

## Background

The Charterhouse is a former Carthusian monastery in London to the north of what is now Charterhouse Square. Since the dissolution of the monasteries in the 16th century the house has served as a private mansion, a boys' school and an alms-house which it remains to this day. Currently there are over 40 brothers (the residential community of single men over sixty years of age) living at the Charterhouse.

From 2014 to 2015 the building underwent a major mechanical and electrical systems refurbishment and upgrade.



The main square and building at the Charterhouse (photo credit: the Charterhouse)

## Issues Faced

The original systems comprised of a very old drinking water system that was unsafe to drink without boiling, a central heating system and hot water generation fed from a central boiler plant along with large constant flow pumps and antiquated controls, all of which failed to maintain the building at an even and comfortable temperature. The centralised hot water distribution and the associated outdated pipework presented many problems with regards to legionella control. The design of this was such that it required constant monitoring and involved a lot of man hours to ensure the safety of the residents.

Furthermore the building contained old, inefficient filament lamp lighting which was not controlled and was often left on when not in use, significantly increasing electricity consumption.

## Actions Taken

The Charterhouse has recently undergone a major mechanical and electrical systems refurbishment and upgrade. The primary objective of this project was to modernise the building so that it delivered safe drinking water, enhanced comfort through the building and provided a safer and more simplified hot water delivery system.

It started in early 2014 and the project completed in September 2015 costing £2.2 million. It was a complex project involving work to a Grade I listed building and involved the entire mechanical and electrical services being removed and replaced with more modern and efficient systems. All of this work was carried out whilst the building was fully occupied, presenting further challenges.

The new central heating design included variable speed pumps, thermostatic control valves on the radiators and a fully optimised and weather compensated building management control. The old hot water delivery system was scrapped in favour of instant hot water heaters at point of use.

New drinking water tanks were fitted with pressurised variable stage speed valves, a booster delivery system and new distribution pipework which feed every room in the building.

The old lighting system was upgraded with state of the art LED lighting which modulates light levels and responds to occupancy presence. New emergency lighting systems and fire alarms were also installed.

**The Outcomes**

Comfort of the Charterhouse

The work certainly met the objectives of delivering safe drinking water, enhanced comfort, and a secure and more simplified hot water delivery system which will help ensure the building can remain a quality, secure almshouse for the brothers going well in to the future. The feedback from those living within the house has been highly positive.

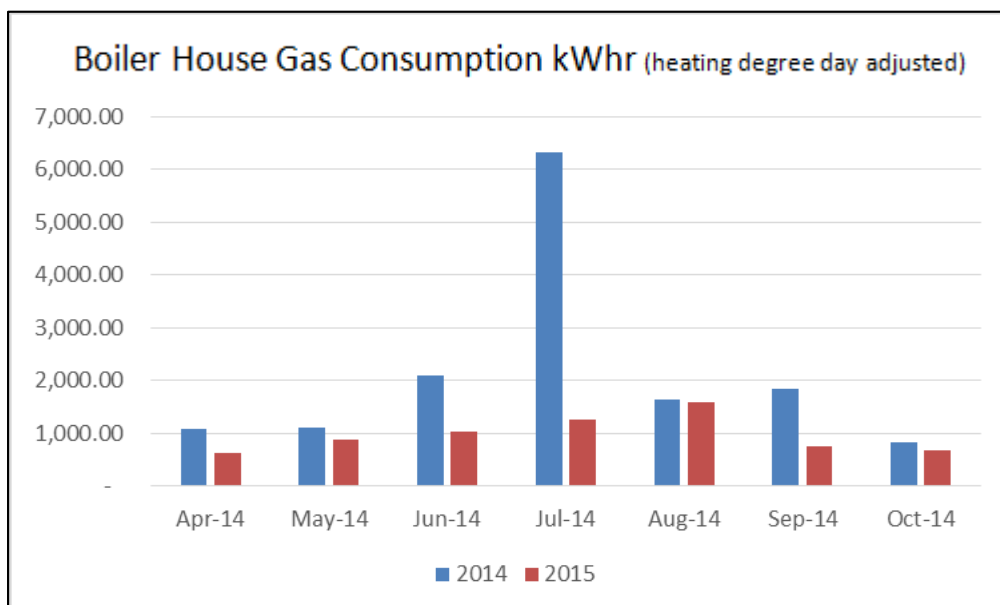
In addition the interaction between the brothers and the project workers on a daily basis was hugely enjoyed by both the brothers and the workers themselves; so much so that two of the project workers subsequently applied for posts on the maintenance team at the Charterhouse!

Gas Consumption

Early indications show that the Charterhouse is tracking a consumption reduction of around 40% compared to the periods April to October 2014 and April to October 2015.

The adjusted heating degree day consumption, a measure which takes in to account outside air temperature, shows that in 2014 the building consumed 14,902 kWhrs/degree day heating, whilst in 2015 the same period showed a consumption of 6,182 kWhrs/degree day heating.

The following graph shows the comparison between the heating degree day consumptions in 2014 and 2015. It is noteworthy that during this entire period of 2014, the system was under refurbishment and so the exact reasons for the anomaly in July are unclear and may have been due to commissioning issues.



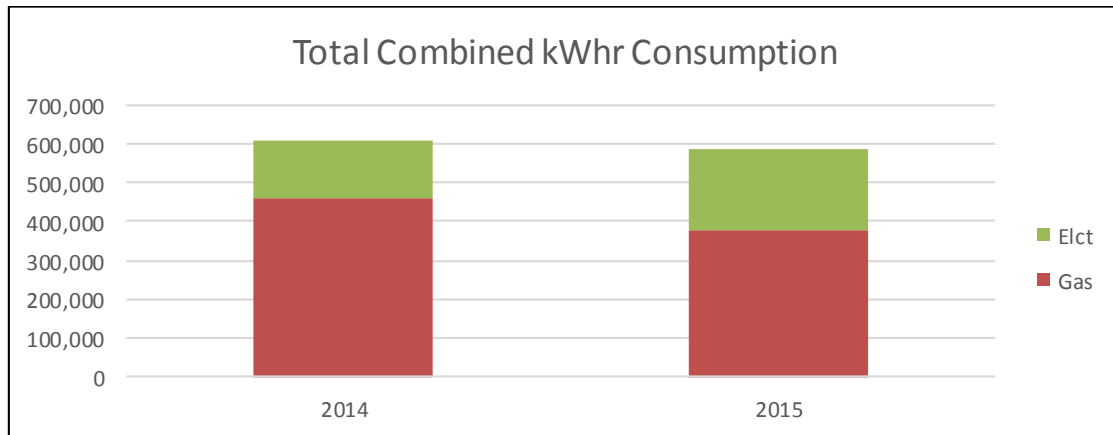
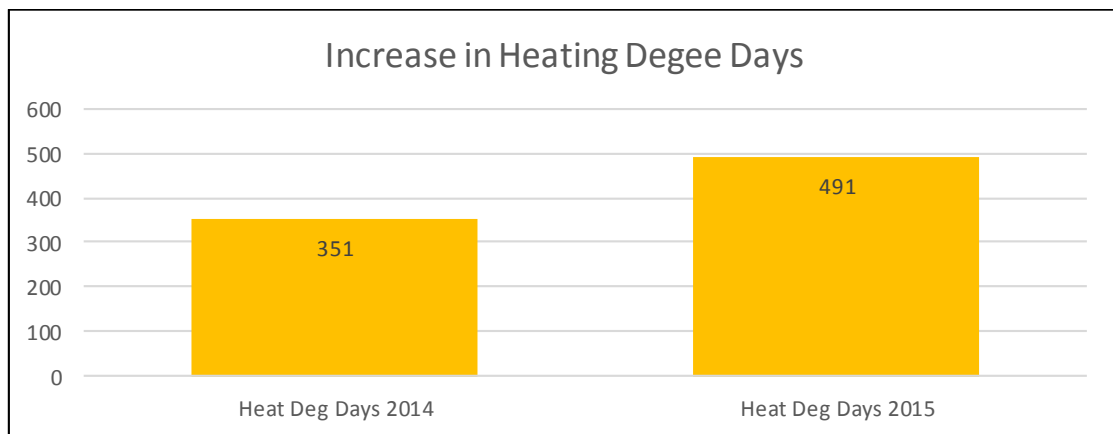
There is an anomaly in August 2015 when consumption almost equalled the same period in 2014 which is attributable to a malfunction of the main heating valve. This was spotted and diagnosed with the help of the new building monitoring system and promptly rectified.

Electricity Consumption

The comparable electrical consumption has increased somewhat for the same period. However the metered electrical system distribution for this building includes other buildings on the site including a nursing home/infirmarary and it is not easy to see at this point how much of the increase is due to other buildings. The increase is also likely to be partly due to increased corporate events in the evenings and weekends in the main building compared to 2014. It is hoped to install more sub metering in this area in the future to get a better picture of where the consumption is being used.

Overall Energy Consumption on the Site

Taking in to account the increase in electrical consumption already mentioned, the overall combined gas and electricity kWhr consumption on the site has still reduced compared with the same period in 2014 and this is in spite of increased heating degree days in 2015 compared with 2014.



**Ongoing Monitoring and Future Plans**

This current review has revealed further opportunities in relation to energy management and the importance of sub metering and ongoing monitoring of the site’s energy profile. This is particularly important as the Charterhouse is considering the possibility of a ground source heat pump which could provide about 20% of the main building’s heating requirements. The heat pump can

potentially exploit ground source heat from the Cross Rail grouting shaft located near the RBS building and there is an exploratory dialogue ongoing with Cross Rail on this matter presently.

Better data is key to managing and understanding where and how energy is used and at the Charterhouse it is hoped to introduce additional electrical sub meters along with the use of a 'energy desktop analysis tool' which will bring together the existing utility consumption data, future sub metered data and the drivers of this energy consumption; therefore allowing informed and early decisions to be made in the future. The sub metering would include the infirmary electrical consumption to be monitored and separated from the main building consumption.

### **Lessons and Ideas**

A major positive throughout the process was to have a professional project manager on site who oversaw the work which meant less strain on the Charterhouse resources and a more efficient project and build run by an expert.

An important lesson for future is to undertake the work when necessary and not delay it. Much of this work could have been completed earlier and would have saved significant costs, maintenance and time over the years.

### **Conclusion**

When Michael Mcnerney from The Charterhouse was informed by the Master that he and the estates staff were still getting used to the idea of a heating system that 'just worked automatically,' he knew the project had been successful. The master further explained that they had spent a lot of time in the previous years 'just pulling levers and resetting buttons to keep the heating working.'

Their energy costs are greatly reduced and their carbon footprint has decreased. The brothers are living in greater security and the Charterhouse can continue to move from strength to strength as a top class historic alms-house.

This case study was collated in January 2016