SYSTEM DECISION SUPPORT FOR ENERGY MANAGERS ON THE PROCESS OF HEAT CONSUMPTION OF THE BUILDING

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With rising energy costs and their deficit is becoming increasingly important to avoid excessive energy, especially associated with the dysfunction of the equipment or ineffective actions of staff. In the energy balance of residential and administrative buildings the largest share (70%) took the microclimate maintenance system in Ukraine - is primarily heating. However, if several decades ago to influence modes of heat consumption in district heating systems could only be the source of heat (at least in the central heat points) by changing the temperature of the coolant, and the methods available to consumers only remained open window or ventilator. In recent years the situation has changed with the introduction of new and reconstructed buildings, individual heat points and controllers inside temperature, allowing to customize the consumption individually for each building (including running time and ambient temperature), and often for each room.

At the same time, the complexity of regulation and the impact of the so-called "human factor" significantly complicated the process of monitoring the efficiency of heat energy. Specialist responsible for the efficiency of heat consumption (energy manager), one or two buildings, the presence of vast experience and understanding of the processes can efficiently manage processes and detect abnormal situations. Given that the number of such buildings is increased, or the absence of sufficient experience in the energy management control process is much more complicated and can not wake feasible without automated systems.

The purpose of research - to develop methodologies and algorithms for analyzing the effectiveness of individual heat consumption at home.

Materials and methods of research. Currently, the European and the national practice of using two basic approaches to determine the effectiveness of heat consumption:

1) Calculation of thermal characteristics on the basis of information on the building envelope and systems engineering;

2) the use of simple statistical dependencies heat consumption temperature.

The disadvantages of the first method include the complexity and high cost performance such calculations (especially when gathering initial information about the building provided the design documentation is missing or was reconstructed) and use simplified methods leads to a significant error in the results, especially in the analysis of short time intervals (of sufficient accuracy can talk only if the analysis time intervals longer than a month, and this in turn can not quickly respond to the situation).

The method is based on analysis of statistics and heat consumption depending on the number of degree-days is quite simple to use, but provides the linearity of the relationship between these indicators. But in real conditions specified linear dependence, especially if the deficit of thermal energy (usually this is reflected in the reduction of the temperature schedule of heating networks compared to the project) and the use of a single accounting unit for heating and hot water.

One illustrative example of the complexity of the application of these approaches was the analysis of heat consumption of public sector institutions. Kyiv, which were equipped with individual heating points (over 1,100 buildings). In particular, the following issues were identified.

1. Lack of or incomplete project documentation, which is not allowed in some cases without even heating measurements to determine the area or volume of buildings, not to mention the areas of walls, windows and doors broken down to the cardinal and heat transfer coefficients as required methodology to determine the thermal performance of buildings, in particular DBN "Insulation".

2. Heat consumption modes schools even built on the same project, often significantly different, the reason could be a different source of heat, and the different behavior of staff and visitors.

3. Lack of metering heat energy to the introduction of regulation that prevented adequate to build a statistical model of heat consumption facility.

4. Use common accounting unit for heating and hot water and two-stage scheme of hot water, which greatly complicated the separation of consumption for heating and hot water.

5. A large number of objects impossible "manual" analysis of the interval, even once a month to a limited number of people (3 - 5 specialists monitoring the buildings in 1000).

6. The lack of experience and understanding of the mode of heat consumption for technical specialists and facilities in subdivisions administrations. This local energy managers usually have a significant amount of additional duties that did not allow enough time given to the analysis of heat consumption.

7. The use of remote data collection, which allowed to obtain indicators of heat consumption at intervals of 1 per hour and more, created a significant additional amount of information that needed a new approach and additional time for analysis.

The need to address these problems allowed to accumulate a large amount of information and to develop approaches to data analysis and rapid response to deviations that can be used in settlements of district heating systems. Further, the following approaches will significantly simplify the planning and implementation of brownie heat consumption regulation that under current conditions is one of the most effective measures.

Results. Were set such tasks.

1. Construction of model graphs of heat energy buildings for different time intervals (year, quarter, month, week), revealed that the main features of heat consumption administrative and public buildings. This allowed even to analyze heat consumption of buildings, which were no statistics through the use of (the first stage) schedules for the same type of heat consumption (according to the classification) buildings. It should be noted that the classification only building series did not give sufficient accuracy, because a number of reasons "same type"

houses had heat consumption schedules that greatly differ. Identified at that stage depending allowed to form a set of options for building models of heat consumption of buildings.

2. Development of methods for model building heat consumption of buildings, based on statistics that would take into account a significant number of influential parameters and "samonalashtovuvatysya" as the new information.

3. Create the rapid test algorithm that would without a detailed energy audit, with information on the results of implementation on such facilities, identify buildings that require urgent implementation.

4. Creation of a system that would allow to collect and analyze information on energy (including heat consumption), characteristics of buildings and energy managers to help detect deviations in time and avoid excessive energy.

Proposed and implemented in the software product energy consumption monitoring system allowed to merge into a single whole streams of data collection on energy consumption (manual and automated) information about objects, blocks of data analysis, and most importantly has created an environment for energy managers at various levels of communication, analysis and accumulation of data for further improvement.

To group objects, depending on the mode of heat consumption, followed by building typical schedules and rapid implementation efficiency analysis were used Kohonen neural network.

To build a model of heat consumption for different time intervals was selected fuzzy neural network.

Conclusions

The question of analyzing the effectiveness of heat energy buildings acquired special significance after the installation of automatic regulation of heat consumption for a particular building or room.

The approaches allow to create effective system of energy use for different initial state of these systems and gradually increase the functionality and accuracy.

Mathematical models and methods to quickly and with minimal involvement of skilled personnel to analyze and draw conclusions about the effectiveness of heat consumption for time intervals of 1 hour to a month.