White Paper – Behavioural Change

Energy Use in Buildings

Energy use in buildings can vary from one building to the next, even two buildings with similar construction can differ dramatically in their use of energy. Three main factors influence the energy use of a building;

- The building fabric and its physical performance relating to the energy efficiency of a building
- The energy system within a building which can comprise of heating systems, mechanical ventilation etc.
- The occupants of a building directly influence the energy use.

With domestic energy use there is a direct connection between the user's energy efficiency behaviour and the cost of energy, however in the non-domestic sector there is often no direct connection to the personal wealth of individual employees/users of those buildings. Some users may have limited influence over the energy efficiency of the buildings, but even when users do have some influence over energy efficiency there may also be a range of behavioural barriers to energy efficiency within non-domestic buildings;

- Lack of interest by users in energy efficiency
- Lack of sharing the objectives (the need behind improving energy efficiency in the building)
- Inertia (this is the way we've always done things)
- Social norms
- Imperfect evaluation criteria (energy bills)
- Split incentives (Improve productivity)

Enabling Behavioural Change

We recommend the first step when pursuing energy efficiency is that a "scoping" activity is undertaken as it can provide an initial sense of issues such as:

- What baselines data exists of energy-related issues
- What issues are stakeholders concerned with in relation to energy? (e.g. issues of comfort, productivity, etc.)
- What agency and control do building stakeholders have over energy (e.g. heating controls)?
- What opportunities for energy savings exist? Which stakeholders have behavioural influence over these opportunities?

In order to enable behavioural change, there is a need to be specific about target behaviours. Rather than speaking generally about saving energy, a goal should identify specific actions by specific people (e.g. energy managers receiving feedback on electricity use and respond to anomalies; office staff switching computers off when they go home).

Capability and opportunity relate to the motivation to carry out a behaviour. For example, a user's capability might be how to operate the heating controls in their room, if the user is too warm and unable to turn down the heating in the room it will in many cases result in that user opening a window. An example of opportunity social opportunity includes whether social norms and expectations support or hinder performance of a behaviour. For example, if the aforementioned behaviour of opening windows when it's too warm in the office becomes the norm, it can become challenging for a single user to break away from this behaviour.

One of the most proven modes of enabling behavioural change is by means of information strategies. Informational strategies aim to change behaviours through the provision of information which can change people's understanding, awareness, norms and attitudes towards energy efficiency.

Feedback measures involve communicating energy consumption to energy users to trigger a change in behaviour. Left to their own devices, users may not know that their usage needs to change, or that they could be saving money from introducing even small measures. Direct feedback can be provided by energy monitoring that is graphically on web-based platforms or mobile apps. Indirect feedback usually comes in the form of usage reports, as part of monthly or quarterly bills. Both methods of feedback are especially effective when they provide comparisons with others, for example, comparing with the energy use for this month last year.

Automation

Automation is becoming increasingly important in energy efficiency discussions thanks to new technologies, ICT, big data and artificial intelligence. These technologies should be used, where possible, to take decisions and manage systems, so that individuals do not have to. Energy management systems are increasingly seen as a solution for improving energy performance, being able to automate the use of energy using smart systems, internet connectivity and artificial intelligence. One of the major benefits of these technologies is that they can circumvent human behaviour, managing energy systems without the need for humans to make decisions and take actions.

Example

Introduction

Tarrant International a haulier based in Cork, they have already taken many steps to minimise their effect on the environment but approached DCSix Technologies in 2020 to peruse improved energy efficiency at the warehouse, garage & offices.

The building occupants will have an impact on energy use through use of appliances, lights and environment controls such as HVAC systems. This use is likely to be influenced by the employee's role, company rules of conduct and normative expectations within the office. Barriers to energy behaviour change may be caused by employees not paying for the energy bill, being unaware of the energy demands of the office, or not seeing any benefit for themselves directly in energy savings.

Typical ways to improve energy efficiency within office buildings to reduce energy consumption are;

- Making changes to the cooling and/or heating set-point temperatures
- Encourage adaptive comfort measures
- Achieving an optimum HVAC operation schedule
- Reducing the number of appliances on 'standby' or left on while not in use
- Upgrade to more energy efficient lighting

Scope

The engagement and interaction began with both the owner and his electrical work contractor discussing the electrical configuration at the depot. From this call and some additional photos provided by Tarrant International we were able to provide a detail and accurate quotation for the planned energy monitoring system. Two Wattrics energy monitoring units were installed within the depot, since then they have been monitoring the energy consumption across 20 different circuits on a combination of single and three phase circuits. The goal was for energy monitoring to be used by as an effective tool to control and reduce energy use at the premises.

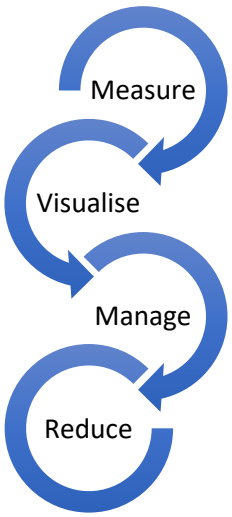

Figure 1

At DCSix Technologies we implement the four-step process shown in Figure 1. The first step to proactively managing energy use is monitoring its use. Effective metering and monitoring give owner's crucial information about how their buildings are performing so that substantial, almost-immediate improvements can be implemented.

In the visualization step, the energy and production information collected in the measurement step must be analysed. Then that information should be visualized by part, product, and equipment.

Energy monitoring can help find the potential for energy reduction, which in turn helps them determine required energy efficiency improvements. Effective energy management requires identifying energy inefficiencies so they can be addressed.

Findings

After leaving the Wattrics units in place harvesting data for one month it was noticed that the baseload at Tarrant International was a substantial, accounting for over 25 kWh/day. After some further investigation it was apparent that a significant amount of this consumption was attributed to the office plugs shown in Figure 2 below. Even at night time when the office wasn't in use the load stayed at around 500W, this definitely not an insignificant load. However, to make change here it would require buy in from staff using the office to reduce the number of devices in the office left on standby overnight.

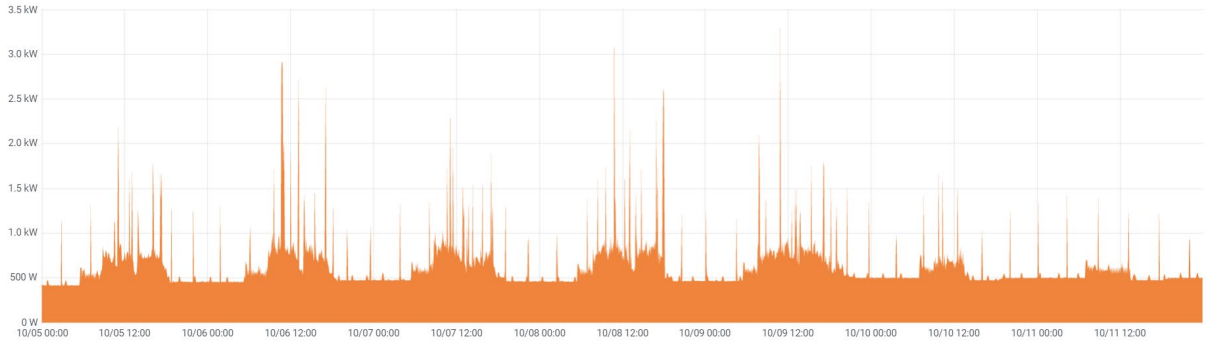

Figure 2

The goal here was to reduce the number of appliances left on or on standby overnight. This would require buy in from all personnel working in the office and a change in behaviour, the first step in enabling this change was the provision of information that would give the personnel understanding and awareness towards energy efficiency.

Direct feedback was provided by giving personnel working from the office access to the Wattrics dashboard. Following feedback with the owner of Tarrant it was decided to customise their dashboard to have a focus on financial indicators as opposed to energy. All of the staff members working in the office we handling the financial operations of the business they were much more familiar with euros and cents as opposed to kW and kWh.

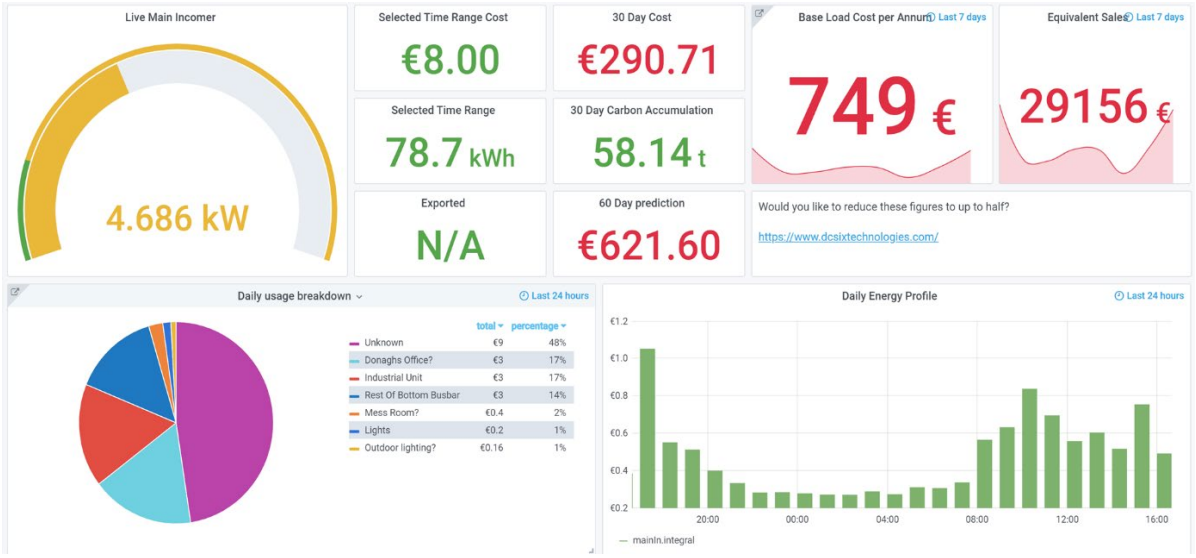

Figure 3

Following this feedback from Tarrant International the dashboard shown in Figure 3 was created. Since the focus was going to be reducing the sites baseload that dashboard was constructed with this in mind, since daily values can seem trivial, we created a panel on the dashboard that showed what the baseload with equate to over a year, small values of a couple of euro a day can quickly add up. To take this one step further we also showed the equivalent sales that would have to be generated to make up for the cost of the baseload based on an average profit margin for this sector.

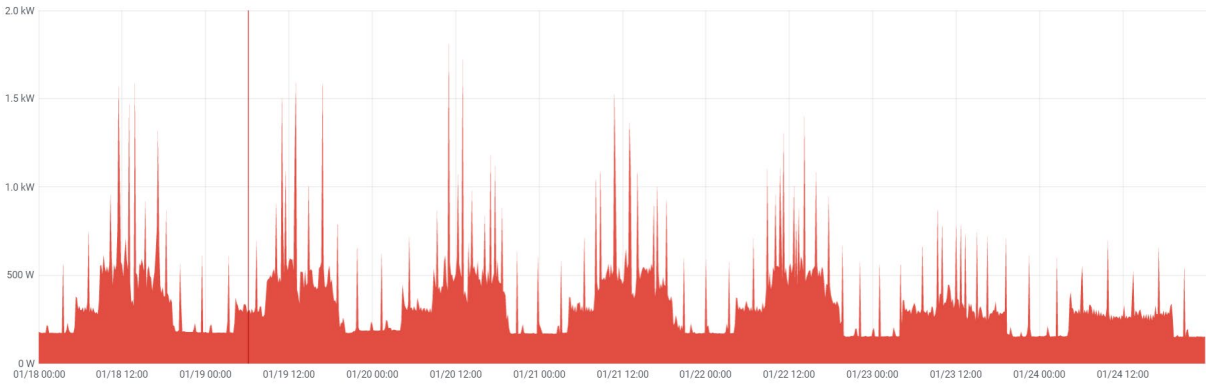

Figure 4

Tarrant International achieved almost immediate energy savings, outside of office baseload dropped to about 175W shown in Figure *4* below, with only essential appliances left on switched on, this equates to an energy saving of about 4kWh/day. It may sound like a modest saving, but it quickly adds up to over €200/ year.

Next Steps

The next area that was looked at was lighting, in January 2020 lighting made up almost 30% of the building's energy needs. Lighting was provided from fluorescent lighting tubes.