84% financial energy savings and improved indoor air quality for University of Cambridge traditional lecture theatre

Our customer

All large and complex organisations have a massive impact on the environment, and the University of Cambridge is no exception. This can often make finding the appropriate environmental solutions extremely difficult, as it is rare that one approach alone can tackle a multitude of energy and carbon reduction problems. At the University of Cambridge one such problem to tackle is the approximate £1,825 spent every hour on energy whilst still providing the best learning environments and minimising disruptions. Consequently, the University of Cambridge have dedicated staff and engineers working around the clock to solve operational inefficiencies while maintaining the high operational standards expected by academics, researchers and students.

The problem

Following conversations with our customers and peers one concern that keeps resurfacing is the difficulty of knowing, in real-time, how many people are occupying a room. This is especially relevant for rooms such as lecture theatres, which have very variable occupancy levels, large volumes of air to condition and, usually, a sedentary audience. Controlling these rooms presents a challenge for setting time schedules and AHU speeds for ventilation controls and lighting.
Appropriate adjustments and close management in conditioning these spaces can reduce energy wastage, improve internal air quality conditions and fulfil thermal comfort requirements. All these features create a healthier working environment, which directly affects occupant's wellbeing and productivity levels.

Together with the University of Cambridge Estate Management we began a pilot for demand based ventilation in the Biffen lecture theatre (with a capacity for 170 people). The goal was to uncover more opportunities for improvement and HVAC automation.

Upon investigation, we found that although there was a manual high/low ventilation switch in the lecture theatre, the standard BMS times schedules did not correlate to when the room was in full use. In addition, the manual switch could be left in high-speed position potentially consuming more energy than required for the size of the audience.

As this was a shared lecture theatre with frequent reoccurring bookings the BMS operatives did not know when the lecture theatre was being used and whilst the room booking system was accurate it did not include the level of occupancy nor was linked to the BMS in case of cancellations or postponed starts. As a result, ventilation was scheduled to run at the same rate each day between 8am and 6pm regardless of the room's usage density.

The solution

Although timers or BMS schedules do help minimise energy wastage over manual controls during a standard 24-hour period, knowing in real-time when and how many people are using your room can minimise inefficiencies to a greater extent and enhance occupant's experience. In such large and dynamic spaces CO2 sensors often lag behind actual occupancy due to natural diffusion.

With LightFi's sensor, we were able to control the ventilation based on number of people detected in the room. Biffen lecture theatre has one AHU that feeds the entire room with three fan-speed settings: off, low and high. LightFi sensor fed occupancy data into the BMS, which enabled the AHU to be controlled in stages based on actual room occupancy level: OFF when below 1/3 occupancy, low above that, and high when the occupancy is above 2/3. These numbers can be customized according to individual room size and peak occupancy rate, and they are not fixed to any sensor.

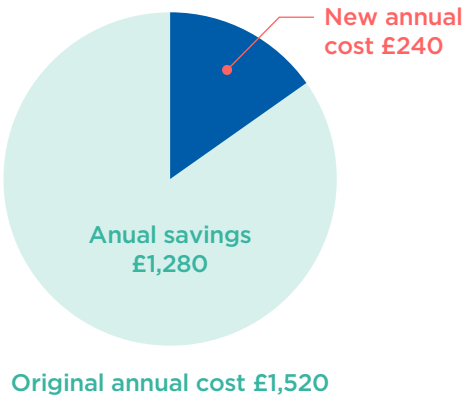
The installation time required to connect LightFi sensors through a cable is 10 minutes. The entire 200 sqm Biffen lecture theatre required one CAT6 Ethernet cable run to connect to Trend BMS via an IQ4E. The real-time control strategy was commissioned on the BMS, on top of the timer schedule, using the output from the LightFi sensor to control the AHU. Clients need to consider these aspects as an added cost for the payback calculation for their projects business case, and may need to hire professionals of their choice.

The result

The result was an 84% annual reduction of energy consumption by the AHU for Biffen lecture theatre.

Our analysis shows that the AHU was originally on for 10 hours daily on weekdays and is now only on for 2.7 hours per day since LightFi sensors were installed.

Original AHU energy use was 12,600kWh per year. In financial terms this is around £1,520 of energy spend per year. The new energy use after our sensors were installed was 2,000kWh per year, or £240 per year, which is approximately 10,600kWh energy saved giving £1,280 financial savings. The payback period for the LightFi system alone is 10 months. If we include the extra Trend hardware, cable run and commissioning time the payback period is 2 years 2 months.



Since we reduced average fan speed, we found that we reduced the air change rate without affecting the indoor air quality and wellbeing, reducing the intake of outside air, and consequently we were able to provide more stable conditions and more energy savings through reduced heating and cooling needs in the winter and summer.

Alongside the financial gains, the multiple streams of data gathered on our platform, through our environmental sensor widget, also revealed some potential health findings. The efficient adjustment and control of room ventilation, especially during peak occupancy hours lead to lower levels of CO2 and VOCs in the air which will improve internal air quality conditions.

As a result, we were simultaneously able to reduce energy consumption and improve the air quality conditions creating a healthier and more productive space that fulfils all of our client's needs.