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THERMOMODERNIZATION AND MEDIA CONSUMPTION ON SELECTED EXAMPLES

The thermal protection of buildings and rationalization of water consumption are directly related with energy savings but also with other aspects. The article presents the real results of the thermal modernization activity based on the monitoring of their effects in fourth educational buildings. The analysis includes water, electricity and energy consumption of these buildings. It was found that after thermal modernization the reduction of the consumption of water, electricity and gas has been noticed. The significant decrease in rates of consumption of media attributed to one student, the learner in a year, in the analyzed schools has been registered.
Keywords: **thermal modernization, water consumption, electrical power consumption, gas consumption, utility costs.**

Introduction. In Poland, in the perspective of the year 2025 it is expected to implement the idea of sustainable production and consumption in relation to the use of water for industrial, municipal and agricultural, to introduce rules for the application of best available techniques (BAT – Best Available Techniques) in systems abstraction, treatment and distribution of water and achievement of indicators of water consumption per unit or value of production and per capita does not exceed the average values for OECD countries. [1]. Activity aimed at more efficient use of water are closely associated with the activities in the area of energy efficiency. Water preparation technology from its collection to final use requires the use of energy. In addition, water often has to be heated to a suitable temperature and for further use in domestic or industrial purposes. For the construction industry it is primarily energy for preparation of warm water.

The energy efficiency is one of the leading issues considered by members of the European Union in strategic documents determining the development direction of the Union [2, 3].

Due to the increasing need for access to clean water and a growing amount of energy used for warming it, the solutions to solve this problem are searched. Among other things, one of the main goals of the UN World

Water Day 2014 was to draw attention to the technologies that would meet the demand for water, while using less energy.

Realization and exploitation of buildings involves in European Union almost 40% of total energy consumption [4]. The issues of thermal protection of buildings and rationalization of water consumption are directly related with energy savings but also with other aspects.

Efficiences energy and water in buildings. Building stock of European Union covers about 200 million buildings, out of which 6 million are located in Poland. Around 70% of energy is consumed for heating and domestic hot water needs [4, 5]. The largest heat consumers in Poland are the households, consume about 54% heat. The heat consumption in Poland has shown a slight declining tendency in the recent years (Fig. 1) [5].

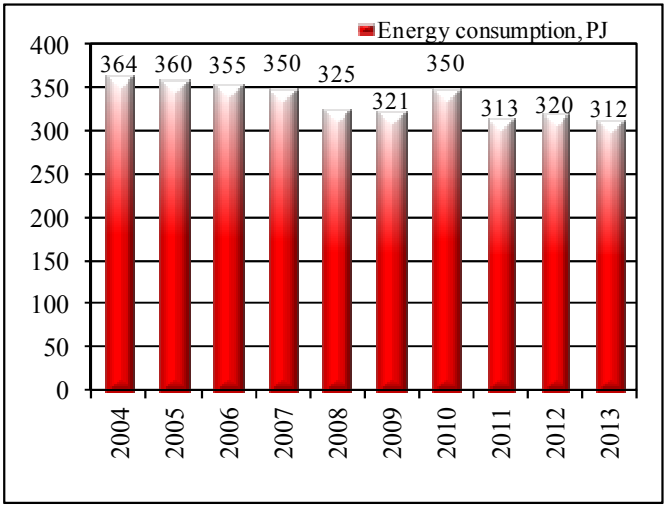

Fig. 1. Energy consumption in Poland in the recent years [5]

The provisions of the directive [2] impose an obligation, inter alia, to elaborate national, long-term strategies supporting the modernization investments covering the specification of optimal ways for improving energy efficiency of buildings and specification of instruments mobilising the investments. Thermal protection of buildings in Poland and ratio-?alization of water consumption is based on the provisions of the Polish Construction Law and on the technical and construction conditions.

The energy efficiency pointed out in the directives constitutes an important basis for reduction of greenhouse gas emissions. Starting from 2021 all newly constructed buildings will be required to have very low energy

consumption, covered mainly by the renewable energy resources. Therefore, it is necessary to promote and implement environmental friendly technologies based on the renewable energy resources.

Non-renewable fuels used in Poland for generation of energy are as follows: hard coal (58.8%), lignite (17.7%), fuel oil (18%) and natural gas (5.6%) [5]. Poland is one of the biggest primary energy producers in the European Union (about 8.5% in 2012) [6]. As far as energy from renewable sources goes, relation of RES production to total energy consumption has been growing both in Poland and in the European Union during recent years (Fig. 2) [5].

One of the elements of improving energy efficiency and reduction of emissions are the undertakings related with thermal modernization of buildings. It has been estimated that through the modernization of an average building in accordance with the currently valid regulations up to 40% of energy may be saved. The implemented in Poland provisions constitute a basis for performing these activities in a complex manner and cost-effectively, considering the investment and utilization expenses.

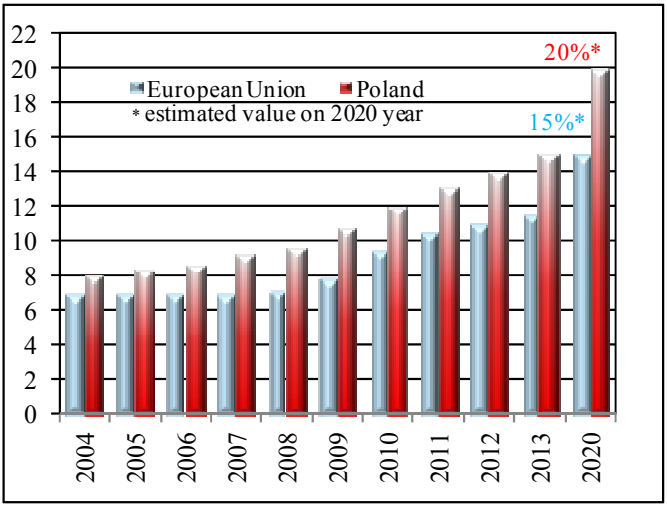

Fig. 2. Share of renewable energy in gross final energy consumption [5]

In the total operating costs of the provided services the main share accounted were costs related to payments for central heating and warm water [7]. The average share of the costs of heating and preparation of hot water in the total operating costs of exploiting buildings (Fig. 3) stood at 59.5% in 2006, and decreased to 53.1% in 2012.

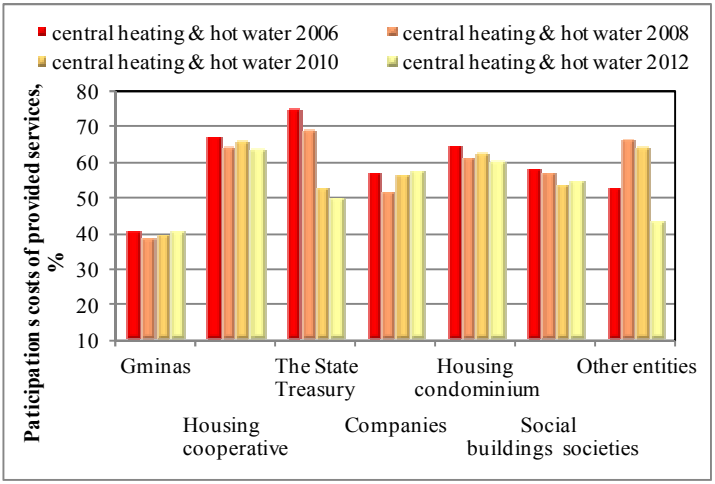

Fig. 3. Structure of share of central heating and hot water costs of provided services as per the forms of ownership in Poland [7]

The average share of cold water and sewage discharge (Fig. 4) increased from 30.4% in 2006, to 33.3% in 2012. It indicates a clear trend declining of the cost of heating buildings and increase in the cost of water in the opera-?ion of the various buildings, in Poland.

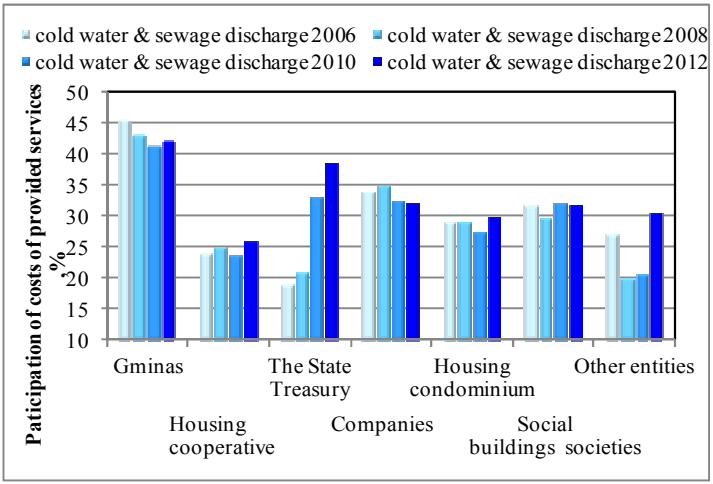

Fig. 4. Structure of share of cold water and sewage discharge costs of provided services as per the forms of ownership in Poland [7]

Examples of thermal modernization and their effects. There are four school buildings, located in the province of Silesia, in the villages Gieblo, Ogrodzieniec, Podzamcze and Ryczow are the examples of buildings for which an assessment of the changes in basic media consumption and the related costs, before and after the thermal modernization.

Objects have been audit analyzed where from 2010 to 2012 the thermal modernization was carried out. The following improvements have been done: the thermal insulation of the external barriers and replacement of some equipment of the buildings. Activities were aimed at improving the efficiency of the energy use for heating and preparation of the domestic warm water.

The monitoring of the results from conducted modernizations showed that average energy reduction effect was at the range of 38÷45%, reduce gas and carbon consumption and associated costs.

Apart from that other components of media consumption and associated costs have been monitored. An evaluation of price changes on individual media in a given period of time have been done. Then the change in the price of media consumption in the analyzed period of time has been compared.

The principle of an average price of water, electricity and natural gas in the year, before and after the thermo, which stemmed from the annual accounts for the type of media have been taken into account. Another aim was to determine the consumption of a given type of media per student learner in a year in a school.

The average price of cold water increased in the period from 2009 to 2013 (Fig. 5). In the analyzed objects in the period before thermal modernization stood at 1.23 € /m^3, and after the thermal modernization it was increased to 1.65 €/m^3.

In the same period, after the thermal modernization the annual water consumption per student in most sites and years was decreased (Fig. 6). Before thermal modernization the average water consumption was 4.32 m^3/(per student a), and after the thermal modernization dropped to 3.85 m^3/(per student a).

The average price of electricity increased in the period from 2009 to 2013 (Fig. 7). In the analyzed objects in the period before thermal moder-?ization it stood at 0.16 €/kWh, and after the thermal modernization it increased to 0.18 €/kWh. In the same period, after the thermal moder-?ization the annual electricity consumption per student in most sites and years significantly was reduced (Fig. 8). Before the thermal modernization the average electricity consumption in the analyzed objects was 169.4

kWh/(per student a), and after the thermal modernization dropped to 143.3 kWh/(per student a).

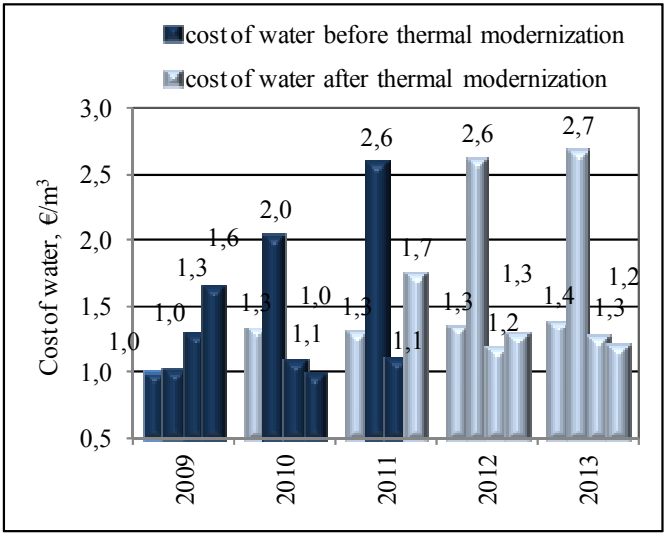

Fig. 5. Cost of water

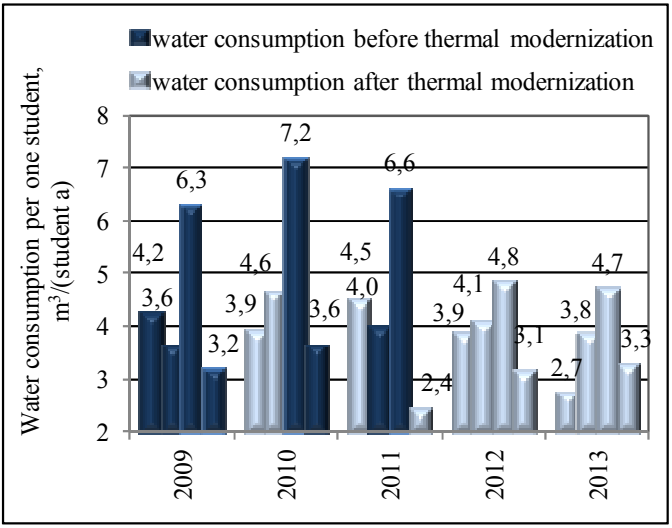

Fig. 6. Water consumption per one student

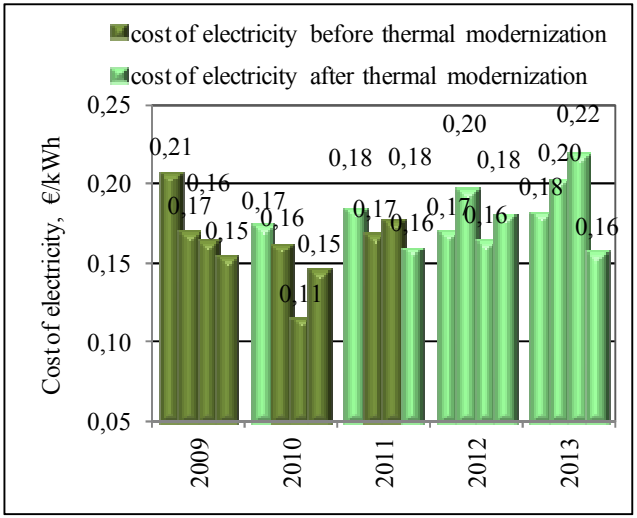

Fig. 7. Cost of electricity

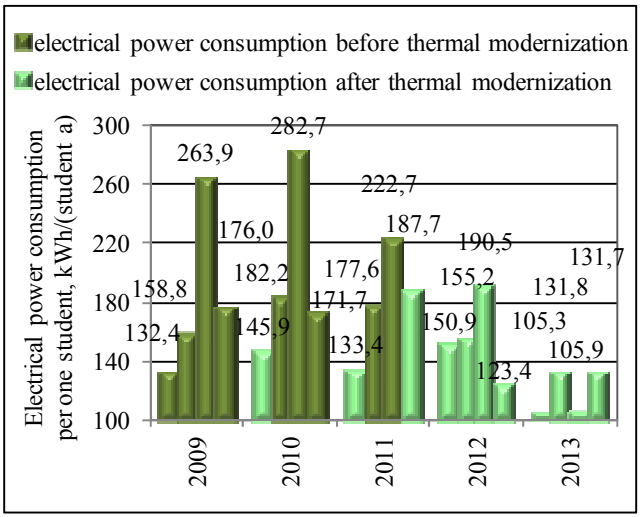

Fig. 8. Electrical power consumption per one student

The average price of natural gas increases significantly in the period from 2009 to 2013 (Fig. 9), in the analyzed objects in the period before thermal modernization stood at 0.47 €/m^3, and after the thermal moder-

?ization increased to 0.62 €/m^3. In the same period, as a result of carrying out the thermal modernization the annual consumption of natural gas per pupil in most sites and years was significantly reduced (Fig. 10). Before thermal modernization the average consumption of natural gas in the analyzed objects was 175.4 m^3/(per student a), and after the thermal moder-?ization dropped to 116.1 m^3/(per student a).

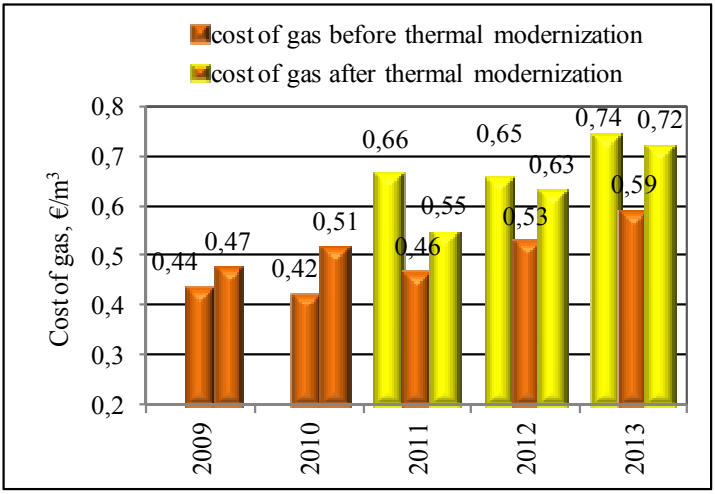

Fig. 9. Cost of gas

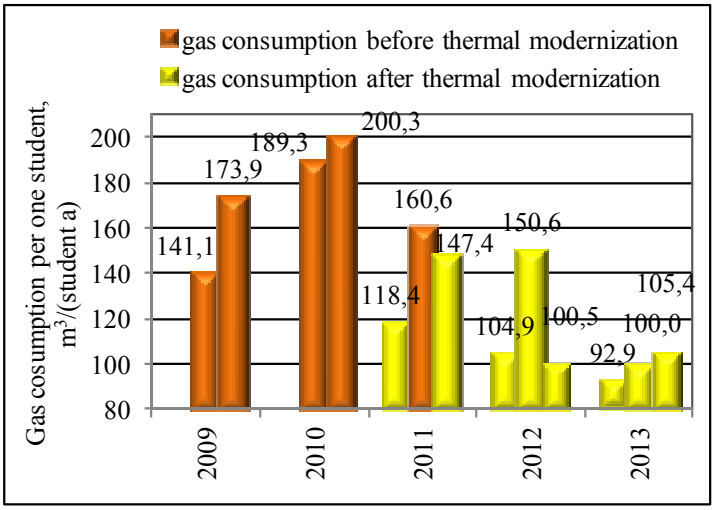

Fig. 10. Gas consumption per one student

Conclusions. In Poland, in the recent period, the decrease in costs associated with the heating of buildings and increase in costs related to the provision of water and sewerage discharge have been noticed.

In this article a case of comprehensive thermal modernization of a educational buildings was described. Comprehensive thermal renewal of a buildings brings the greatest effects and the shortest time of return on invested capital. The study showed that the thermal modernization initi-?tives contribute different effects related to sustainable development of construction industry and contribute to the improvement of energy efficiency.

Thermal modernization and observance of the rules of sustainable building allows reduction natural resources: water, gas and carbon. These activities contribute to the reduction of gas emissions and decrease of buildings operation costs. Average reduce energy in monitored period in these buildings was at the level of 38÷45%.

In the analyzed objects there was found that after the thermal moder-?ization not only energy consumption for heating was lowered, but also there were obtained other interesting effects including economic results.

Despite rising prices for water, electricity and natural gas the consumption rates of these media, per student were lower than before the thermal modernization. Reduction of water consumption per student was approximately 14% and the electricity 25%.

1. II Polityka Ekologiczna Państwa. Rada Ministrów RP, Warszawa 2000. **2.** Directive 2012/27/EU of 25 October 2012 on energy efficiency. **3.** Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings. **4.** Environment, Statistical Information and Elaborations, Central Statistical Office, Warsaw 2013. **5.** Energy Statistics, Statistical Information and Elaborations, Central Statistical Office, Warsaw 2013. **6.** Informacje o mieszkalnictwie. Wyniki monitoringu za 2003, 2004, 2011 i 2012 rok, Instytut Rozwoju Miast, Kraków 2004, 2005, 2012 i 2013. **7.** Housing economy in 2006, 2008, 2010, 2012 - Poland, Central Statistical Office, Warsaw 2007, 2009, 2011, 2013.

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ТЕРМОМОДЕРНІЗАЦІЯ ТА ЕКСПЛУАТАЦІЙНІ

ЗАТРАТИ – ВИБРАНІ ПРИКЛАДИ

Термомодернізація будівель та раціоналізація споживання води безпосередньо пов'язані зі збереженням енергії, а також з іншими отриманими позитивними результатами. У статті представлені реальні результати термомодернізації, які були отримані на основі моніторингу в чотирьох навчальних закладах. Аналіз стосувався витрат води, електроенергії, газу та споживання тепла у цих будівлях. Було відмічено значне зниження споживання тепла, води, електроенергії та газу після термомодернізації з розрахунку на одну особу, яка навчається, в рік.
Ключові слова: **термомодернізація, споживання води, споживання електроенергії, споживання газу, експлуатаційні платежі.**

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ТЕРМОМОДЕРНИЗАЦИЯ И ЭКСПЛУАТАЦИОННЫЕ РАСХОДЫ - ИЗБРАННЫЕ ПРИМЕРЫ

Термомодернизация зданий и рационализации потребления воды непосредственно связаны со сбережением энергии, а также другими положительными получаемыми результатами. В статье представлены реальные результаты термомодернизации, которые были получены на основе мониторинга в четырёх учебных зданиях. Анализ касался расхода воды, электроэнергии, газа и потребления тепла в этих зданиях. Было отмечено значительное снижение потребления тепла, воды, электричества и газа после термомодернизации в расчёте на одного учащегося в год.
Ключевые слова: **термомодернизация, потребление воды, потребление электроэнергии, потребление газа, эксплуатационные платежи.**
