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ENERGY AND ECONOMIC EFFICIENT OPERATING MODES OF THE ENERGY SUPPLY SYSTEM WITH COGENERATION HEAT PUMP INSTALLATION

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The aim of our study was estimated energy and economic efficient operation modes of the energy supply system (ESS) with cogeneration heat pump installation (CHPI) on the example of the thermal scheme of heating boiler house, with using the research results from our study [1].

ESS with CHPI provide high efficiency of energy conversion and are designed to meet the needs of heat consumers, as well as their own needs for electricity.

The study [1] was aimed at determining the effective modes of operation of the ESS with CHPI on the example of the thermal scheme of the heating boiler house. In our study, the efficiency of the modes of operation of ESS with CHPI for the thermal scheme of heating hot water boiler house on natural gas, with using in CHPI the heat of boiler exhaust gases.

The maximum heating capacity of the investigated boiler house is 7,57 MW. The maximum capacity of consumers of hot water supply from the investigated boiler house is 3,23 MW. The study [1] evaluates the effectiveness of four modes of operation of ESS with CHPI in the thermal scheme of the heating boiler house when working with variable loads of heat consumers.

The following modes of operation of ESS with CHPI in the thermal scheme of the boiler house are investigated: for operation in two seasons with use of 100% of the heat capacity of the exhaust gases in the contact utilizer; for operation in two seasons with use of 80% of the thermal power of the exhaust gases in the contact utilizer; for operation in two seasons with use of 60% of thermal power of exhaust gases in the contact utilizer; for operation in two seasons with use of 40% of thermal power of exhaust gases in the contact utilizer.

According to [1], the most efficient mode of energy and economic indicators is the variant of ESS operation with CHPI in the thermal scheme of the heating boiler house with using 40% of the thermal power of the exhaust gases in the contact utilizer.

According to [1], the thermal capacity of heat pump installations is 963 kW in the first season, 2215 kW in the second season; the maximum electrical power of the compressor is 818,87 kW. The total thermal capacity of ESS with CHPI in the first season is 1,295 MW, in the second season - 3,343 MW.

According to the results from [1], for ESS with CHPI the gas-piston engine-generator with nominal power of the electric generator of 1000 kW, the heat pump with estimated heat productivity 3000 kW, recycling equipment and pumps were chosen.

The study [1] analyzes and determines the effective modes of operation of ESS with CHPI on the example of the thermal scheme of the heating boiler house.

In our investigation is estimated energy and economic efficient operation modes of the ESS with CHPI on the example of the thermal scheme of heating boiler house, with using the research results from our study [1] and developed by the author methodological fundamentals for assessing energy, economic and environment efficiency of ESS with CHPIs, covered in publications [2 – 12].

The energy and economic effects from the introduction of ESS with CHPI in the thermal scheme of heating boiler house is confirmed by the efficiency of compared to the basic version of the heat supply source– the existing boiler house. Estimation of indexes of energy and economic efficiency for basic and alternative (with ESS with CHPI) variants of heat supply sources is executed based on researches [1 – 12], results are summarized in Figs. 1 - 2.

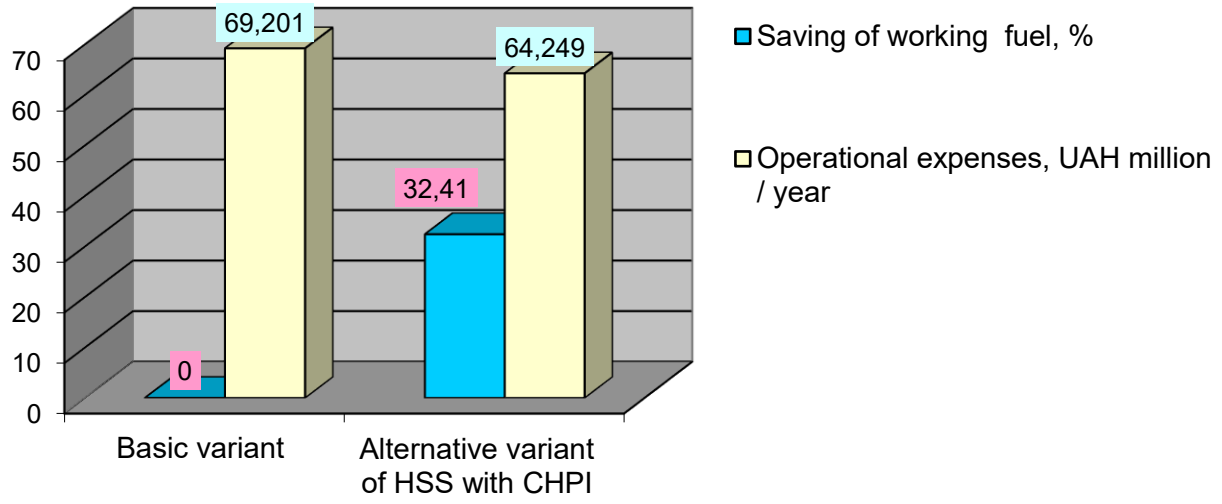

Fig.1 – Indexes of energy and economic efficiency of the variants

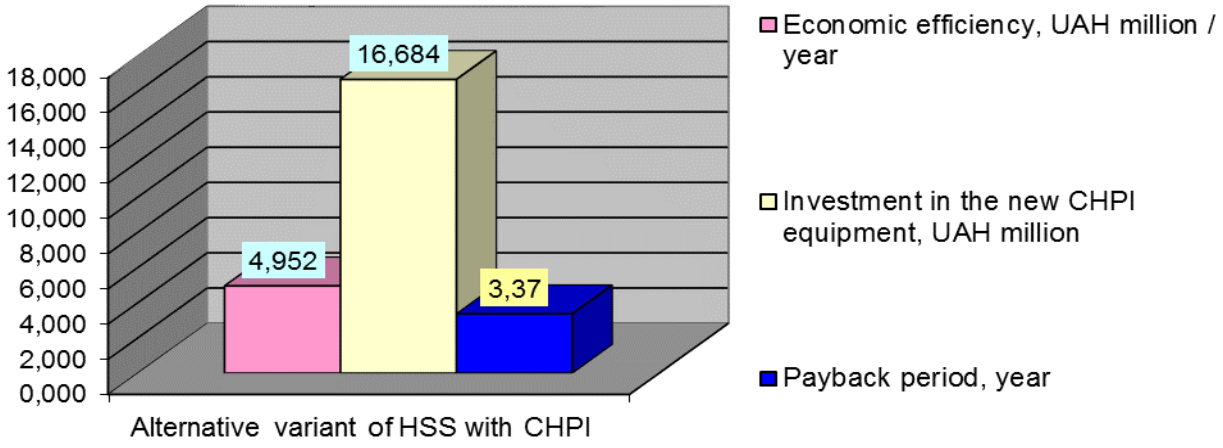

Fig.2 – Indexes of economic efficiency

Conclusions

In investigation estimated energy and economic efficient operation modes of the energy supply system (ESS) with cogeneration heat pump installation (CHPI) on the example of the thermal scheme of heating boiler house.

According to the results of the analysis of the indexes of energy and economic efficiency of ESS with CHPI in the thermal scheme of heating boiler house, it is determined that:

– the most efficient mode of energy and economic indicators is the variant of ESS operation with CHPI with using 40% of the thermal power of the exhaust gases;

– saving of working fuel will be provided in the amount of 32,41%;

– will reduce the operating costs (economic efficiency) of the boiler house with ESS with CHPI in the amount of UAH 4,952 million / year;

– investment in new CHPI equipment will amount to UAH 16,684 million;

– payback period of new CHPI equipment in the thermal scheme of heating boiler house will be 3,37 years.

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