and also standing heat losses on the distribution pipework of around 950 kWh.

Cooling

The building is cooled by a 4 x 245kW centralised roof top chillier that provides chilled water to air handling units and fan coil units for both the teaching and clinical blocks. The circulation is provide by run and standby duty Grundfos TPD 100-170 inline pumps with motor rating 5kW via variable speed inverter control for both teaching and clinical blocks and 4 chiller shunt pumps Grundfos TP80-70/-4 with motor rating 1.1kW.Total annual electrical energy consumption for the chiller and pumps is around 238,560 kWh There is an opportunity to reduce energy use by increasing the cooling temperature set point from 21°C to 23°C and will save an estimated 12,875 kWh of electrical energy used by the chillers. There are also a small number of DX split cooling units serving localised high heat gain spaces such as wiring centres etc.

Roof mounted chillers teaching block

Ventilation

The teaching block is served by 5 air handling units, AHU's 1 and 3 serving mainly lab areas (4m3/sec each), AHU 5 serving lab area B07 (1.07m3/sec), AHU 6 serving seminar rooms etc on A and B floors (1.07m3/sec) and AHU 7 serving the main lecture theatre (4m3/sec). AHU's 1 and 3 and extract airs units 2 and 4 operate to time schedules as dictated by the BMS and linked via run around coil heat recovery systems. AHU's 5, 6 and 7 operator to time schedules with the lecture theatre AHU 7 having the addition of thermal wheel heat recovery and PIR occupancy control. The Clinical block is served by AHU's 1 and 2 (4.13 and 3.7m3/sec) serving main lab areas and operate to time schedules as dictated by the BMS and linked via run around coil heat recovery systems. The reminder of the supply air is balanced by the extract air from 12 fume cupboards. These fume cupboards would benefit from a conversion to variable air volume extract system to reduce energy consumption when the sash is in the lowered position which enables supply air volumes to be reduced by around 75% and would save an estimated 164,063 kWh of energy.

On close inspection of the BMS it was noted that the cooling valve was passing on the clinical block AHU1 and the teaching block AHU 2 resulting in additional heating requirement. The net effective of this is to increase the annual energy use by 86,878kWh of heating and 31,281kWh electrical energy for the chillers.

Ventilation air handling units roof top plant room and lecture theatre roof teaching block

Hot water service

Domestic hot water service is provided by 2 Gas fired water heater Lochinvar LGC 380-560 CE each rated at 29kW with 388 litres located in the roof top plant room and serves the teaching block. The Clinical block has it's own hot water generating plant consisting of 2 x 1000 litre storage calorifiers with heat source from the teaching block CT heating. Based on daily water consumption of 4,000 litres the systems annual energy consumption is estimated at 68,675 kWh. Other energy use associated with this system include the standing heat loss on the insulated circulating flow and return system pipework, estimated at 18,845 kWh and the circulation pumps at 4,821 kWh. There is an opportunity to reduce these operating standing losses over night and at weekends simply by turning the circulation pump off during these out of hours periods. This would achieve annual savings of 3,088 kWh of energy used by the circulation pump and approximately 12,114 kWh of heat loss on the circulating distribution pipework. This change in operational control would require sign off/ agreement from our compliance team to ensure we are not compromising any water hygiene requirements.


Hot water heaters roof top plant room teaching block hot water calorifiers in the clinical wing

Cold water service

The cold water service enters the teaching block via 54mm rising main to a ground floor plant room to serve storage tank of capacity of total capacity 16,000m3 segregated 10,000L for domestic water and 6,000L for lab cold water service. The outlet from the tanks is boosted via 2 pump sets, each with 3 x 1.1 kW rated motors to provide pressurised water at 3.5 Bar with total estimated annual energy consumption of 308 kWh

The cold water service enters the Clinical block via 54mm rising main to a ground floor plant room to serve storage tanks of capacity 4,000L for domestic water and 6,000L for lab cold water service. The outlet from the tanks is boosted via 2 pump sets, each with 3 x 1.1 kW rated motors to provide pressurised water at 3.5 Bar with total estimated annual energy consumption of 240 kWh

Lab and domestic water pumped booster set ground floor plant room teaching block

Lighting

Lighting throughout the building is 95% florescent light source with a combination of 600mm and 1200mm fittings with T5 and T8 lamps, compact fluorescent, wall mounted or recess down lighting fluorescent. Annual energy consumption is significant and estimated to be around 286,750 kWh. It is recommended that the light source is replace with LED and there are 2 options available, either complete light fitting replacement or replacement of lamps with direct LED equivalent. Both achieve similar energy saving, but the option to replace the complete fitting is considerable more expensive and disruptive. Either option would achieve annual savings of around 135,000 kWh.

Lighting in an office and the lecture theatre of the teaching block

Compressed air and Vacuum service

Both blocks are served by an 11kW air compressors and 2.2kW vacuum generator located in the Teaching block roof top plant room and provide service throughout the buildings via distribution pipework. Operation of these system and associated energy use is relatively low due to the overall limited demand throughout the building and is estimated to be 3,300 kWh per annum.

Air compress and vacuum generator located in roof top plant room of the teaching block

Laboratory equipment

There is a significant amount of specialist equipment used throughout the main laboratory areas including, -80C freezers, incubators, autoclaves, centrifuges and drying cabinets/ ovens etc. which in total are estimated to consume around 300,000 kWh annually. Survey and use of laboratory equipment is underway as part of the LEAF initiative for sustainable labs with the aim to reduce unnecessary energy consumption.