Sutton Bonington Campus

Plant Sciences Building

Energy Survey Report

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Carbon Reduction Manager

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Summary of potential energy savings

Opportunity	Description	Estimated annual savings KWh	£	CO2 t	Estimated Cost (£)	Payback (years)
1	Turn CT heating off when outside temp exceeds 18C	12,550	£1,813	1.3 t	none	n/a
2	Cooling set point 23°C instead of 21°C	9,843	£1,427	1.1 t	none	n/a
3	Reduce air supply volumes by 10%	83,948	£9,076	21.5 t	none	n/a
4	Reinstate operation of AHU heat recovery coils	500,417	£22,518	93 t	£8,000	< 1 year
5	Convert to electric water heating	8,861	-£4.431	5.4 t	£35,000	n/a
6	Replace lamps with LED using same light fittings	46,860	£6,795	4.7 t	£46,500	7 years
6a	Replace complete fitting with LED	46,860	£6,795	4.9 t	£150,500	14 years
7	Replace main glasshouse lighting with LED	53,600	£7,772	5.4 t	£175,000	22 years
8	Supplementary heat pumps	190,000	£1,780	56 t	£616,000	342 year

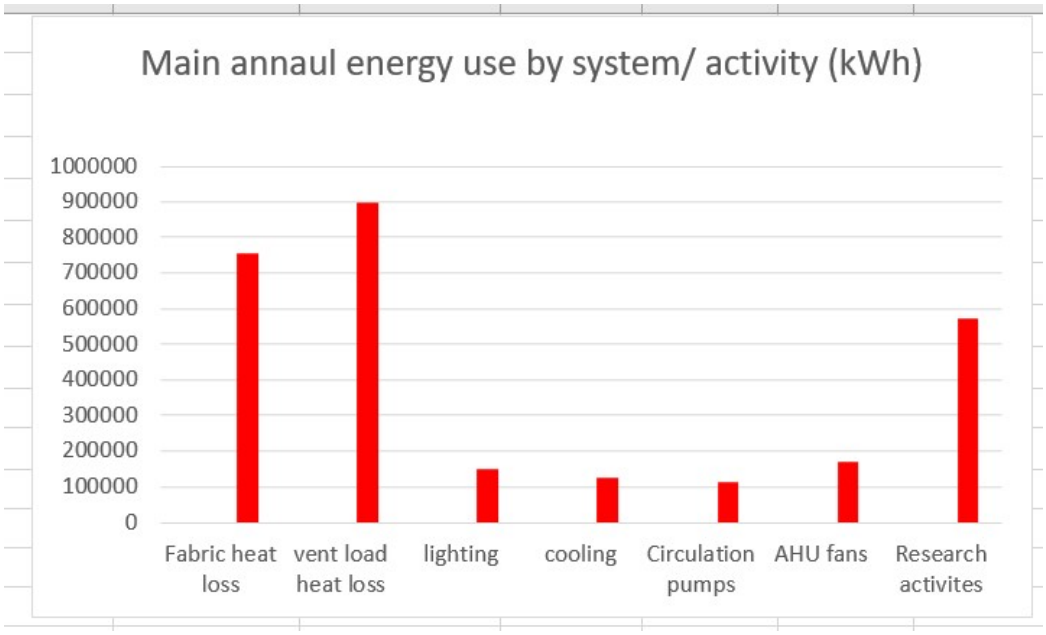
Carbon emissions based on predicated UK average power generation emission factor over the next 12 years and fixed emission factor for combustion of natural gas

Background

Plant Sciences 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.

Electricity	1,250,000 kWh, £181,250, 239 t CO2
Natural Gas	2,150,000 kWh, £96,750, 378 t CO2
Water	1,860,000 Lts, £4,092

The main energy consuming systems and activities are shown below the greatest being the heating energy required for the large ventilation systems that serve the building, followed by the fabric heat loss, 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 4 x 600amp 3 phase supplies serving, switchboard A, switchboard B, Mechanical services panel and a dedicated supply to the large roof top chiller. In addition, there is an independent electrical supply provided by a standby generator to serve essential services throughout the building should the site mains fail.

The building is served by a 100mm diameter gas supply from an external meter housing and supplies, heating boilers, water heating boiler and gas use within laboratories. The gas supply also feeds a small plant room at the rear of the building via a 65mm main to serve heating boilers for the glasshouse.

Mains cold water service is via a 54mm rising main at the front of the building that serves 2 break tanks in the main plant room.

Building Fabric

The building has an internal floor area of 4069m2 over 2 story with intermediate plant room level between the 2 floors , with approx' 2200m2 of lab area, 1350m2 of office type space and 500m2 of plant room. Constructed in 2001 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. The building benefits from external solar shading on the south east elevation glazing to reduced solar gains during the summer months.

Heating

The heating system consists of 6 x 200 kW gas fired Hamworthy Wessex LPHW boilers providing constant temperature heating circuit serving air handling units, reheat coils, fan coil units and radiator circuits via a variable temperature weather compensated circuit. The circulation is provide by run and standby duty Grundfos LPD100-200-164 inline pumps with motor rating 11kW via variable speed inverter control. Annual energy consumption for the boilers is estimated to be 1,800,000 kWh together with 85,000 kWh of electrical energy for the circulation pumps.

The boilers are due for replacement under the capital backlog replacement programme and should save around 90,000kWh. 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.

As there are no reheat requirements for humidity control or domestic hot water requirement from this system it is recommended the pumps and boiler are turned off when outside temperature exceed 18°C. This will save significant electrical energy of up to 11,500 kWh and also standing heat losses on the distribution pipework of around 1050kWh.

Cooling

The building is cooled by a large 500kW centralised roof top chillier that provides chilled water to air handling units and fan coil units. The circulation is provide by run and standby duty Grundfos LPD 125-200-183 inline pumps with motor rating 18kW via variable speed inverter control. Annual electrical consumption energy is around 120,000 kWh and this has recent been reduced by increasing the cooling temperature set point from 21°C to 23°C and will save an estimated 9,842 kWh of electrical energy used by the chillers.

Ventilation

The main lab areas are served by 2 large air handling units (11m3/sec each) and one smaller units (1.7m3/sec) that serves the office accommodation on the first floor. There are also 2 extract units and 16 fume cupboards that balance air volumes of the supply air handling units. The 2 large lab units include variable speed inverter control to enable reduced operating speed overnight from 70% during day to 40% overnight. Due to the high air change rates during the day (7.7 AC/hr) there is the opportunity for the air supply volume to be reduced by 10% saving an estimated annual energy demand of 83,948 kWh.

There are also heat recovery run round coils on the 2 lab supply and extract systems which are currently not operating, requiring service/ maintenance, which should reclaim about 50% of the required heat energy. Annual energy saving potential is a very significant 500,417 kWh.

Hot water service

Domestic hot water service is provided by Gas fired water heater Hamworthy Dorchester DRLA rated at 58kW with 317 litres of storage together with 1,450 litre additional storage vessel. Based on daily water consumption of 3,000 litres the system annual energy consumption is estimated at 51,000 kWh. Other energy use associated with this system include the standing heat loss on the insulated circulating flow and return system pipework, estimated at 5,940 kWh and the circulation pump at 1,578 kWh. Replacing the gas fired with new direct electric emersion heater cylinder would reduce energy use by around 8,861 kWh and carbon impact but would cost significantly more due to the cost difference between unit cost of gas to electricity.

Cold water service

The cold water service enters the building via 54mm rising main to the plant room and splits to feed 2 storage tanks, nom 7500L for Lab and domestic hot water and nom 4500L for general cold water service. The outlet from the tanks is boosted via pumps sets, rated at 1.5 kW and 1.1 kW to provide pressurised water at 3.5 Bar with total estimated annual energy consumption of 369 kWh

Lighting

Lighting throughout the building is all 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 120,000 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 47,000 kWh.

Compressed air and Vacuum service

The building is served by 3 x 1.1kW air compressors and 1 x 1.5kW vacuum generating plant that provide service throughout the building via distribution pipework. Operation of these system and associated energy use is relatively low due to the overall limited demand throughout the building.

Glasshouse

There is a large glass house, nom 34m x 19m, attached to the rear of plant sciences that is heated from 2 Hovel SR plus LPHW boilers located on the ground floor at the rear of the main building with gas supply from the building. Although there is no separate metering information available for these boilers annual gas consumption to heat the glasshouse is estimated to be 320,000kWh. The glasshouse is served by a dedicated 415v, 3phase, 125 amp electrical supply as there are high levels of lighting required currently provide by 140 x 400 watt high pressure sodium (Son T) lamps with around 2,400 operating hours annual energy consumption is 134,400kWh. To replace these fittings with specialist LED light source units would save approximately 40% of the annual energy use or 53,600 kWh.

Growth rooms

There are 8 temperature controlled growth rooms that operate with lighting on for 16hrs per day and have high intensity lighting and cooling to maintain suitable growing conditions served by a dedicated 415v, 3phase, 200 amp electrical supply. Lighting for most of these rooms is provided by 72 x Philips Master TL-D 70w /835 (5kW lighting load per room) which together with the cooling load gives an estimated annual energy of 270,000 kWh. There is scope to replace the 70 W Philips fluorescent tubes with LED equivalent but this is subject to successful completion of growth trials to ensure the LED light spectrum is suitable.

Laboratory equipment

There is a significant amount of specialist equipment used throughout the main laboratory areas including, -80C freezers, cold rooms, incubators, laminar flow hoods, autoclaves, centrifuges and drying cabinets/ ovens etc which in total are estimated to consume around 200,000 kWh annually.