Energy and Water Technology Optimisation Services - EWTOPS by JBA Consulting

CASE STUDY | ENERGY DATA ANALYSIS FOR THE BEACON AND OCTAGON BUILDINGS, STAFFORDSHIRE UNIVERSITY

Challenge

Staffordshire University commissioned JBA Consulting to conduct a mathematical analysis of the supplied 30 minute gas consumption data for the Beacon and Octagon buildings (two of their largest mixed use buildings). Faced with what the client perceived as an overwhelming quantity of data and a preliminary finding of a higher gas energy usage in 2012 than 2011, Staffordshire University looked to JBA Consulting to provide an explanation. Additionally, the University was looking for JBA to recommend solutions to reduce energy consumption and associated costs, and therefore increase energy efficiency. Lastly, the client was considering purchasing a new control system and wanted quantified validation and confidence to proceed with this purchase.

Solution

To identify the factors behind an increased energy consumption, JBA Consulting conducted a mathematical analysis using data collected by the University over the years. First, the data was normalised using Heating Degree Day (HDD) data, based on the external air temperature. Then, a number of other variables affecting energy usage (i.e. other weather related conditions) were considered. This approach allowed JBA to identify all possible variables driving energy consumption and statistically determine their significance. This multivariate analysis helped determine the weight (significance) of each variable allowing the client to understand which parameters were having an impact on the energy consumption. After identifying significant variables, an iterative review of the data with regards to the significant variables was completed in order to draw further conclusions and make recommendations.

Lastly, once a relationship is established between the factors of influence and the energy demand, the factors of influence are used to calculate the theoretical energy consumption and compared to the actual energy consumption for each 30 minute time step. Errors were then recorded between the actual and theoretical energy values – creating a cumulative sum of errors plot. This analysis can be used to show changes in settings (introduced by the user) or maintenance issues that are leading to reduced efficiency.

Results and analysis

With preliminary findings of a higher gas energy usage in 2012 than 2011, the primary analysis also illustrated a 30% energy efficiency reduction for the Beacon and Octagon buildings in 2012, in comparison to 2011. After normalising the data using HDD, the multivariate and iterative approach was used to obtain the following conclusions:

- There were irregular spikes of gas energy consumption and periods where the energy profiles deviated from the expected shape (based on expected/typical building occupancy).
- Electrical energy usage maintains a high base load year round. As a result, lowering this high base load for the building would increase electrical energy savings.
- There was no correlation between electrical energy consumption and meteorological factors leading to the potential variable of occupancy affecting energy consumption.
- Identified the cause of "out of hours" energy spikes by further analysis of data throughout the working week that illustrated temperature control was becoming less well-defined over the week.

Benefits and recommendations

The conclusion from the mathematical analyses helped Staffordshire University understand their energy profile and data. It was obvious that the University did not need to change the control systems, but to take control of it.

The multivariate and iterative approach helped consider all influencing factors of energy consumption. Consequently, meteorological factors were removed and decreasing temperature control throughout the working week was identified as a significant factor. As a result, the University was able to implement behavioural change programmes to help reduce their energy base load and keep control.

Finally, a cumulative sum of error analysis was introduced to the University to act as a maintenance tool to ensure they maintain an optimum efficiency close to design intent.

Regardless of the industry or process, all factors of energy consumption must be considered. The multivariate and iterative approach is pertinent to identifying the significance of these variables. In the manufacturing industry, variables could include the quality of production product, or the temperature of the storage of raw materials.

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