DECERNA

Delivering, unlocking & advancing the low-carbon economy

Energy monitoring and metering

CASE STUDY	
Business Type:	Factory
Location:	Hartlepool
Monitoring period:	4 days
Recommendation:	Installation of a diverter valve on extraction shaft allowing for the powering down of one of the extraction systems when demand is low .
Installed cost:	£3,000

ANNUAL SAVINGS	
Electricity:	24,118kWh
Cost:	£3,217
Carbon:	7.2 tCO_2e

WHY SHOULD I CONSIDER ENERGY MONITORING?

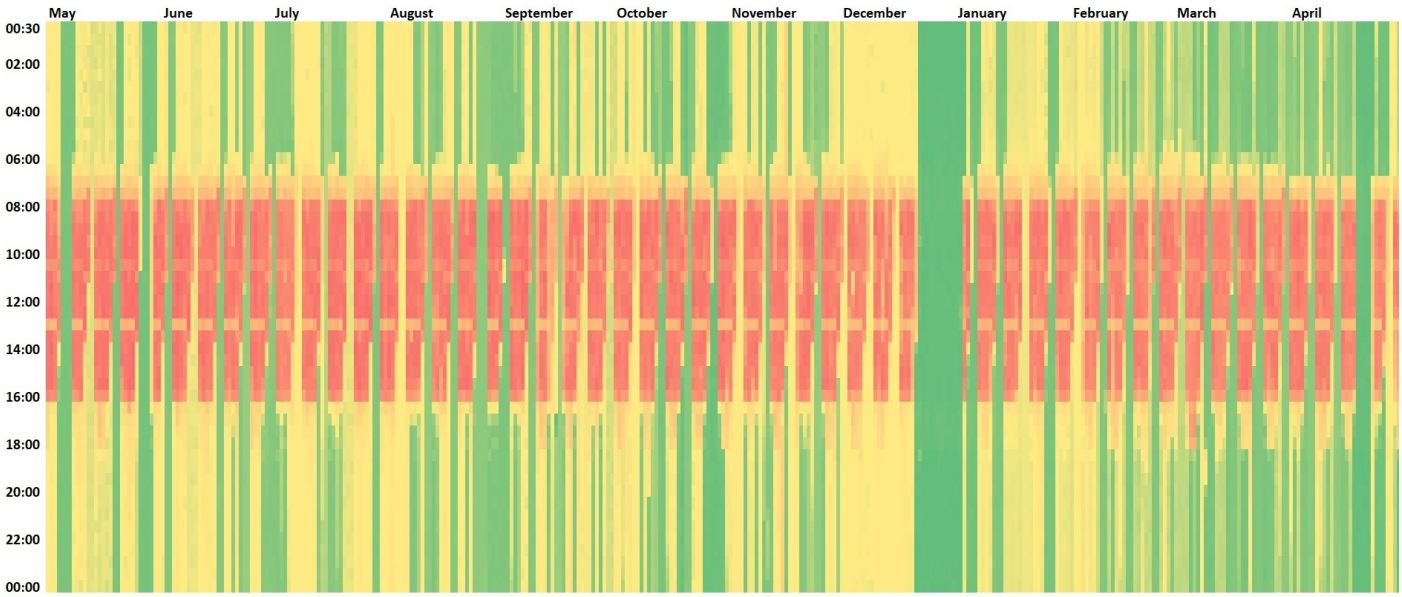
Improving energy efficiency is a worthwhile aim for any organisation. It can reduce carbon emissions, cut energy bills, prevent overuse of equipment and provide a better working environment for staff. Taking sensible measures to achieve this requires careful examination of an organisation's activities and there is never a one size-fits-all solution. It is essential to properly understand how energy is being used and the most accurate way to do this is to measure consumption through metering and monitoring.

Most people are familiar with energy metering, either from domestic electricity and gas supplies or in the workplace. Meters inform the consumer of the number of units of energy consumed within a given time period. Energy metering can be put to further use to shed light on how and when energy is being used. Keeping a record of the energy used each month can show how energy consumption changes between seasons and from year to year. It should then be possible to identify whether consumption is unreasonably high in a particular billing period.

In addition to direct measurement of energy use, it is possible to monitor the use of equipment or the effect it is having on a building's indoor environment. Monitoring air temperature can be performed to assess whether the heating system and timer programme are achieving the correct air temperatures at the desired times. Light sensors can be used to monitor when indoor lighting is being switched on or off, or when a door is being opened and closed, for example. There are many sensor types available to log readings over time, and give an understanding of how a site is really being used.

HALF HOURLY DATA

Some electricity and gas meters remotely report consumption to the supplier every half-hour, without the need for manual readings to be taken. This function is known as Automatic Meter Reading (AMR) and results in detailed 'half-hourly' (HH) energy consumption data. Electricity meters with this function will have an MPAN profile class of '00', indicating HH data is being collected. This data is used by energy suppliers to create bills as normal, but also to give detail on what times of day energy is being used and possibly apply variable tariffs based on time of use. All suppliers who obtain this data are obliged to provide it to their customers when it is requested. Some suppliers will provide analysis of this data as part of their service, but having the data on hand can be very informative for consumers themselves. The data is often provided in a spreadsheet, with a column for each day of the year, and a row for each half hourly time period. Simple editing, such as colouring the spreadsheet according to each numerical value in the cell, can provide immediate understanding of usage patterns. This can quickly highlight any unintentional consumption.



Displayed above is the half-hourly electricity consumption for a factory with colour coding as previously described. The daily work pattern is clear to see; the highest energy use is from 8am to 4pm. A period of low consumption is visible in late December, which corresponds with the Christmas shut down. The areas of most interest are the out-of-hours periods from approximately 4pm to 8am. This period shows occasional raised levels of energy use, indicating possible unintended consumption and is worth investigating. This data is key for guiding an energy management strategy for the factory.

ENERGY MONITORING SYSTEMS

Beyond the insight provided by the main energy meter(s) for a site, businesses can benefit from looking at energy consumption in more detail to show exactly what is responsible for consumption. This is often made possible by implementing an energy monitoring system. Such systems can be very simple meters that are read manually but installed in a number of locations around a site. Depending on the level of detail required, they can be installed at the main incomer to show what each distribution board is consuming, or at the distribution boards themselves to show consumption at each circuit; or for the greatest detail, at each piece of equipment.

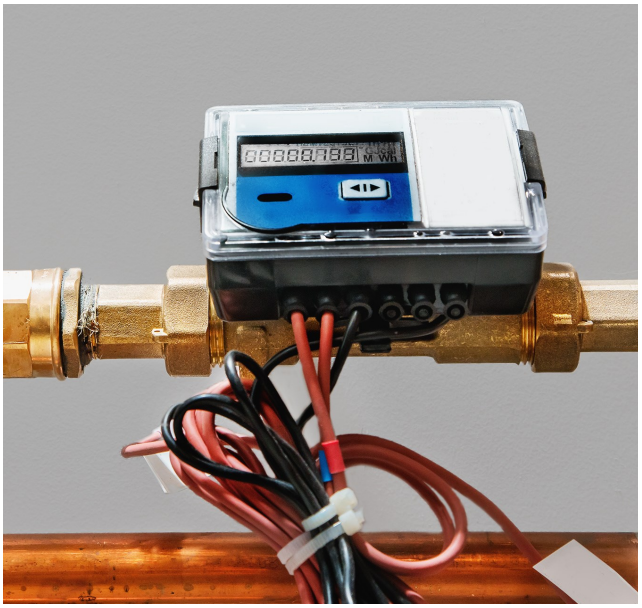
This approach requires good record keeping to make sure consumption is recorded consistently and this means regular meter reading across the site. There are many systems available, however, which automate the meter reading process and wirelessly communicate readings from all locations to a single online platform.

It is becoming increasingly common to integrate an energy monitoring system with a site's Building Management System (BMS) to create what is known as a Building Energy Management System (BEMS). These make use of energy data to make adjustments to the controls of the building's systems (heating, lighting, ventilation etc.) that may achieve gains in efficiency and eliminate accidental consumption.

TYPES OF METER AND MONITOR

The type of electricity meter used depends on how accurate the data needs to be—whether it is required for billing, or if simple energy measurement is needed. The most common type of electricity meter used for monitoring (as opposed to billing) relies on a coil or clamp, known as a 'current transformer' or CT. These are fitted around the live cable of an appliance or circuit, and when current flows in the cable this induces a small current in the coil which can be read by the meter.

This kind of device can be quite inexpensive and require no disconnection of existing cables, meaning a number of them can quickly be fitted across a site to create a comprehensive energy monitoring system. It is important to understand that if any energy meter is to be used for billing tenants or any other kind of occupant, it must be 'MID approved' and these tend to be hard wired devices rather than CT based.



Although electricity tends to comprise the largest number of metering opportunities in a given site, other energy sources may benefit from dedicated monitoring as well. Gas, heated water and steam are the other main energy streams that need their own types of metering, all of which require some kind of flow meter to calculate energy use.

Flows of heated water and steam, either for space heating, domestic hot water or for industrial processes, can be measured using a combination of a flow meter and a pair of temperature sensors. Heat meters such as these can be 'MID approved' as with gas and electricity meters and are particularly important for measuring renewably sourced heat such as from biomass or heat pumps. They can also be implemented throughout a site to see where most heat is being used. Heat meters are a somewhat more substantial piece of engineering than electricity CT meters, however, so it is not always economical to install large numbers of them unless there is a sufficiently large heat use to warrant the additional cost and complexity.

MONITORING AND TARGETING

Beyond comparing consumption from one year to the next, energy monitoring data can be put to use by taking a Monitoring and Targeting (M&T) approach. This involves setting expected consumption values for various activities or pieces of equipment, then measuring the observed energy use against these 'target' figures. Wherever metered consumption exceeds the expected value, there is a potential energy saving to be made. If this is done across a whole site, the difference between expected and actual consumption for each energy meter can be ranked in order of kWh to give an order of priority with which to address these potential savings.

The biggest challenge with M&T is to establish the expected consumption values in the first place. Some energy use may be straightforward to predict; for example, a room with a given number of lights may be in use for a set number of hours every day for a set number of days per year. Energy use can therefore be estimated by multiplying the power consumption of the lights by the number of hours per day/month/year that they are in use. If measured consumption exceeds this number, it may suggest that the lights have been left on out of hours, or that some part of the control system is malfunctioning.

BENCHMARKING

As well as comparing energy consumption from month to month or year to year, another option is to look at how a site compares with national averages for similar sites. This practice is known as energy 'benchmarking' and can be very useful in analysing how efficiently a site is using energy. Certain organisations, such as CIBSE, provide sets of energy benchmarks for a range of organisations and building types, giving figures for 'typical' and 'good practice'. The figures are mostly given in terms of kWh per m^2 of floor area per year for both electricity and fossil fuels.

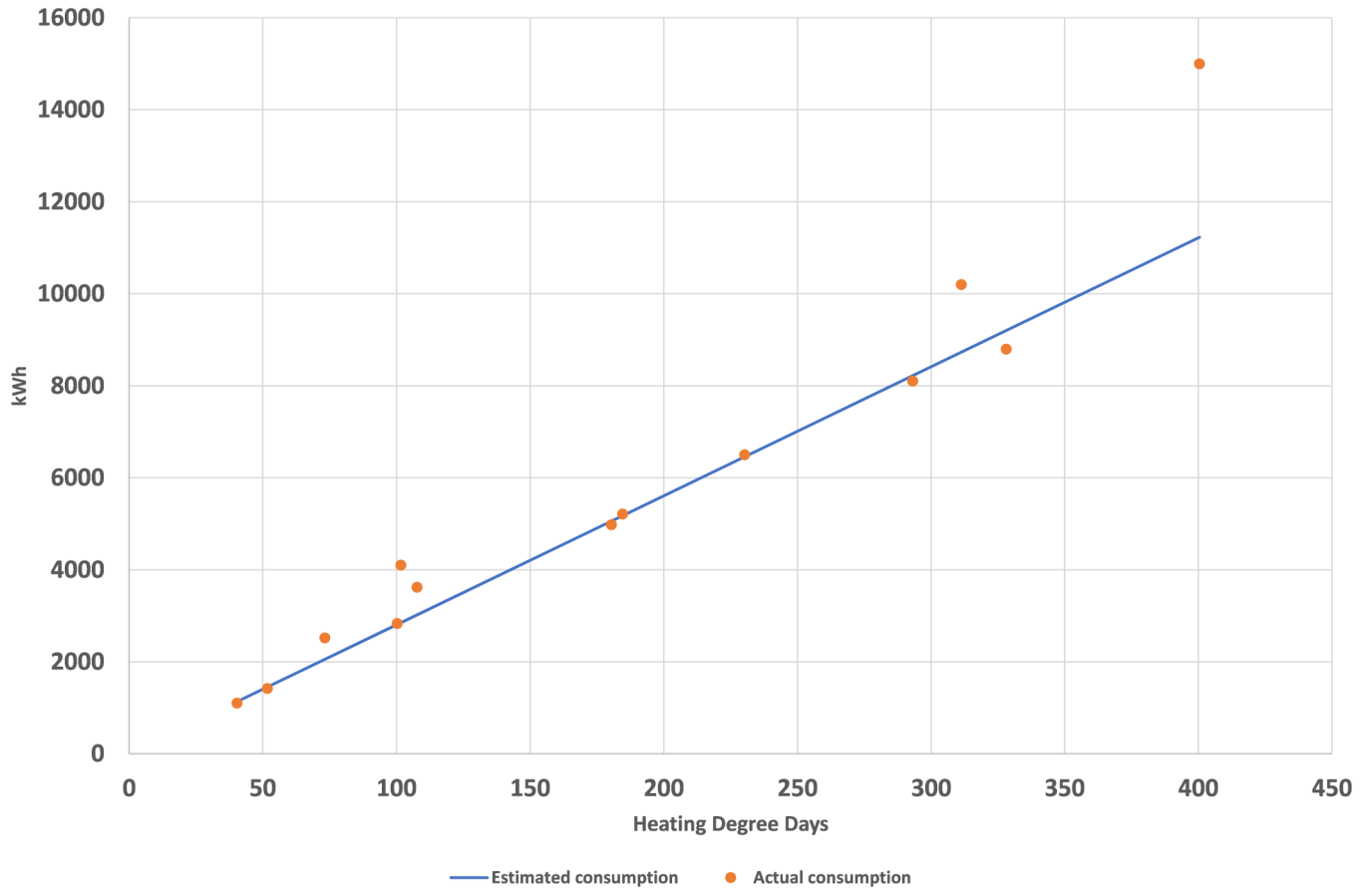
If a standard, naturally ventilated open plan office building, for example, with a floor area of 250m^2, had an annual electricity consumption of 26,000kWh per year, this could be compared with the benchmark figure for this category of building. CIBSE give such a site an electricity consumption of 85kWh per m^2 per year, so for this office, it would indicate a total of 21,250kWh annually. The 26,000kWh actual consumption would suggest that the site may be using some equipment excessively. Such a finding should trigger an investigation of the site's consumption in detail. The benchmark can be seen as a starting point or baseline level against which a site compares its own consumption and whether significant energy savings are likely to be identified.

Benchmarks tend not to include consumption for certain operations within some of the categories. The figures given for manufacturing sites, for example, do not include consumption due to the manufacturing processes themselves because there are so many variables that are site specific.

HEATING DEGREE DAYS

For weather related energy consumption, previous weather data can be used to establish how consumption might vary over a given period of time. Heating Degree Days (HDD) are a measure of how cold the weather has been for a given period of time. In other words, they are a sum of how often and by how much the outdoor temperature falls below the point at which indoor heating is required. Once in possession of energy consumption data from heating, measured at regular intervals, it can be compared with heating degree day data. Energy consumption should rise and fall over time in proportion with heating degree days, which is quite easy to see when consumption for each period is plotted against HDD on a graph.

The example below shows one such comparison, where the blue line shows the theoretical consumption and the orange points represent actual consumption. Any points that are significantly higher are easily identified and give an idea of the time periods during which energy may have been wasted. From that information, it can allow a better focus on what to investigate and improve. If consumption does not follow the expected pattern, it may be because controls are not properly managing indoor temperatures, because the heating plant is working inefficiently, or there could be a fault in the system somewhere.



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Decerna provides a wide range of consultancy and development services, to ensure that the right decisions are made, to support our customers in the whole journey, from initial concept through to implementation of low carbon systems and infrastructure. Please get in touch to find out how we can help your organisation to de-carbonise.

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