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RES ADDITIONAL APPLICATION IN CONTEMPORARY BUILDINGS

Теплові насоси і сонячна система надають нам найефективніший шлях забезпечення нагрівання і охолодження у багатьох напрямках застосування, оскільки вони використовують поновлювальні джерела довкілля. Експериментальні виробничі приміщення нашого факультету "Центр економічних досліджень з поновлювальних джерел енергії і систем розподілу" був заснований з метою досліджень можливості зменшення енергетичних витрат на будівництво, пов'язаних з економією. Реалізований проект цього Центру створює реальне навколишнє середовище для ефективного проведення технологічних досліджень в лабораторії у режимі експлуатації: технології співгенеруючих елементів, теплові насоси, фотогальваніка, теплові капіляри і польові технології вимірювань і регулювання.

Ключові слова: поновлювані джерела енергії, прогресивні технології для закритих приміщень, HVAC.

Heat pumps and solar systems offer the most energy-efficient way to provide heating and cooling in many applications, as they can use renewable heat sources in our surroundings. The experimental workplace of our Faculty "Economic Research Centre for Renewable Energy Sources and Distribution systems" was founded with the purpose of investigating possibilities to reduce the energetic costs of buildings tied to economy. The realized project of the Centre creates real environment for effective implementation research of technologies in laboratory and operative conditions: technologies of co-generative elements, heat pumps, photovoltaic, thermal capillaries, and technologies in field of measurement and regulation.

Key words: renewable energy sources, progressive indoor technologies, HVAC.

Introduction. An increased utilization of renewable energy sources in the heat and electricity generation is one of priority tasks of the Slovak Republic to boost the use of domestic energy potential and thus to decrease the Slovakia's dependence on imported fossil fuels. Based on the "National Action Plan for Energy from Renewable Energy Sources" (approved on 6th of October 2010) Slovak Republic should focus specifically on the use of biomass. Ministry of Economy and Construction of the Slovak Republic states, that the use of biomass can be in many cases price-competitive with fossil fuels. In the National Plan is written that "increasing the use of biomass, energy savings as well as geothermal and solar energy use will lead us to reduce the consumption of natural gas for heating". Slovakia currently uses renewable resources, especially hydropower. [1]

One of the main sources of the energy consumptions are buildings. In European Union they are responsible for consuming as much as 40% energy. The problem is not only in heating but also in cooling the building during hot summer. Besides energy consumption problems extra high temperature during the summer 2003 killed only in EU more than 30 000 persons. The black out in Italy occurred during the summer. This happened as a consequence of installation and switching in too much of air conditions. In 2006 European Union define energy intelligent near zero building as a building where ratio between fossil energy and renewable energy should be 20% to 80%. As we shall show further on the heat pump system based on water combined with progressive microcapillar heating/cooling system could reach the limits for renewable energy given by EU in terms of heat and cool. What is also very interesting is that heat pump system could extremely reduce greenhouse emissions

In-situ experimental Centre. The experimental workplace of our Faculty "Economic Research Centre for Renewable Energy Sources and Distribution systems" was founded with the purpose of investigating possibilities to reduce the energetic costs of buildings tied to economy. The realized project of the Centre creates real environment for effective implementation research of technologies in laboratory and operative conditions: technologies of co-generative elements, fotovoltaics, cogeneration unit heat pumps, thermal capillaries, and technologies in field of measurement and regulation [2], [3]. The solution is the project with possibility to repeat it on other similar applications as well as the utilization of experience and determination of economical expedience of researched technologies implementation. Next phase of the research will be evaluation of operative behavior of the building, interaction with building constructions and study of inner climate parameters and overall results for central heat supply system.

Technical data. The office building in the centre of Kosice city (see Fig. 1) as large as 4000 m^2 has been step by step reconstructed since 1996. The heat consumption of the building in 1996 was about 3200 GJ per year.

Figure 1. CEF experimental building

Following technical improvements has been done:

- Reconstruction of the original energy source
- Window exchange and outside shield heat protection
- Thermostatic regulation
- Zone regulation
- Heat pump system introduction (Figure 2)

Figure 2. Heat pump in the boiler room

Partial results. The figure 3 shows the effect of the above technical improvements on heat consumption.

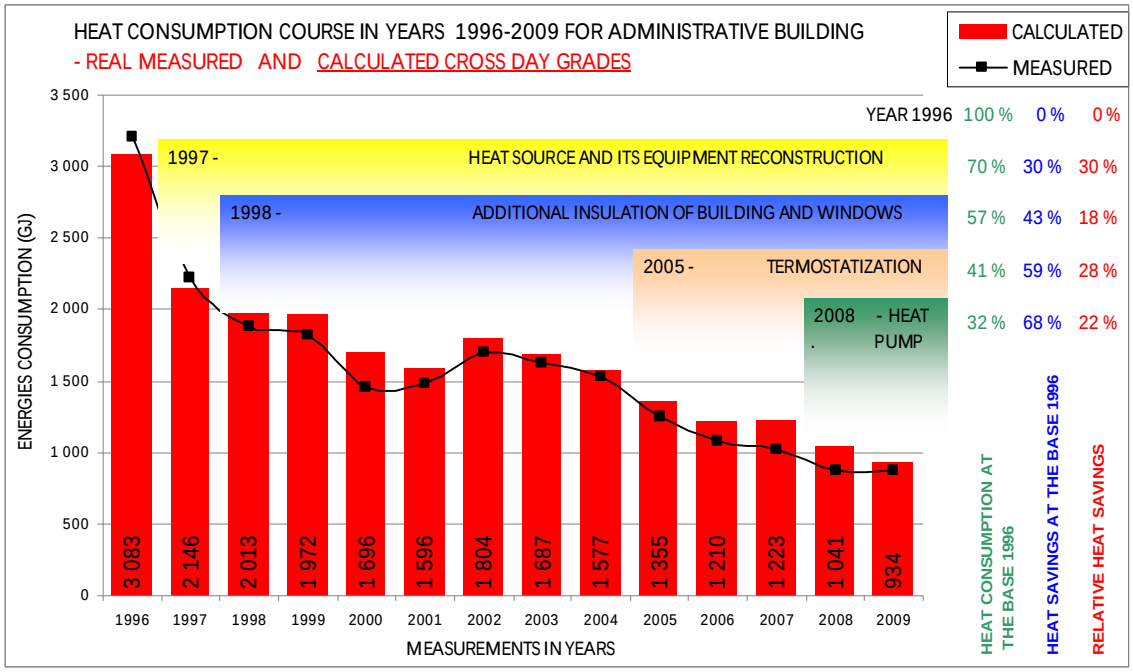

Figure 3. Heat consumption of the office building

From the Figure 4 it is possible to say that the main improvement in heat reduction has been reached via reconstruction of the energy source and better regulation either zone regulation or thermostatic regulation. The heat consumption went down from the level of 3 200 GJ to 934 GJ per year. This numbers are calculated as numbers adjusted to day degrees. From the data collected through the years till 2010 it is possible to say that almost 68% of the heat consumption per year has been saved. The construction of the building is based on use direct ventilation system through windows. This avoids installing many energy consuming ventilation systems and has no problem with the problem known as building sick syndrome.

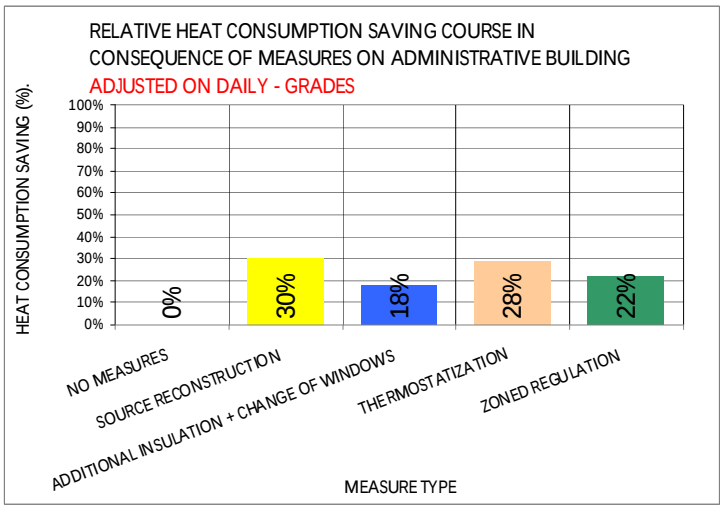

Figure 4. Relative effects of various improvements on heat saving

Greenhouse emissions CO2. Comparing the data given in the figure 3 and 5 it is the same until 2008 when the heat pump system has been introduced. SPF 3,04 and 3,16 has been reached in the year 2008 and 2009 respectively. This reduced the consumption of primary energy by the factor of SPF. On top of 22% savings due to the - zone regulation also another 53% of the primary energy has been saved as a consequence of the introduction of the heat pump system as it is given in the Figure 6.

A very similar chart to chart of primary energy (Fig. 5) is observed regarding saving emissions (see Fig. 7). However the sharp decrease of the emission produced as side product of the primary energy production is observed when heat pump system has been introduced. Total decrease of the emissions comparing the year 1996 has been reached up to 96%. 59% of the reduction could be attached to the heat pump system. From the relative point of view a reduction of up to 86% of the emissions produced before installation heat pump systems.

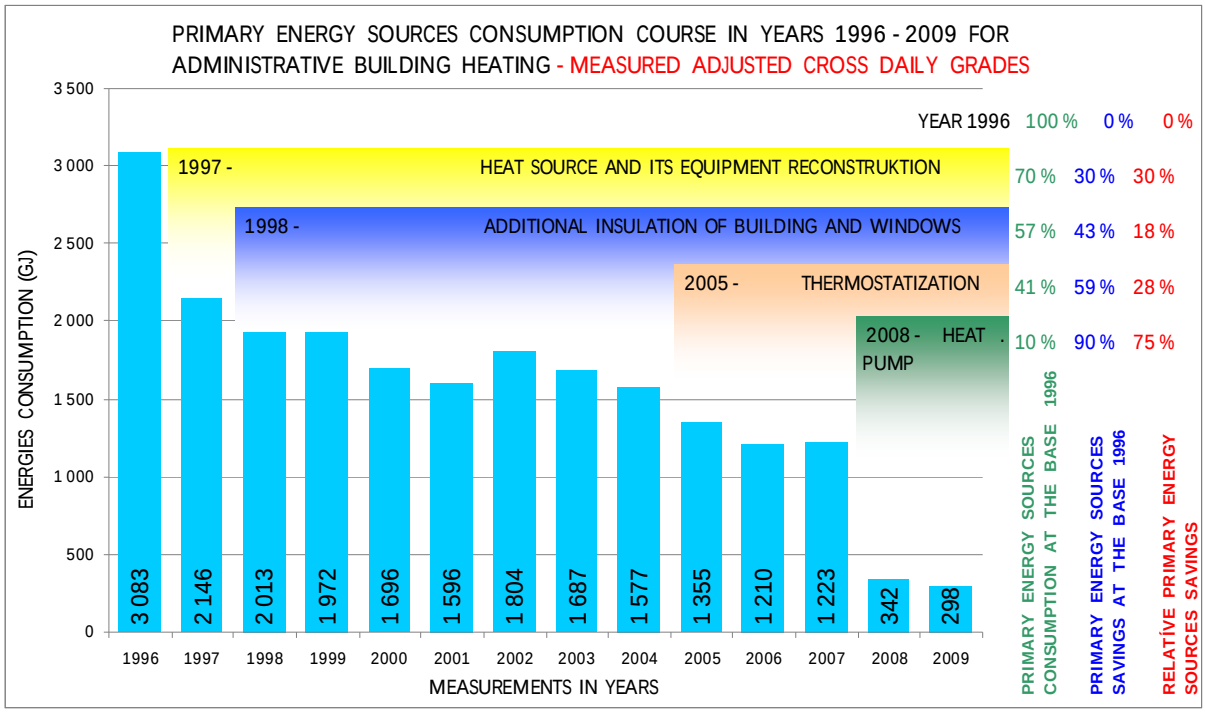

Figure 5. Primary energy consumption of the building during the years 1996 till 2009

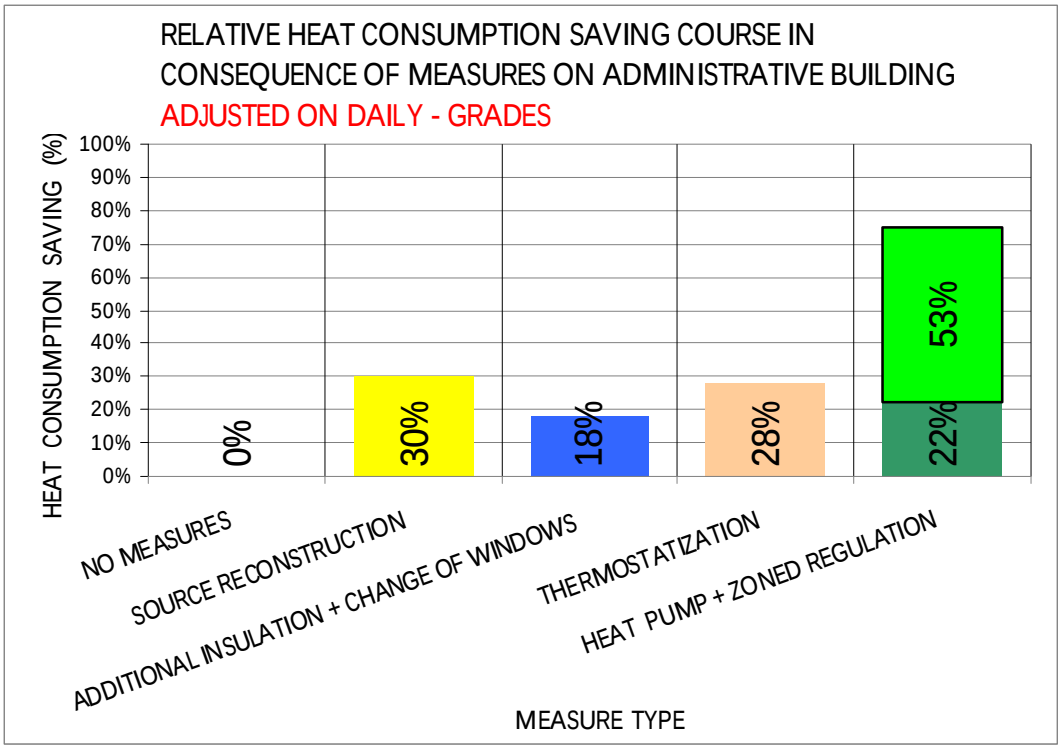

Figure 6. Relative effects of various improvements on primary energy saving

HVAC system . Micro capillary systems use for a transport of energy a radiation part. Replacing classic conventional radiators within the complex systems will shift the working point of the heat pump system and based on the first measurements and further calculation it is possible to reach SPF during heat period as much as 4,22. However micro capillary system allows also cooling buildings with the extremely small energy consumption The calculated SPF has been reached 14,98. If we combine above figures we can reach for the total year SPF as much as 6,91. This ratio is nothing else than 13% of the primary energy and 87% of secondary energy. From the point of view renewable energies it is necessary to stress out that an electricity mix in Slovakia consists 15% of the production from water electricity stations so then we can calculate the ratio for renewable energy as (SPF+0,15)/(SPF+1) which gives us 89%.

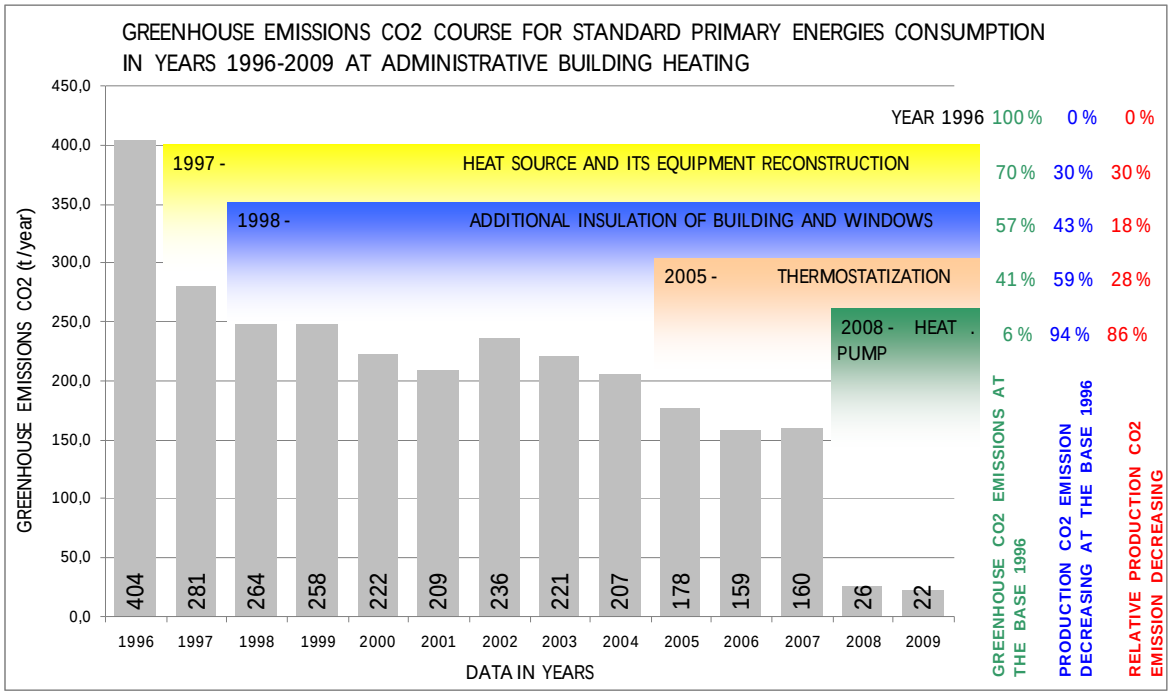

Figure 7. Greenhouse emissions

The Figure 8 shows some illustrative pictures from heating/cooling micro capillary system by thermo camera.

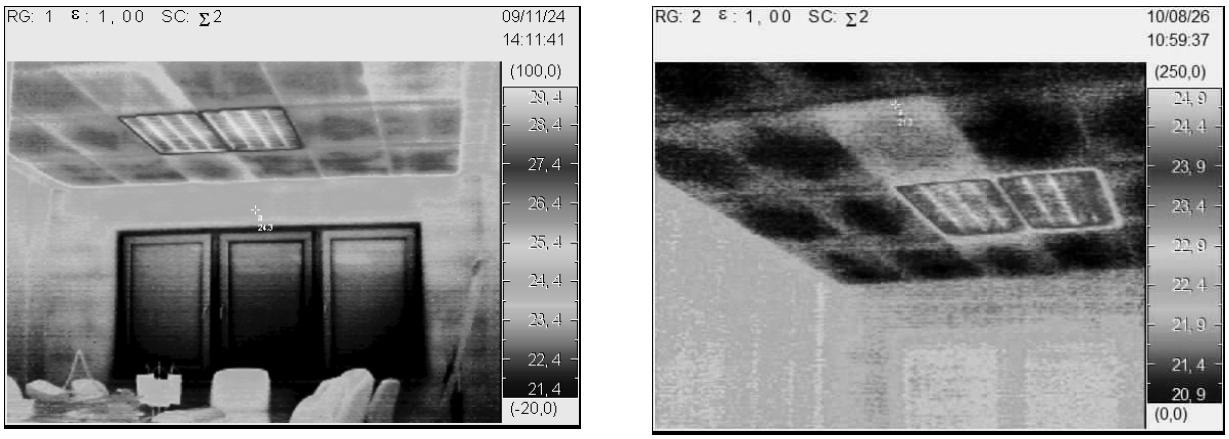

Figure 8. Heating (left) /cooling (right) space of office room

Conclusion. Heat pump system combined with micro capillary system provides an extremely efficient tool to reduce fossil energy consumption and in the same time also greenhouse emissions CO_2. Our experiments showed that nearly 95% of the greenhouse emissions could be saved. Moreover the heat

and cool primary energy can be reduced 80% and better. From the point of view of heat and cool it is possible to say that the system reach the target of EU - energy near zero intelligent buildings. The energy power of the water well allows even to put exceeded energy on the local market so the building could be converted from the energy consumption into the energy supply status. Heat pump system build within the building far exceeds the limit given by EU for SPF in order to be calculated into national renewable energy quotas. The potential of the heat pump system is widely used in Sweden, Germany or Swiss. The potential of water based heat pump system is very attractive not only for heating but for cooling buildings as well as very effective and possible cheaper solution comparing to other possibilities. Combination with the micro capillary system also introduce for the human very comfort heating and cooling system due to radiation based transport of energy. This type of transport of the energy is very convenient to the human. It is expected that it could be a factor which could positively influence the environment within the building and has a potential to influence also the productivity of the work in office space.

Heat pump systems have a possibility to reduce greenhouse gasses production up to 95% and it could provide renewable energy more than 80% from the energy consumed. To overcome the economy crises will be enough to follow the solution from 70ties and reduce fossil energy consumption per GDP to 50% level or we have to in the same time reduce the greenhouse gasses more than 50%? The ecology oriented scientists are given many facts that we have to reduce also greenhouse emission production. Hence the heat pump system addresses both problems.

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