BEMS - Managing your energy use in a new way

WHITEPAPER

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1.0 Introduction

Man-made climate change is beginning to have a visible effect on our everyday lives. Most nations are now seeing changes in weather patterns, in some cases severe. Despite some recent political attempts to deny the existence of these changes, most governments now accept that we have precious little time to act.

Globally, we have seen several initiatives over recent years to address this man-made climate change. These have largely focussed on a move to clean and renewable energy to reduce emissions - and as part of this, the reduction of energy wastage.

Many initiatives have already had a noticeable effect, with figures showing that, thanks to the adoption of 'low energy' lighting and the increasing efficiency of domestic appliances, energy demand is falling back to earlier levels. This is despite population increases and the adoption of electric car charging.

However, it is inevitable that the adoption of Electric Vehicles (EVs) will increase electricity demand again. To make a positive impact on climate change the electricity for this and general demand growth must come from clean and renewable sources such as solar and wind.

For more than a century, coal power has been a primary form of power across Europe, with Germany and Poland respectively the ninth and eleventh largest users of coal worldwide. Things are changing though. In the UK, there are now only four coal power stations still in operation; in May 2020, the UK did not use any coal-generated power for the whole month – showing it is possible to rely more heavily on renewables such as biomass, green energy and nuclear power, rather than carbon-based fuels.

Currently, Europe has not deployed large scale demand-management storage[1] – such as 'battery farms' – to cover when renewables are not available, so during the transition from coal, gas and oil, efficient energy usage is more important than ever before.

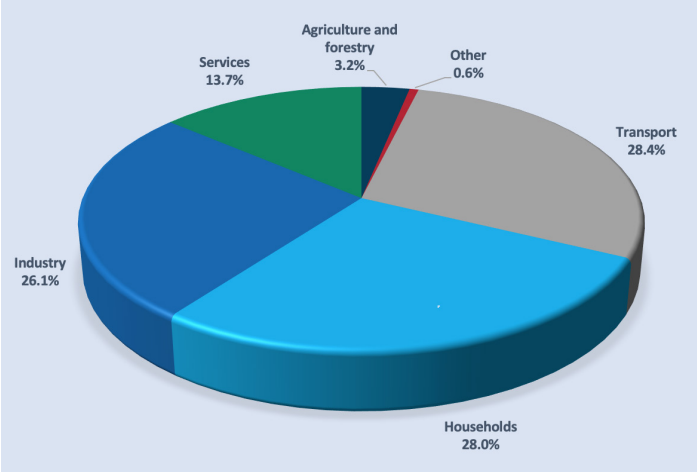
This white paper is looking primarily at commercial energy use, specifically in buildings. Energy is the largest operating expense in commercial buildings, requiring approximately one-third of the operating budget.

Buildings are responsible for 40% of global energy consumption and 33% of greenhouse gas emissions, as well as 25% of global water usage. Ensuring new buildings are sustainable and energy-efficient will be key to our efforts to tackle climate change.

No one group of stakeholders, whether researchers, project developers, policy-makers, public donors or private investors, can do everything. But everyone can, and must, do something.

Given the massive growth in new construction in economies in transition, and the inefficiencies of existing building stock worldwide, if nothing is done, greenhouse gas emissions from buildings will more than double in the next 20 years. Therefore, if targets for greenhouse gas emission reduction are to be met, it is clear that decision-makers must tackle emissions from the building sector. Mitigation of greenhouse gas emissions from buildings must be a cornerstone of every national climate change strategy.

Final Energy consumption by sector, EU, 2022
(% of total, based on terajoules)



[1] International aviation and maritime bunkers are excluded from category Transport.

Source: Eurostat (online data code: nrg_bal_s)

eurostat

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2.0 How energy legislation has and will affect business decisions

Legislation is one of the key motivators for making companies change their ways of thinking and sometimes forces them into new ways of doing business. The use of energy is no exception.

The Energy Efficiency Directive 2012/27/EU (abbreviated to EED) is a European Union directive which mandates energy efficiency improvements within the European Union. It was approved on the 25 October 2012 and entered into force on the 4 December 2012.

A foremost intention of the directive is to provide legal enforcement of measures to encourage the more efficient use of energy in business, and at all stages of a supply chain. It promotes energy efficiency across the EU and set an initial energy efficiency target of 20% by 2020, while setting out the basis for additional improvements in the future.

The directive also intended to lead to national level energy efficiency targets for 2020. EU member states were required to establish and submit their National Energy Efficiency Action Plans (NEEAP) by the 30 April 2014. These plans were required in order to set out the actions that these nations have put in place to improve energy efficiency, along with what the expected savings are to be. Annual progress reports are required to demonstrate what progress has been made towards the targets. The directives are the minimum targets, but member states are free to go further should they wish.

Included in the directive is a legal obligation to establish energy saving schemes in all Member States: Energy distributors or retail energy sales companies were obliged to save 1.5 % of their energy sales annually, by volume, through the implementation of energy efficiency measures. These include improving the efficiency of heating systems, installing double glazed windows or insulating roofs, among final energy customers.

A new target of a 30% improvement in energy efficiency by 2030 was announced by the European Commission on 23 July 2014. Although the UK is no longer part of the European Union, it has pledged to meet its original agreements through the fourth phase of its ESOS directives.

Virtually all companies in the European Union are economically or morally obliged to participate, so how can companies meet these directives?

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3.0 How to meet company and legislative energy directives – easy steps

There are some easy steps that can be taken to ensure meeting a company's energy or legislative directives:

- Appoint a dedicated person in the organisation to oversee and manage energy
- Decide clearly what assets a company want to include i.e. buildings, out-buildings, capital plant etc.
- Measure in a reportable way the total energy consumption for buildings, industrial processes and transports. Please note this could be on a simple Excel spreadsheet
- Identify areas of significant energy consumption, i.e. that take up at least 50% of the total company/organisation energy consumption
- Show a list of cost-effective energy efficiency recommendations for areas of significant energy consumption or use existing energy efficiency activities as a route to legislative compliance.

4.0 Why invest in energy saving activities?

The Continental Automated Buildings Association (CABA) recently published the top three challenges property owners and managers face:

1. **Improve spending decisions** where many property owners and managers are unable to determine their buildings' energy use patterns, making it difficult to identify energy-saving opportunities. Without this knowledge, managers may implement energy-saving measures that don't go far enough, leaving potential savings untapped. Or they may resort to heavy-handed energy reduction initiatives that needlessly reduce tenant comfort.

2. **Reduce energy consumption and spend** and therefore identifying inefficiencies is only the start. Building managers also need a way to control costs. Prior to this, most building systems operated on fixed schedules with fixed setpoints. The only way to make adjustments was to send out maintenance staff. What managers need is to be able to remotely observe and adjust building systems with a tap of a button, making it far easier to bring costs down.

3. **Improve operational efficiency.** Since most buildings are full of operational silos, with separate systems for HVAC, lighting, power, indoor air quality, internet connectivity and refrigeration, this is not an easy challenge. Not only does this make it hard to gain a clear picture of a building's health, it stymies efforts to optimise overall building operations. What building managers need is a scalable system that creates an opportunity to integrate data from numerous silos into a single analytics platform. In this way, managers can apply a holistic strategy to building operations.

It is obvious from these three points that there is a common theme running through these areas: energy management and reduction. However, before any company will invest in energy management resource or equipment, it will still need to see what ROI it can get to assess how much money to allocate to the issue.

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5.0 Wasted Energy – how much are we losing?

There is an old saying that "Time is money". ***However, "wasted energy is wasted money"!***

In business, we constantly look for ways to grow our turnover and profitability, yet wasted energy is just throwing away any growth that we achieve. The irony is that often increasing our profitability is outside our control, but avoiding energy wastage is under our control. With the right procedures and technology, keeping business costs down and profitability up is an easy win.

Recently published energy wastage documents[3] show energy waste by so-called vampire devices. These are electrical and electronic devices that are left in a standby or idle mode and are just waiting to be used. A typical PC on standby alone costs about 28€ per year in wasted energy. Combine this with other vampire devices, such as printers, monitors and charging pads creates an interesting reflection as to how much energy is wasted in every workplace in Europe. In total, it is now estimated[4] that the annual vampire cost for devices in an office per employee is an estimated 170€. This figure is based on the average office employee leaving devices such as monitors and PCs on standby when not in the office. However, the largest source of wasted energy in commercial buildings is through wasted heat, when heating is left on when offices are not used, or temperature controls being not utilised efficiently.

A major issue therefore for commercial building users is how to understand the return on investment required for installing energy monitoring systems to monitor and control this wasted heat and vampire devices. Energy and building managers need to find cost effective ways to know where and when energy is being used, and then with this information decide how to reduce this wasted energy.

Device	Watts while "on"	Watts while in "standby"	Average watts (W)	Monthly kilowatt hours (kWh)	Monthly cost to run ($)
Laptop computer	60 – 120	60	100	50.24	$6.03
Desktop computer	120 – 240	60	200	67.84	$8.14
Large flat-screen monitor	30 – 150	3	100	19.232	$2.31
Large Plasma TV/monitor	150 – 300	30	200	51.52	$6.18
Printer/scanner/copier	200 – 300	50	150	53.6	$6.43
Internet modem/router	2 – 20	6	6	4.32	$0.52
Incandescent lights (4 @ 60W)	240	-	240	42.24	$5.07
LED lights (4 @ 10W)	40	-	40	7.04	$0.84
Incandescent desk lamp (1 @ 100W)	100	-	100	17.6	$2.11
LED desk lamp (1 @ 14W)	14	-	14	2.46	$0.30
Ceiling fan	55 – 100	-	75	13.2	$1.58
Air conditioning (window unit)	500 – 1,500	-	1,000	176	$21.12
Central air conditioning*	3,000 – 5,000	-	3,500	231	$27.72
Cell phone charger	2 – 6	0.5	3	0.8	$0.10
Tablet charger	10 – 30	0.5	15	2.912	$0.35
Smart watch charger	2 – 6	0.5	3	0.8	$0.10
External hard drive	10 – 30	0.5	15	2.912	$0.35

Typical energy usage of devices. Copyright Fentress Incorporated

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6.0 Smarter buildings enable energy management

Despite rising energy costs and the reduction in the price of energy monitoring equipment, many buildings have yet to adopt any type of IoT technology to help with energy management. According to ENERGY STAR[5], "as of 2018 there were more than five million commercial buildings in the United States of 50,000 square feet or less that didn't use smart devices to monitor energy use, temperature, or other factors. These buildings were estimated to use as much as 30% more energy than they needed. Worldwide, the number of such buildings is far higher."

Energy wastage is a combination of inefficiency at both the individual and business levels. Real change can and must be made. For an individual or business, this wastage represents a significant loss of money that could be saved with the correct action. We must each play our part in counteracting climate change, but it doesn't hurt to save some money in the process!

A major reason many buildings owners and managers are hesitant to adopt smart building technology is the perceived complexity of these solutions. To simplify deployment, owners and operators need to partner with systems integrators (SIs) and IoT device/solutions providers who can meet three main criteria:

SCALABILITY:

Start small and grow the system to meet available budgets to try to avoid unnecessary expense. Sometimes, proprietary solutions such as Building Management Systems (BMSs) do more than what is currently needed or require long-term upfront commitments. Therefore, select an open platform that allows new capabilities to be added as needs change.

EXPERTISE:

This can be in-house or with a preferred SI. Do they have the necessary multiple capabilities, including device connectivity, to gather required data and create the return-on-investment (ROI) analytics.

INTEGRATION:

This key criterion is to find an implementation partner that will work with, rather than replace, existing infrastructure and devices, keeping investment costs down.

According to research from CITYNVEST[6] "Energy efficiency investments have proven to be lucrative for building owners, as they ensure long-term financial benefits through reduced energy bills. By cutting down the energy bills of individual buildings, the investments can reduce energy poverty. The retrofits can improve health and life standards. On average, we spend 90% of our lives in buildings, and thus improving energy usage we can bring important advantages in terms of higher productivity rates, learning abilities and better health conditions."

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7.0 If you can't measure it, you can't manage it

The ongoing enforcement of stricter environmental legislation will require many businesses to look for tools that will help them meet the demands. However, the benefits in terms of money savings and the environmental benefits make the effort worthwhile. And the higher the energy price, the shorter the payback time.

If you have no automated energy monitoring system in place on your assets, it is still perfectly feasible to take your first step into energy monitoring and management by manually taking regular (e.g. weekly) meter readings from your designated assets and write them into a spreadsheet (please see basic suggestions in section 8). In reality this would be a very time consuming and inefficient method of energy management! There are alternatives. Also IoT systems can help resolve this issue by espousing detailed energy use data, allowing managers to spot inefficiencies.

7.1 Smart meters

With the introduction of smart meters in our homes, we are familiar with the concept of monitoring our energy through an app or website. If someone is self-employed or a very small business, then this can offer a very basic but low-cost way to manage energy efficiency. However, for bigger businesses that fall into the remit of environmental legislation, this is unlikely to be sufficient, although it can be a useful starting point to monitor energy use.

7.2 BEMS (Building Energy Management Systems)

Many will be familiar with Building Management Systems (BMS) but more recently a lower cost solution has appeared in the form of Building Energy Management Systems (BEMS).

BEMS is a simple way to monitor and control energy-related building services, such as HVAC and lighting systems. A BEMS can provide the building manager with key data about energy usage which will enable them to analyse and understand where their energy is trending, look for areas of wastage and inefficiency, control usage and compare energy performance which is vital as part of compliance with sustainability obligations.

Consultants who specialise in energy legislation can help a business owner or manager to fully understand their obligations and objectives. To help with the practical changes that may well result from a consultation, a BEMS system can shine a spotlight on the key performance indicators highlighted by the consultant, making compliance considerably easier.

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7.0 If you can't measure it, you can't manage it - continued

7.3 What is the difference between a BMS and a BEMS system?

A full BMS system is designed to provide building managers with complete control over all aspects of a buildings system, such as; air, heating and cooling, fire systems, door access control, CCTV and intruder alarms.

A BMS is an overarching building manager, often designed for multi-user access and the ability to integrate multiple sites/buildings. Though powerful, it can be expensive to install and maintain and even more complicated to navigate and use. If energy management is your main concern a BMS system can however be overkill, and this is where a BEMS solution can be much more cost-effective.

As both BMS and BEMS developers embrace IoT technologies, there is presently a debate as to whether BMS will begin to take on some of the BEMS applications for larger applications. However, the more competitive pricing offered by BEMS will mean that it will continue to be attractive for anyone needing to monitor and control energy use, especially in small to medium enterprises (SMEs) where a BMS is more than they need.

There is growing agreement that energy data is sometimes best suited to the more cost-effective BEMS, which can be used and understood easily without the need for training or specialist knowledge, as these deliver data in a much simpler to understand format.

Perhaps the most important difference between a BMS and BEMS system is that BEMS systems can be purchased as an out-of-the-box solution (BIAB), where as a BMS needs configuring and integrating.

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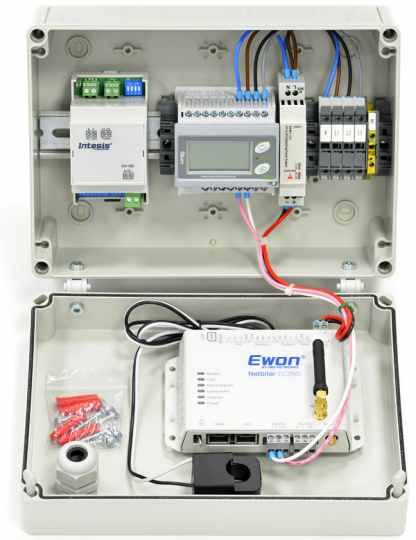
8.0 What is a BEMS in a Box (BIAB)?

Many SMEs are wary of how much they will need to invest even in a BEMS, let alone a full BMS. This is where a new innovation, nicknamed 'BEMS in a Box' could help.

BEMS in a Box (BIAB) come in various configurations, dependant on the application and data monitoring that is required. Normally users start off slowly with just one or two energy meters, a power supply and an IoT gateway, which send the energy data to a cloud-based storage and analysis system. A pre-configured, integrated BEMS offers the end user a simple to deploy IoT monitoring system which typically communicates via mobile networks directly to a secure cloud system with access to view data/data history and is open to multiple users via any web browser-enabled device.

Designed to be as close to 'plug and play' as possible, BIABs come pre-wired internally, so all the user needs to do is to mount the box near to the incoming power cables, connect a mains voltage to the terminals in the housing, connect onto the incoming power cable the supplied clip-on current transformers (CTs) for electricity monitoring, (enabling deployment without power interruption) and then turn the power onto the box.

The concept is often subscription-based, minimising up-front commitments by a business wanting to use a BEMS, but can also be bought outright with just the monitoring service being paid for with a minimal subscription.



Typical HMS Networks/Uniq Solutions Ltd BEMS in a Box with Intesis Gateways

BIABs can be fully scalable and are not just limited to one or two meters. Modern BIABs are now self-contained IoT solutions, offering live data collection via pre-configured meters to meet the sites' requirements. This allows users to install and get usable data out of the BIAB in minutes. Live data allows the ability to react to situations in real time, rather than finding out about an issue the following day. This helps to reduce costs. Being a scalable device, by using simple gateways, it is easy to connect the BIAB to monitor similar systems like water, gas, heat and cooling meters, and air-conditioning systems.

8.1 What is a typical BIAB application?

A typical type of business that would benefit from BIAB would be a multi-site retail business with lots of small units. Typically, they have heating and cooling and of course lighting for the shop floor and back-office areas. A simple BIAB is perfect for this type of application due to its low cost and easy installation. It would also suit multi-site restaurants, bars and apartment blocks, schools, and libraries and is perfectly suited to logging data from large LV panels to gain a clearer understanding of the properties' major loads.

8.2 How can a BEMS be integrated into 'Smart Buildings'?

As mentioned earlier, BMS systems are increasingly IoT-based and are enabling the creation of what is often call a smart building. In a smart or connected building the BMS control system can not only monitor the building's energy performance, but can make changes to the way energy is utilised to reflect how the building is being used - for example, automatically closing windows, opening blinds. BMSs are designed to control multiple systems within a property using data from a vast number of sensors and timers. These systems were not predominantly designed to offer a live view of energy data to every level of a business to help drive efficiency within the business, so the user must decide which suits their application and energy reporting needs best.

An increasing trend is to connect a BEMS onto a BMS and use the BEMS for real-time energy monitoring in smart/connected buildings, while sending the data to the central BMS to look after the overall building control. This combination is easy to set up, as common communications protocols such as Modbus RTU/TCP are usually used on both systems. Failing that, there are lots of off-the-shelf smart building protocol converters/gateways that can help, such as HMS Networks Intesis gateway range. The Intesis range of smart building gateways allow BIABS and normal BEMS to extend their communication from power meters to also send and receive data via smart building networks such as Dali, BACnet and KNX to a host of devices. The intesis portfolio also allows BIAB or normal BEMS to interface to most manufacturers air-conditioning systems allowing simple remote and management and control of even these energy heavy systems.

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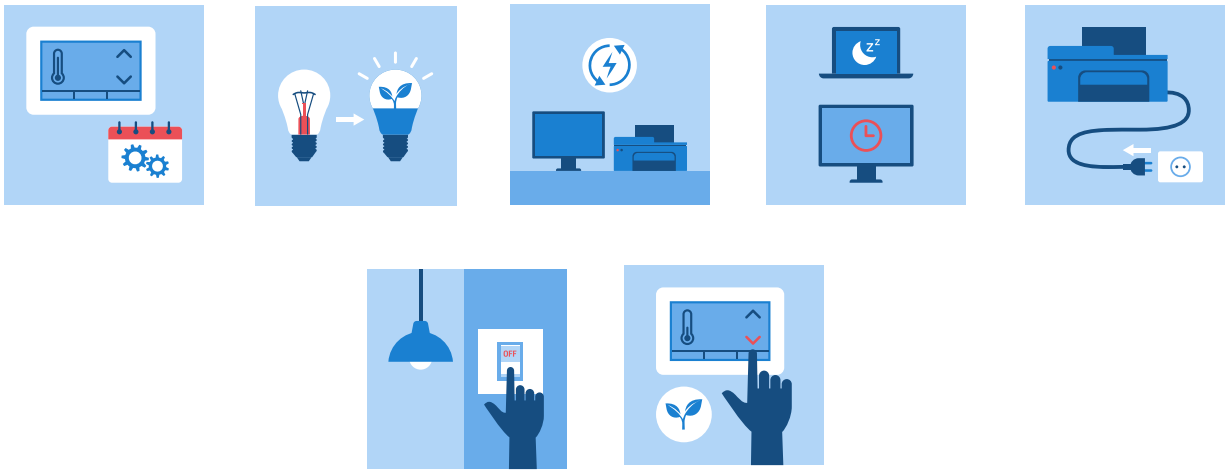
9.0 How can I reduce my energy use now?

There are very simple ways to reduce energy consumption. Below is a list of examples that may help. Please note the list below is just a brief overview and a specialist BEMS supplier will be able to advise you on other things that can be done to reduce energy consumption.

- **Regular machine maintenance.** Preventative maintenance on factory floor machinery, AC systems etc. will ensure that as well as reliable functionality they will run as efficiently as possible.
- **Low energy lighting / lighting control.** Low energy lighting may seem a 'no brainer' but many older offices and factories may still be using older and less efficient lighting technology. Whilst replacement itself has a cost, long term it will save money. In addition, having lighting controlled by movement sensors can save significant energy by not lighting unoccupied areas.
- **Heating systems.** Keeping your heating system well maintained is vital for energy efficiency as are good levels of heat insulation for offices and factories.
- **PC & office equipment.** There is a temptation to leave PCs on and locked in many businesses and whilst systems such as file servers need to remain on, a great deal of energy is wasted by PCs running unused.
- **AV equipment.** In modern offices and factories, it is common to have a large number of televisions, which are used for everything from presentations, news feeds and TV for staff relaxation and dining areas. Unless required for 24/7 operations, these TVs & screens should be powered off as even in standby mode they are consuming energy.
- **Use energy efficient control for air-conditioning used in buildings.** Air conditioning can also be connected to BEMS systems to allow users to monitor and control energy used on air-conditioning units.



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10.0 References

(1) UK Government publishing service

(2) Energy Efficiency Directive 2012/27/EU

(3) “Recently published” energy wastage documents

(4) Annual vampire cost for devices in an office per employee

(5) ENERGY STAR

(6) Research from CITYNVEST

(7) ENERGY EFFICIENCY FOR BUILDINGS
United Nations Environmental Program (UNEP)
https://www.euenergycentre.org/images/unep%20info%20sheet%20-%20ee%20buildings.pdf

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