(ENERGY) HARVEST FOR THE WORLD

There has never been a more pressing need to husband the world's resources and reduce global energy consumption. Developments in building automation are a promising way forward; in particular, using self-powered devices that harvest energy from the environment and manual operation, says Graham Martin, Chairman and CEO, EnOcean Alliance.

The need is urgent. Most of the world's offices are underused, thereby overusing power and materials just when these resources are becoming scarcer and more costly. In the past year, energy prices have doubled or tripled in parts of the world, for example, Europe. Couple that with similar increases of interest rates and mortgages, eye-watering inflation, and global consequences of famine and strife.

The coronavirus pandemic may be over, but the trend to hybrid working casts its shadow. Post-Covid-19, office spaces remain 50% to 70% occupied - leaving 30% to 50% energy wasted and a legacy of unnecessary CO2 output. Meanwhile, cabling and batteries are draining resources such as copper and lithium. This is taking place in the context of pressure from world leaders to reduce carbon emissions and reverse the impact of global climate change.

Emissions from buildings are a significant issue. Globally, buildings account for almost 40% of the world's energy usage and are responsible for 36% of global CO2 emissions. To meet the United Nations and other climate goals, it is imperative to make buildings more energy efficient. Retrofitting old buildings is quicker than building new ones and is the only option that can meet the increasingly urgent climate and sustainability goals.

On a governmental level, Europe's 'Green Deal' initiative starts from the premise that the production and use of energy accounts for more than 75% of the EU's greenhouse gas emissions. Main pillars are to promote innovative technologies and modern infrastructure, whilst boosting energy efficiency and promoting eco-design in products. Forward thinking businesses are responding. Deutsche Telekom has pledged to become climate neutral by 2025 and similarly the EU by 2050. Whilst Microsoft wants to be CO2 negative by 2030.

Break free from proprietary standards and hard-wired tech

Responding to these challenges highlights significant differences between hard-wired, proprietary solutions and wireless, standardised, extensible solutions. Such challenges can be addressed by open wireless systems. These benefit from an open data interface and even the option to extend the existing system with sensor types (such as CO2, desk utilisation or temperature sensors).

Wired sensors are not cost-effective. With wiring costs of over 100 euros per sensor, the typical acquisition costs are tripled. A wired solution is also inflexible; each time a change is made, time is lost, and new wiring costs are incurred. Wire-free communication eliminates the need for installing new cabling and for physical access to the existing building automation system. Self-powered sensors further optimise the installation - with an open system configuration alongside broad support for additional sensor types.

Smart buildings on the way for flexible data harvesting

With new buildings, smart features can be designed in the early planning stage. They can then be implemented while eliminating cables and removing reliance on batteries.

Maintenance-free wireless devices with energy-harvesting technology use environmental energy as their source of power. Innovations over the past ten years have demonstrated the success of greener self-powered devices, where kinetic energy, light, magnetic fields and temperature differences can all be used to generate sufficient electricity.

Thanks to these sensors, the smart building can monitor the status of its environment and use this data to make any necessary adjustment or for analytical purposes. The data is gathered and processed by a cloud-based IT platform, as a digital twin if required. The physical space is combined with digital services and analytical tools. A dashboard can then present the data in a user-friendly way for managers and decision makers to view and act on.

These advances are highlighted in the example of 'The Squaire' – a smart building in Frankfurt, Germany. Here the installation of more than 20,000 wireless and battery-free sensors and switches saved over 95km of cabling and many person-years of installation time.

Reaping the energy harvest

Let us review four effective ways to harvest energy that's freely available in the typical building environment and using it to power sensors that collect data and even actuators to control outputs.

Smart-building devices can generate electricity from kinetic energy. One press of a button can generate enough power to send a radio signal to dim the lights. The PTM switch module has created an international industry standard that makes it particularly easy for manufacturers to integrate the module into all common switch design variants. The basis for this is the electromechanical energy converter which – like a bicycle dynamo – generates energy when the switch is

being pressed. This energy harvesting technology, kinetic switches are a resource-saving alternative to battery-powered or wired switches. An identifying code embedded in each radio transmission matches a particular switch to an individual light, allowing thousands of switches to be used in the same building without any interference. Each signal can be received up to 300 metres away.

Another option is to harvest the ambient light, by generating and storing electricity from solar cells. A solar-powered sensor can measure for example temperature, humidity, occupancy, air quality or door/window status with low power consumption and high reliability. The modules' tiny internal storage enables transmission of measured values even in total darkness for many days.

> **"Wired sensors are not cost-effective. With wiring costs of over 100 euros per sensor, the typical acquisition costs are tripled."**

Thermoelectric effects offer further energy resources that can be harvested: this time using tiny temperature differences to create electricity through long-known physics principle the Seebeck Effect using Peltier elements. Temperature differences offer the ability to harvest a great deal of energy. For example, the warming of a drop of water by one degree Celsius requires the same amount of energy needed to send about 10,000 EnOcean wireless telegrams. That is enough to operate not just a wireless sensor, but even wireless actuators such as heating valve actuators. Using a DC/DC converter combined with a Peltier element, manufacturers can also utilize thermo-electric powered applications. As EnOcean wireless modules are optimised for a wide input voltage range, the converter is a complete match for energy harvesting applications that take advantage of temperature differentials.

Rounding out the quartet of possibilities there is magnetics. Electrons flowing in cables can deliver energy through magnetism ready to harvest. This goes beyond simply measuring energy consumption through the electrical buses. Harvesting some of the energy from the bus is utilized to send data to the building system.

Conclusion

The combination of intelligent wireless buildings with energy-harvesting controls and operation is the key that unlocks the potential of smart buildings and makes the technology economic and practical in new construction and retrofit situations. The elimination of cabling minimises installation costs, the elimination of batteries eliminates operating costs, and together they create a solution that is maintenance-free and can be quickly and easily adapted to changing operational requirements whilst optimising energy use and costs at any time.

www.enocean-alliance.org