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Artificial Intelligence

Artificial Intelligence and energy performance in smart buildings

Will technology take us closer to the goal of creating symbiotic relationships between buildings and their natural environment? Can AI be used to make buildings smarter and more sustainable?

As regulatory pressures grow and expectations for the next generation of smart buildings continue to rise, so do advancements in AI. This article explores how technology and in particular AI can be utilised in buildings to increase energy efficiency and improve environmental performance.

Drivers for change

Reform in the real estate sector is crucial to achieving the EU's decarbonisation targets. Real estate is the largest energy consuming sector in Europe, reportedly consuming 40% of total energy. It is estimated that 75% of buildings in the EU are energy inefficient, particularly older stock.

The Energy Performance of Buildings Directive (EPBD), which originated 15 years ago, was intended to set new benchmarks to improve the energy efficiency of buildings, thus driving the adoption of smart technologies and reducing the impact of climate change. A revised EPBD came into effect on 9 July 2018 and member states will bring into force the laws necessary to comply by 10 March 2020. It remains to be seen whether and how the requirements will be implemented into UK domestic law in the light of Brexit.

One of the focal points of the revised EPBD is to advance the realisation of Smart Ready Technologies (SRT) in the building sector. A requirement of the directive is the development of a voluntary European scheme for rating the smart readiness of buildings called the Smart Readiness Indicator (SRI). The SRI aims to deliver greater clarity and certainty about the benefits of smarter buildings in order to motivate investment and adoption amongst owners, tenants, managers and users. The indicator is also intended to support linkages between buildings and other key policy segments, particularly energy, transport and information communication technology (ICT), thereby integrating buildings into future energy markets, transport systems and the broader digital infrastructure of cities.

The methodology for calculating the SRI will take into account the use of interconnected and intelligent technologies such as smart meters, building automation and control systems, self-regulating devices for indoor air temperature and humidity, recharging points for electric vehicles and on-site energy storage capabilities. What is key is the interoperability of all of these features.

In addition to what is set out by EPBD, landlords in the UK also need to ensure that their buildings are compliant with Minimum Energy Efficiency Standards (MEES). Since 1 April 2018, it is prohibited to grant a new lease or to renew an existing lease for a commercial building where the Energy Performance Certificate (EPC) has a rating of less than 'E'. These rules extend to all existing leases from 1 April 2023. Furthermore, the Government's Clean Growth Strategy published in October 2017 indicated that in the future an EPC rating of 'C' may be required, as is already the case in the Netherlands. The incorporation of smart technologies and AI into buildings could be pivotal in achieving compliance with these stricter energy efficiency standards.

Building design

Design is a key factor influencing the environmental performance of buildings and the construction industry increasingly utilises AI to identify the most efficient building designs. Generative design software allows architects and engineers to input the parameters of a project, including materials, manufacturing methods and cost constraints. The software tests and learns from each iteration of the design to select the most efficient option.

For example, Manitoba Hydro Place in Winnipeg, Canada uses an energy efficient design to reduce its carbon footprint by 70% compared to a similar office building of conventional design. Passive systems, such as south-facing winter gardens, natural daylighting and a solar chimney, take advantage of the environment to reduce energy usage. Active systems, such as computer-controlled natural ventilation, minimise the need for air-conditioning and interact with the design of the building to help maximise its effectiveness.

Data driven decisions

Smart buildings are already being fitted with omnipresent internet of things (IoT) sensors that support a network of interconnected devices, allowing the building to collect and analyse a wide range of data. AI systems can process this information, learn from patterns and use it to make decisions for the building.

Example: energy use

Integrated solar panels and wind turbines are a key feature in smart buildings. The Bullitt Centre in Seattle, which has 575 solar panels on its roof, stores surplus energy produced in the summer on Seattle's electrical grid, but takes back electricity in the winter. The Bullitt Centre system includes two electricity meters that record energy consumption. In the future, a more advanced AI system could interpret this real time data, identify trends and make decisions about when to store or sell electricity, and even communicate directly with external electricity suppliers.

Example: temperature control

AI energy management platforms can be used in smart buildings to adjust temperatures using predictive energy optimisation. These systems interpret data on the building's characteristics and historical usage, and respond by precooling or preheating a building without any human intervention. Among other factors, the technology can identify how human activity, the weather and heat from electrical equipment can affect the building's temperature and will make temperature adjustments accordingly. 311 South Wacker, known as the 'smartest building in Chicago', provides an example of this technology in practice. Following an energy efficiency retrofit, outdated thermostats were replaced with wireless ones connected to a cloud-based intelligent building system that can manage the conditions remotely. The system uses sophisticated algorithms to utilise real time data and make operational energy saving decisions.

Example: water supply

Smart buildings can also use AI systems to manage water supply. Westfield Shopping Centre in London incorporated rainwater harvesting into its design to improve environmental performance. The centre has a built-in electronic control unit which monitors water levels, filtration requirements and pumping facilities. The system can switch to mains water if rainfall levels have not been sufficient to fill the tank and can report information to facilities managers remotely. In the future, AI could be used to collect data and predict how weather changes, opening hours or other factors may affect Westfield's water needs. The building could 'learn' when it needs to store more water for anticipated periods of higher demand and lower rainwater supply, for example, by turning off or reducing non-potable water fountains or display features.

Example: adaptable workspaces

Another common use of AI in smart buildings is smart lighting, which increases the energy efficiency of buildings by using motion sensors that automatically switch-off lighting when areas are not in use. The Edge building in Amsterdam has taken this concept to the next level with over 28,000 sensors detecting motion, light, temperature, humidity and infrared. Using a smartphone app, employees input their light and temperature preferences and the system tracks their GPS, automatically adjusting the environment as they move around the workspace.

Conclusion

There is increasing recognition amongst forward-looking developers, investors, property owners and managers that incorporating cutting-edge, smart technology into buildings is key to:

— ensuring compliance with tougher regulation around energy efficiency standards;

— adapting to the challenges of increasing energy costs;

— delivering greater visibility and benchmarking on energy consumption;

— meeting internal environmental, social and governance (ESG) requirements to protect both company brand and reputation; and ultimately

— creating better spaces and places for an increasingly demanding user base.

It is yet to be seen just how far AI could go in improving the environmental performance of smart buildings, but the potential it holds is incredibly powerful.

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