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***YOUNG RESEARCHERS IN THE GLOBAL  
WORLD: VISTAS AND CHALLENGES***

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## **DEVELOPMENT AND IMPLEMENTATION METHODS MULTICRITERIA EVALUATION OF EFFICIENCY ENERGY SAVING ACTIVITIES IN THE FIELD OF HEAT SUPPLY**

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In recent years a significant number of cities in Ukraine have joined the Covenant of Mayors on Climate and Energy, which provides for the holding municipal authorities measures to significantly reduce greenhouse gas emissions by 30% by 2030 [1]. Achieving this result requires a new strategy for the use and development of the municipal energy system, which envisages increasing the environmental safety of boiler plants and thermal power plants through the introduction of innovative high-efficiency energy-saving, environmental and economically sound technologies [2].

Consequently, our purpose was to create and practical implementation method of multicriteria assessment of the effectiveness of energy saving measures with thermal energy of buildings by indicators of energy, environmental and economic effects. To achieve this goal, the following tasks were solved, such as: the creation of a multi-criteria method for evaluating the effectiveness of energy conservation measures in the field of heat supply and realization of the created method for assessing the effectiveness of energy-saving measures recommended for implementation at full-scale facilities.

The following indicators are used as criteria for assessing the effectiveness of the studied measures: 1) energy effect – the absolute and relative value of the saved thermal energy ( $E_I$ ); 2) environmental effect – the amount of fuel saved, reducing emissions of greenhouse gases and pollutants into the atmosphere ( $E_{II}$ ); 3) economic effect – the cost of saved thermal energy and fuel ( $E_{III}$ ) (Fig. 1).

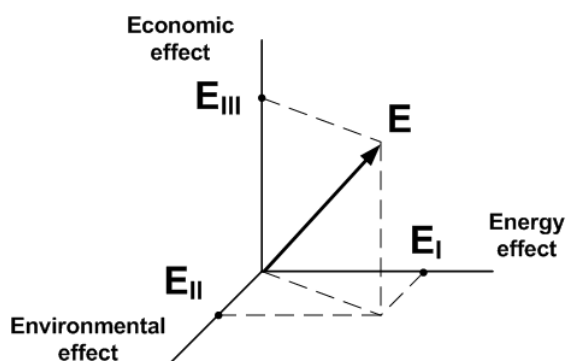


Fig. 1. Components of the overall effectiveness of energy conservation measures in the field of heat supply

The practical realization of the created method basis on the 2 full-scale objects: № 1 – a 3-story fragment of the administrative building of O. M. Beketov National University of Urban Economy in Kharkiv with a total heated area of 225 m<sup>2</sup> and No. 2 – the building of the communal institution «Kharkiv Palace of Children and Youth Creativity» with a total heated area of more than 13700 m<sup>2</sup>.

For full-scale object № 1, the effectiveness of using «smart home» technology to control the thermal conditions of the building's premises using the HERZ Smart Comfort automated system has been evaluated. The following performance indicators for the use of this measure for the heating period are thermal energy savings – 3734 kWh or 17%, reduction of natural gas consumption for heating – 406.4 m<sup>3</sup>, reduction of CO<sub>2</sub> and NO<sub>x</sub> emissions – 789.1 kg and 0.86 kg, respectively reduction of payment for consumption of thermal energy – 4041 UAH and fuel – 4441 UAH.

For full-scale object № 2 was evaluated the effectiveness of 2 energy-saving measures: controlling the thermal conditions of the building's premises with the HERZ Smart Comfort system and using an alternative heat source – heliosystem, which consists of 180 solar collectors. It was established that the 1-st measure has such an annual effect: energy – 130,3 Gcal or 11.1%; ecological: reduction of natural gas consumption – 16.5 thousand m<sup>3</sup>, reduction of CO<sub>2</sub> and NO<sub>x</sub> emissions – 32.0 tons and 0.035 tons, respectively; economic: reduction of payment for searing – 249.5 thousand UAH; 2-nd measure has such an annual effect: energy – an additional amount of thermal energy – 376.7 Gcal or 20.2%; ecological – reduction of natural gas consumption – 47.7 thousand m<sup>3</sup>, reduction of CO<sub>2</sub> and NO<sub>x</sub> emissions – 92.6 tons and 0.101 tons, respectively; economic: reduction of payment for thermal energy – 721.3 thousand UAH; the payback period of the measure is 5 years.

The research results showed such properties of the proposed method for evaluating the effectiveness of energy-saving measures, such as: high information content of the results, providing the possibility of multicriteria optimization of the parameters of heat supply systems and heat consumption of the research object, ability to improve by increasing the number of studied performance indicators.

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