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Assessing the Potential of Smart Building Management Systems (BMS) to Improve Non-Domestic Building's Performance

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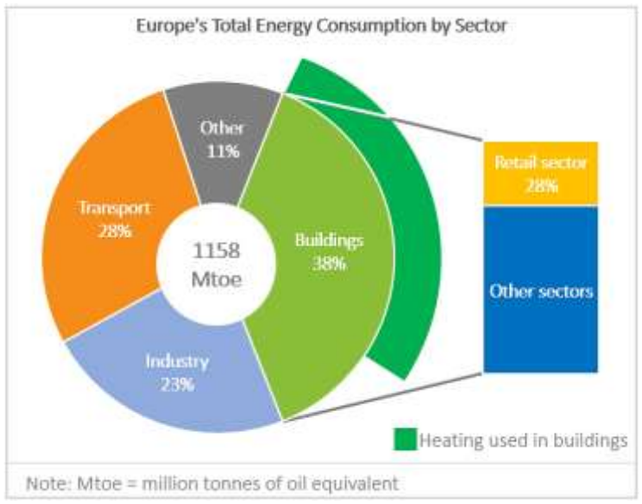
BACKGROUND



Buildings have become the largest energy consumers in Europe and heating is the main player.

Commercial retailers are the greatest energy consumers within the sector.

Energy efficiency solutions play a central role in the:

- decarbonisation of the sector
- minimisation of energy consumption costs

Building Management Systems (BMS) play an important role on creating smart, energy efficient and near-zero emissions buildings. Modern BMS could be capable of **optimising energy consumption, scheduling, and the overall building's performance**, while improving **occupants' satisfaction**.

Among the stakeholders, one of the most benefited from retrofitting their BMS are **commercial retailers**. They have the **greatest potential** in terms of energy savings and return of investment.

Diverse and **innovative solutions** have been created to enhance the performance of BMS. However, they are **not optimum for all customers** due to their complexity and difficulty to be standardised.

AIMS OF THIS RESEARCH:

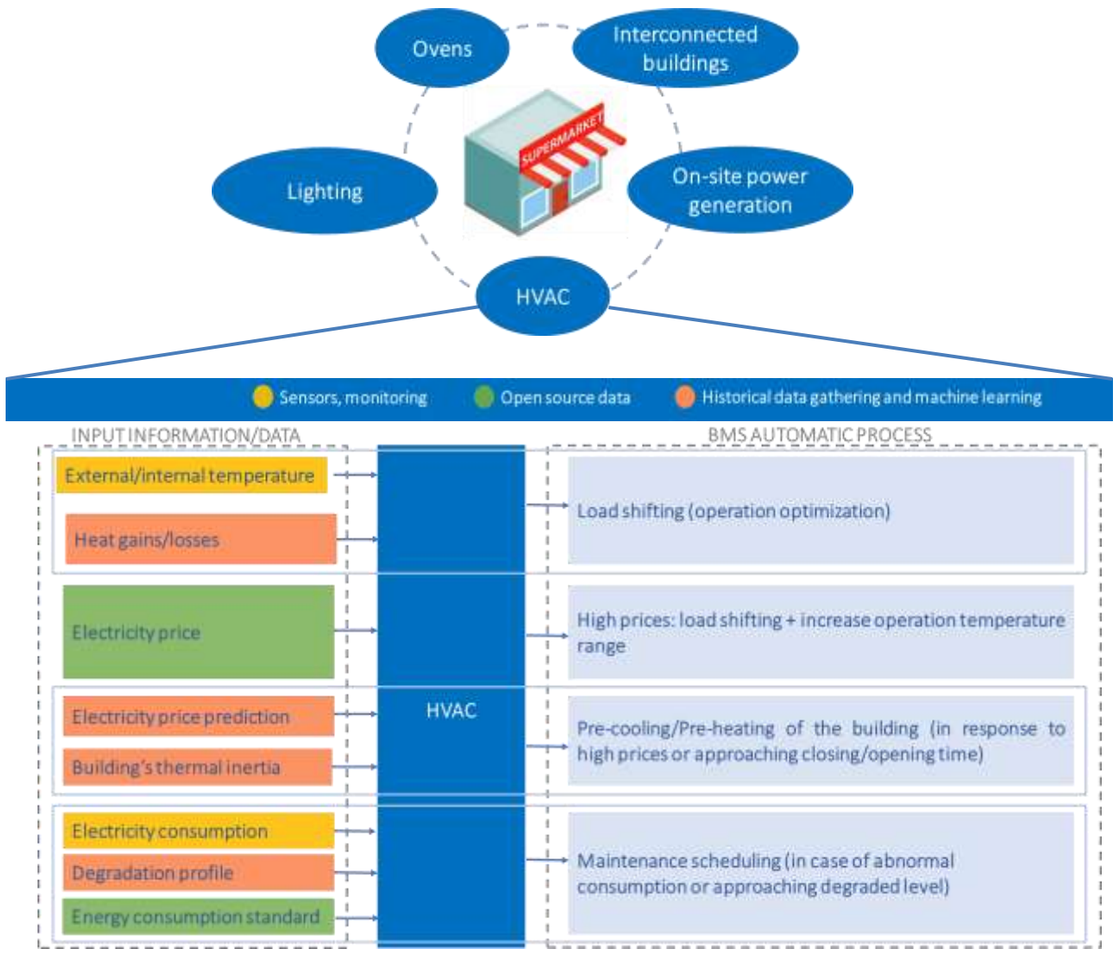
- Understand commercial retailers' main drivers and restrictions to enhance the performance of their BMS.
- Find which functionalities can be implemented in the BMS as part of a smart strategy.
- Economically and environmentally justify the HVAC Smart BMS techniques.

METHOD:

- Qualitative study: interview stakeholders and build commercial retailers profile.
- Quantitative study: use historical data of a retail store to build a heating estimation model (Degree-days methodology). Then, simulate three HVAC smart strategies.

SMART BMS ROADMAP FOR THE RETAIL SECTOR. HVAC ABSTRACT

Presents a **vision of the modern BMS**. The strategies cover the **5 main areas of interest** in a supermarket. According to the BS EN 15232-1 standard, it is possible to achieve a **class A building** thanks to the deployment of these new functionalities.



SIMULATION OF HVAC SMART STRATEGIES

Equations 1 and 2: Model's objective functions. Minimise:

Monthly energy costs: $\sum_{day\ 1}^{day\ 30} \frac{U' * Degree-days}{\eta} * Gas\ cost + Power * Electricity\ cost$

Fixed [£] — Half-hourly [£]

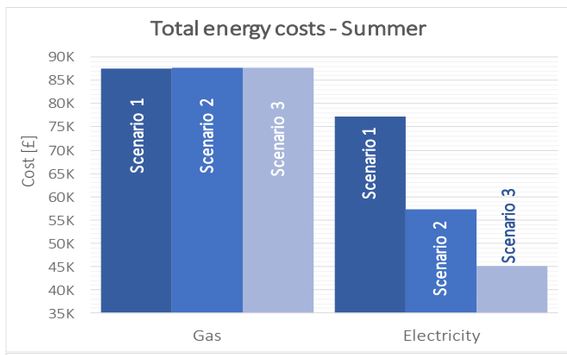
Daily Heating [kWh] — Daily power [kWh]

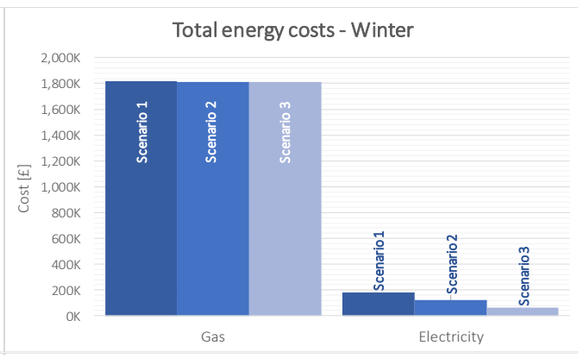
CO2 emissions: $\frac{C_f F}{1000}$

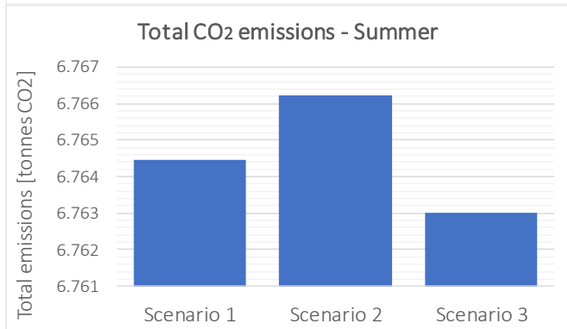
Scenario 1: Constant operation of the HVAC at internal ambient temperature setpoint of 19°C.

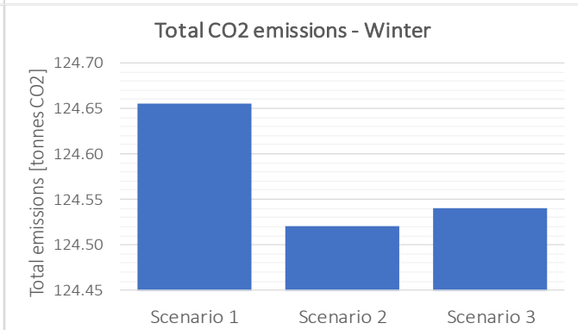
Scenario 2: Intermittent operation at 19°C (occupied period) and 16°C (unoccupied period).

Scenario 3: Response to high electricity prices by lowering HVAC load during peak demand.





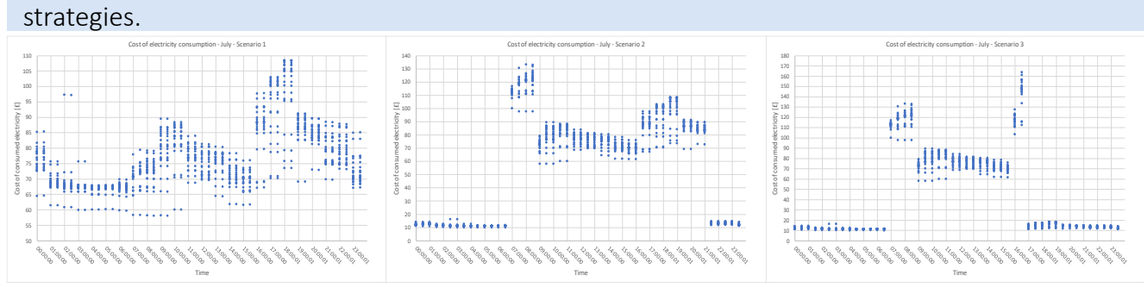




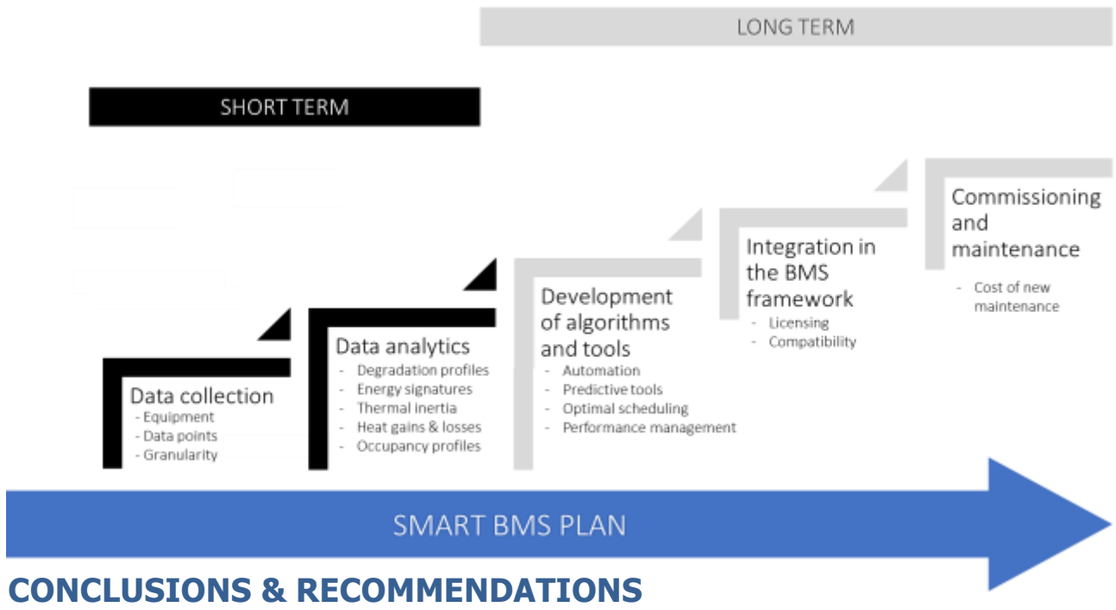
Summer: Energy savings of **12% to 19.3%** compared to a "business as usual" operation. Carbon emissions are reduced by **0 to 0.02%.**

Winter: Energy savings can go from **3.1% to 6%.** Carbon emissions are reduced by **0.9% to 0.1%.**

Real-time electricity pricing: consumption profile (£ vs time) improves thanks to the smart HVAC strategies.



RECOMMENDED SMART BMS RETROFIT TIMELINE



CONCLUSIONS & RECOMMENDATIONS

- Smart BMS allow commercial retailers to remotely monitor and control their assets, compare the performance of their stores, ensure optimal energy consumption and maintenance scheduling.
- Degree-days is a simple and straightforward method to model a building's behaviour.
- Recording the correct data is a key element to implement smart techniques.
- Refrigeration plays and important role in the supermarket's environment (e.g. heat losses)
- Further work: 1) use more data from different months, seasons and stores to validate the model and increase accuracy, 2) study collateral impact of HVAC strategies (i.e. HVAC reduced lifetime, increased refrigeration load, loss in heat source's efficiency due to part-load-operation, 3) Simulate the effects of climate change, and lighting envelope retrofitting.

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