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BENCHMARKING AS AN INSTRUMENT FOR ENERGY MONITORING RELIABILITY

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The vast majority of Ukrainian enterprises participate in energy efficiency programmes in order to improve their competitiveness, primarily by expanding production capacity, rather than by improving the energy efficiency of existing equipment by reducing non-productive losses [1]. Therefore, these programmes have little or no impact on the actual decarbonisation and the achievement of enterprises target annual energy consumption reduction [2].

The purpose of the research is to assess the feasibility and required regularity of energy monitoring, as well as to find ways to improve its reliability in order to reduce energy costs and actually reduce greenhouse gas emissions.

To achieve these goals, an energy audit of two supermarkets of similar format (with an area of 9991 m² and 8708 m²) located in Kyiv shopping centres was conducted, a comparative analysis of their power consumption was performed, and their energy efficiency was benchmarked [3]. Based on the results of the on-site surveys, it was found that the energy-consuming equipment in both supermarkets is almost identical and is used in similar regimes.

Taking into account the difference in the area of supermarkets, the comparison of power consumption was made not in absolute, but in specific values (per 1 m² of occupied space). As a result, it was determined that the power consumption of Supermarket 1 exceeds the power consumption of Supermarket 2 by 55%. This discrepancy is extremely large, even taking into account the small difference in equipment and operation patterns.

In order to determine the estimated electricity consumption of each supermarket, all the power equipment was documented, with an indication of its installed capacity, operating hours and usage modes. Thereafter, respective calculations were carried out. In addition, measurements of power consumption were conducted for main distribution panels (power, lighting, ventilation) and for the most energy-intensive consumers (compressors, ovens, stoves, proofing chambers) as well as their groups (fish and meat departments, cookery, bakery). As

a result, it was determined that the average actual power consumption of Supermarket 1 exceeds the calculated value by 44%.

Given the significant deviation between the estimated and actual power consumption, a hypothesis was put forward that the electricity metering results in Supermarket 1 is incorrect. In order to confirm this hypothesis, a detailed analysis of electricity bills was carried out. However, analysis of the archived data for each of the meters over the past two years revealed no anomalies: consumption either fluctuated within 10% range or had a clear correlation with seasonality. The problem was discovered only after an on-site inspection of all meters at Supermarket 1. It was found that the meter readings of reactive power were added to the consumption of active power, resulting in an overestimation of up to 80 000 kWh per month.

Moreover, in the bills issued by the shopping centre, the sum of active and reactive power is multiplied by the active power tariff, which is considerably higher than the reactive power tariff. This in turn led to significant overpayments for more than two years. By eliminating the identified discrepancies, it was possible to save a significant amount of funds and recalculate the actual specific power consumption of Supermarket 1, which decreased from 37.7 to 27.7 kWh/m²/month. Nevertheless, this value exceeded the same indicator for Supermarket 2 by 14%.

To further conduct internal benchmarking studies, power consumption of similar consumers (and their groups) in both supermarkets were compared. As a result, the largest discrepancies were found in the refrigeration systems.

Indeed, the on-site inspection of Supermarket 1 showed increased losses due to significant damage to the insulation of refrigerant pipelines, compressor frosting, and the operation of the refrigeration unit with suboptimal parameters of the refrigerant evaporation and condensation temperatures.

It is proposed to use part of the saved funds to implement energy efficiency measures in the refrigeration system of Supermarket 1, which will allow to reach a specific power consumption of 25.2 kWh/m²/month, which differs from the same indicator of Supermarket 2 only by 3%. At the same time, the planned annual reduction in power consumption is 300 000 kWh, and the reduction in greenhouse gas emissions is 126 tonnes per year.

Notwithstanding, it is worth mentioning that the search for electricity overruns at the enterprise was not carried out in time, took a lot of effort and required the involvement of third-party energy auditors.

In conclusion, the lack of energy monitoring at enterprises can lead to significant cost overruns that are difficult to control. Moreover, enterprises face the problem of insufficient engineering staff. As a result, the amount of time that employees can devote to energy monitoring is too small to perform it properly, and therefore its regularity is unsatisfactory.

Furthermore, a simple analysis of energy consumption against previous periods can only indicate random deviations. In order to identify systematic deviations, it is necessary to apply benchmarking or calculate and justify the target

energy consumption. The use of such methods can significantly increase the energy monitoring reliability.

References:

1. EU4Business: Annual report 2024.
2. The Law of Ukraine “On Energy Efficiency”. Version of 18.09.2024.
3. DSTU EN 16231:2017 Energy efficiency benchmarking methodology.

CONSTRUCTIVE FEATURES OF INSULATION SYSTEMS IN MODERN CONSTRUCTION

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In modern construction, significant attention is paid to developing and implementing energy-efficient solutions, one of which is the use of thermal insulation systems for walls. An insulation system typically consists of the following primary components: the load-bearing structure, the thermal insulation layer, and the external protective covering. These elements function together to ensure the required level of thermal comfort in buildings.

The load-bearing structure is usually made of durable materials, such as construction bricks, reinforced concrete, aerated concrete, or other block materials. It serves as the base for attaching insulation materials and bears the weight of the entire system. Modern construction frequently employs porous blocks, which additionally reduce heat losses due to their structural properties.

To achieve building energy efficiency, materials such as mineral wool, expanded polystyrene, or extruded polystyrene foam are most commonly used. The choice of material depends on climatic conditions, the building's functional purpose, and insulation requirements. For instance, mineral wool provides high vapor permeability, preventing moisture accumulation in walls, while polystyrene offers low thermal conductivity and high mechanical resistance.

The final layer is the external covering, which performs decorative and protective functions. This is usually plaster, facade tiles, or ventilated facade panels. Specialized fastening systems are used to securely bind all layers, ensuring the structure's durability and resistance to mechanical impacts and temperature variations.

Fasteners play a crucial role in the functioning of the insulation system. These are made from stainless steel, polymers, or composite materials. Polymer fasteners minimize the risk of "thermal bridges," positively impacting the overall insulation level of the building. The placement and number of fasteners depend on the structural features of the wall. Typically, fasteners are spaced at 400–600 mm intervals.