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Long term experimental evaluation of the influence of heat cost allocators on energy consumption

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Introduction

- *rationalization of energy consumption in residential sector*
  - heat source,
  - heating system,
  - hot water preparation system.

but what can we do in many existing buildings?

- after thermal retrofits of envelope,
- after modernization of heating system.

education of energy users

(for example by providing residents with information about the energy consumption in their flats using individual metering)

Introduction

This may be done by:

- *installation of individual heat consumption meters,*
- *individual heat cost allocators*.

However …

Materials and Methods

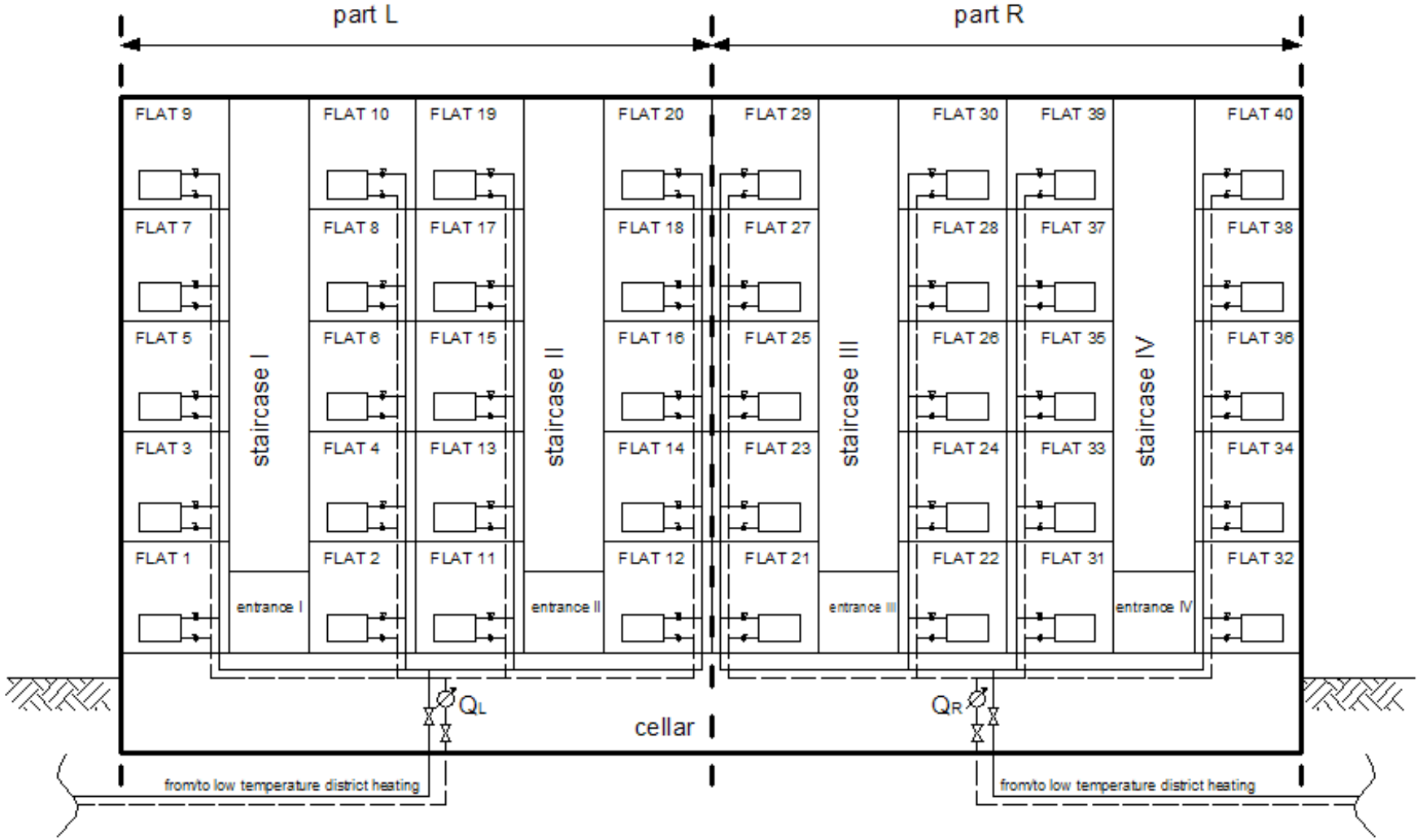

Fig. 1. *Scheme of the analyzed building (Cholewa i Siuta-Olcha, 2015)*

Materials and Methods

Modernization activities in the building:

- **in 1996** heat cost allocators were installed on radiators in the **part R** of the building (staircase III and IV);

- in the **part L** of the building (staircase I and II), heat cost allocators were not installed **until 2011**, and the costs of heating used to be charged on the basis of square metre of the floor surface area;

- in the summer of 1998 the thermostatic radiator valves (TRVs) were installed;

- in the summer of 2005 was made the thermal modernization of external walls (10-cm thick styrofoam).

Materials and Methods

Methodology:

- analyzed period of time: from December 28, 1997 to April 22, 2014;

- readouts from two heat meters (part L and part R) were performed monthly;

- the comparison of the heat consumption between both parts of the building (part L and part R) did not include the corrective coefficients taking into account the influence of outdoor air temperature on the heat consumption.

- the energy savings achieved due to the use of the heat cost allocators were calculated as:

$$Q_{SAVE} = Q_{part\ L} - Q_{part\ R} \quad [GJ]$$

where:

$Q_{part\ L}$ - total amount of heat delivered to left part of the building, [GJ],

$Q_{part\ R}$ - total amount of heat delivered to right part of the building, [GJ].

Results- for building as a whole

1. Modernization of external walls – 22% of energy savings;
2. Installation of heat cost allocators in part L- 19%.

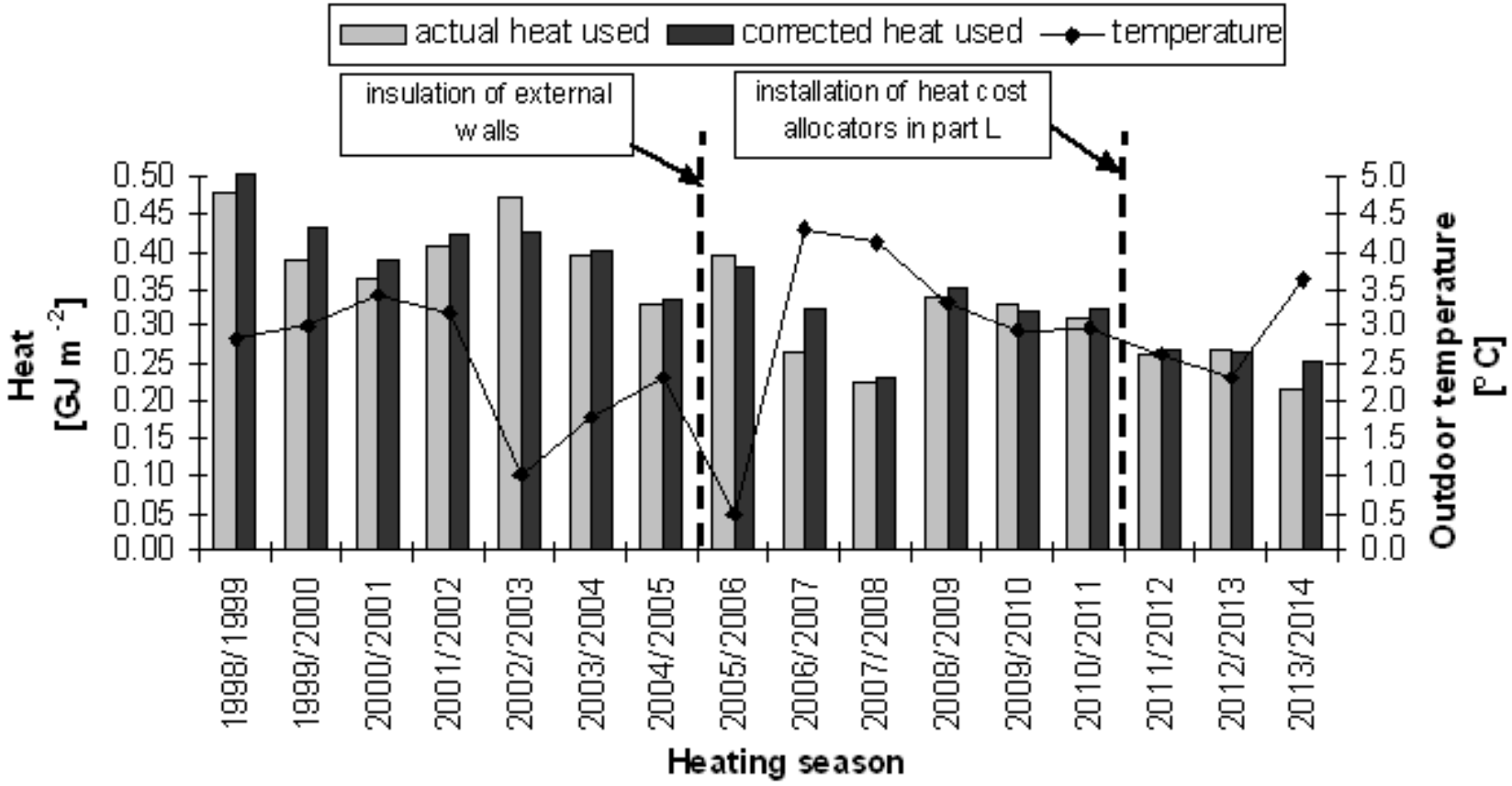

Fig. 2. *Average amount of actual and weather-normalized heat used per square metre of floor surface area in the building (Cholewa i Siuta-Olcha, 2015)*

Results - before the installation of TRVs

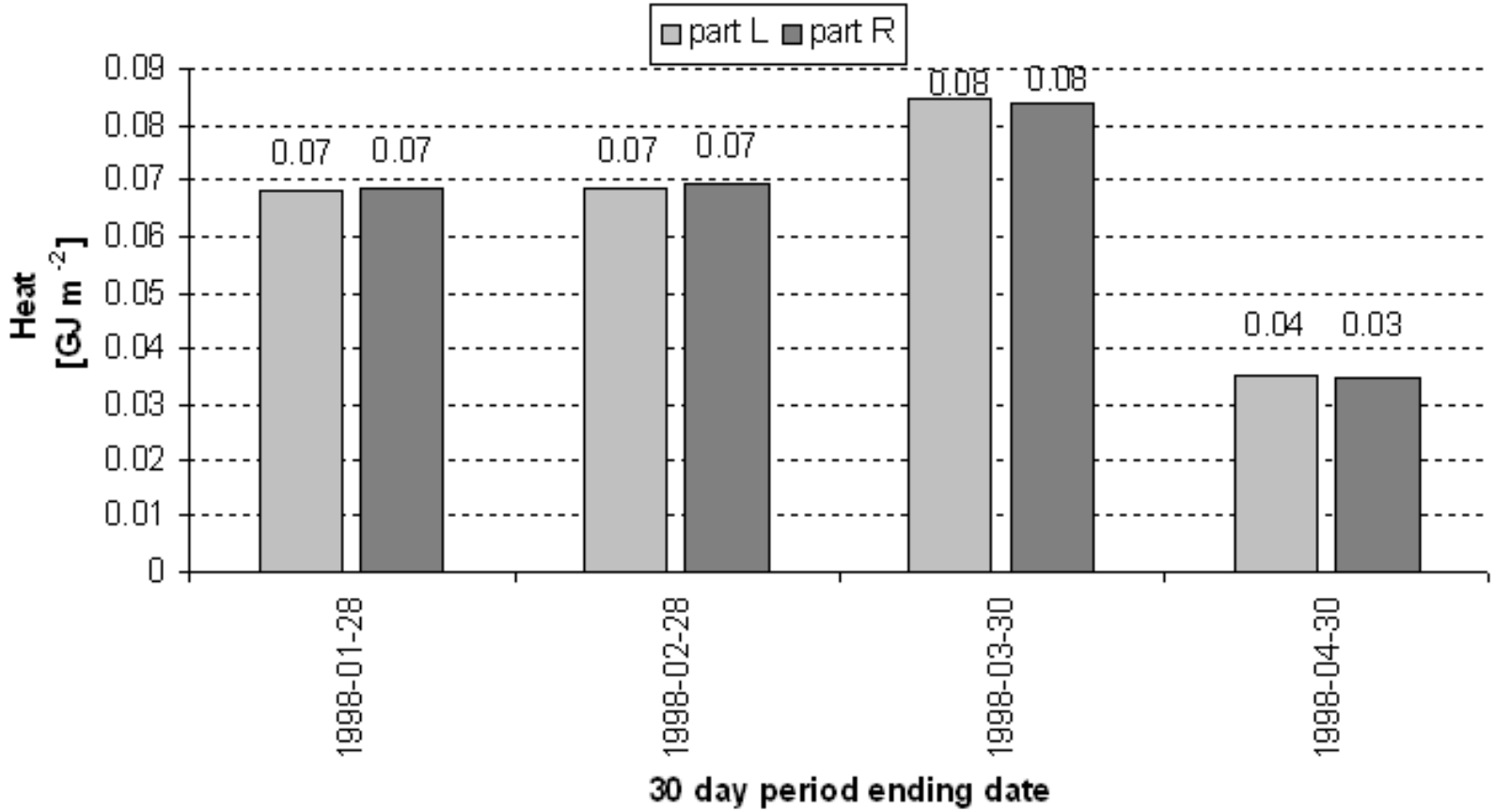

Fig. 3. *Heat consumption in part L and part R of the building before the installation of thermostatic radiator valve (1997/1998) (Cholewa i Siuta-Olcha, 2015)*

Results

Thermostatic radiator valves (TRVs) have two functions:

- controlling the indoor air temperature by changing the flow of heating medium to the radiator (local regulation);

- hydraulic balancing of central heating system by use of preliminary setting of the valve.

The use of thermostatic radiator valves (TRVs) may generate energy savings, which may be

equal to…

and depend on…

Results- before the external walls insulation

differences between the heat consumption in the part R and the part L: 26.6%

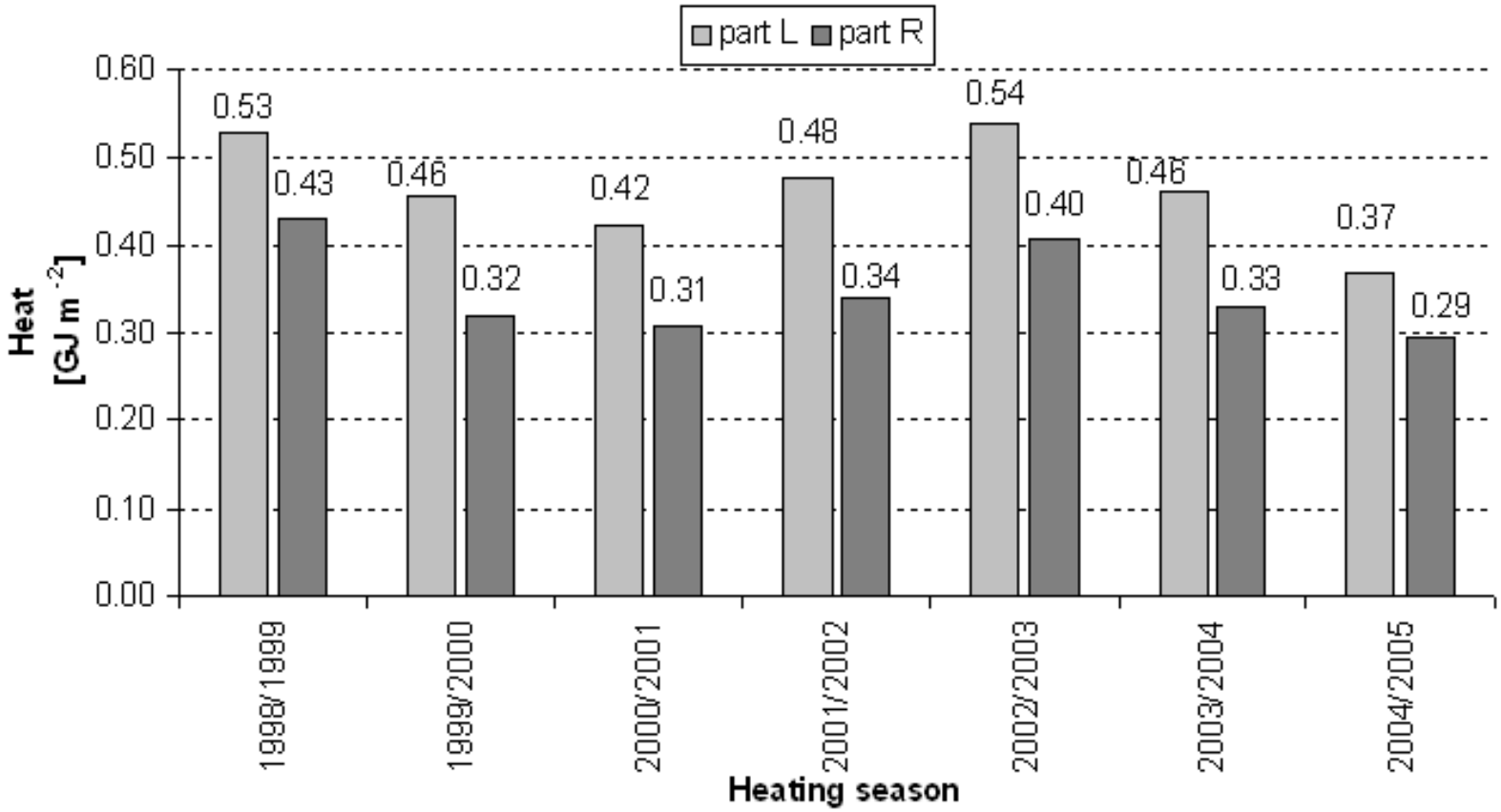

Fig. 4. *Average amount of heat used per square metre of floor surface area in both parts of the building during each heating season before the external walls insulation (Cholewa i Siuta-Olcha, 2015)*

Results- after the external walls insulation

differences between the heat consumption in the part R and the part L: 30.5%

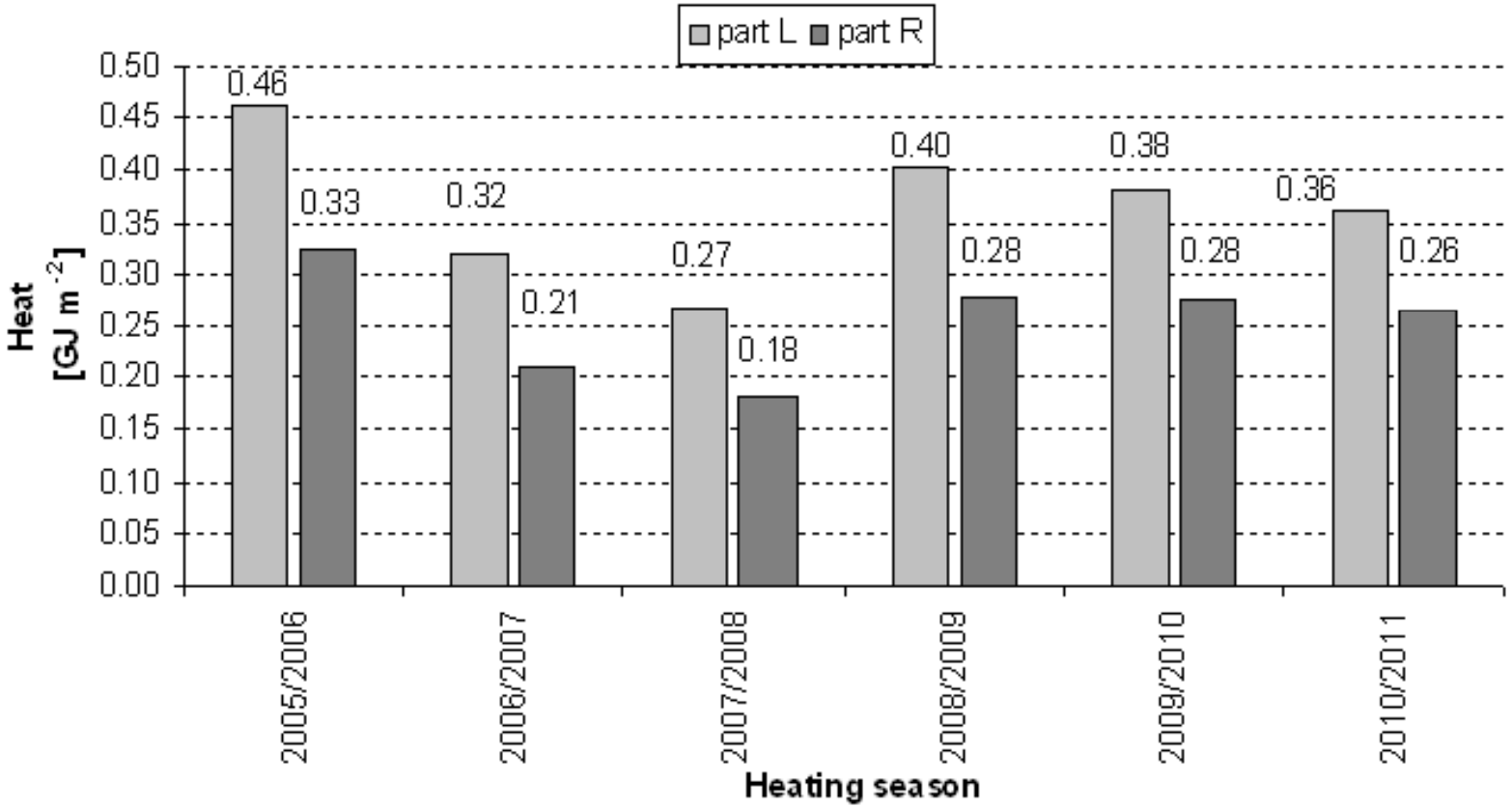

Fig. 5. *Average amount of heat used per square metre of floor surface area in both parts of the building during each heating season after the external walls insulation (Cholewa i Siuta-Olcha, 2015)*

Results- after the installation of the HCA in the part L

difference between the average heat consumption in the part L and the part R: **18%** → **13%** → **3%**

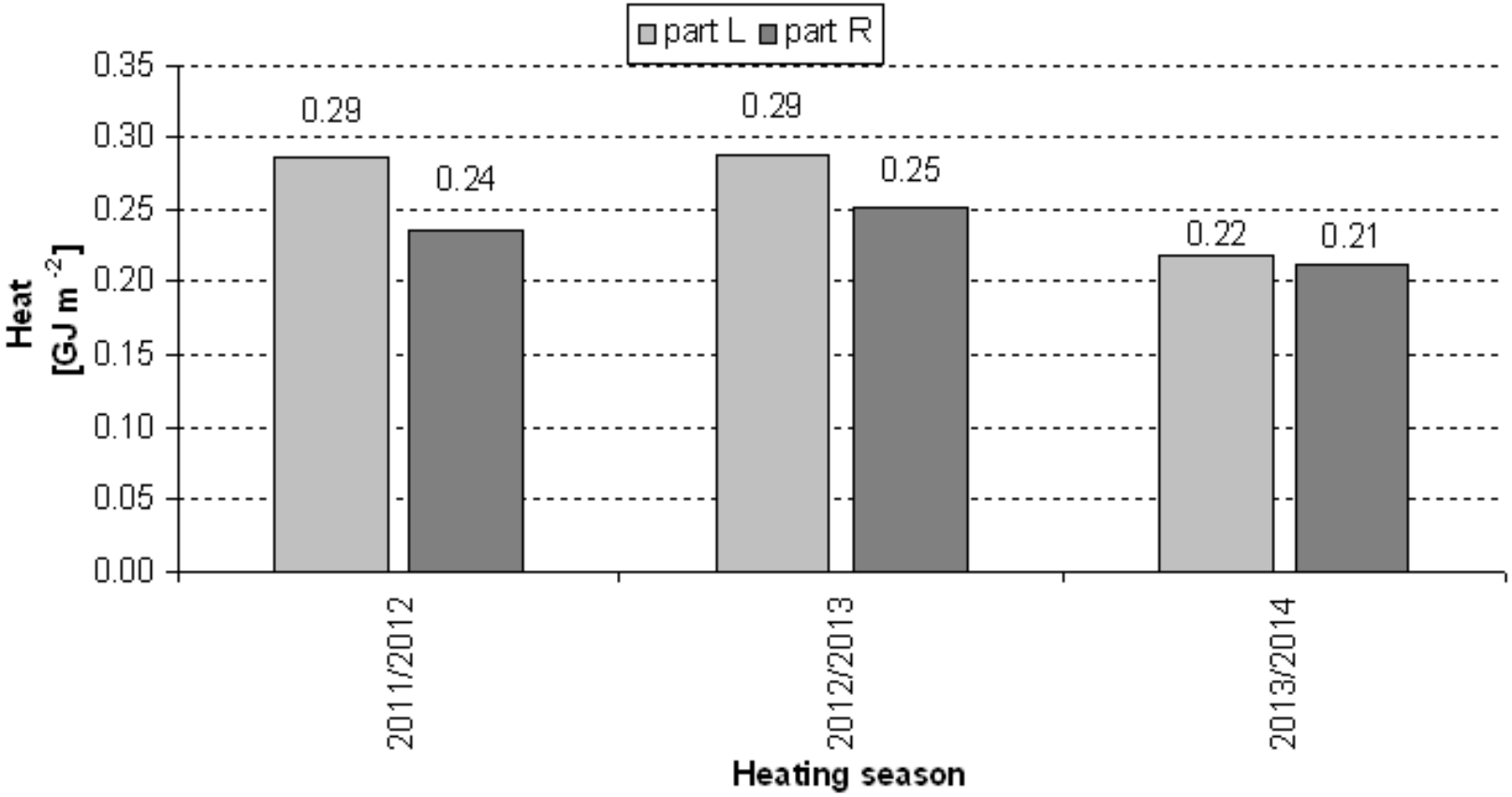

Fig. 6. *Heat consumption in both parts of the building after the installation of the heat cost allocators in the part L of the building (Cholewa i Siuta-Olcha, 2015)*

Results- Cost analysis

- price for 1 GJ of heat supplied from district heating equal to €10 for heating season 1998/1999, increasing by about 1.0% in each, following the heating season;

- the cost savings were calculated on the basis of the weather-normalized heat savings in each heating season, which were estimated as the difference between the heat used in the part L and in the part R;

Results- Cost analysis

- cost of installing the heat cost allocators (including the cost of devices) and the annual cost of reading and maintaining such devices:

Tab. 1. *Cost of installation, reading and maintaining the heat cost allocators in relation to a single heat cost allocator, the flat and the part of the building (20 flats) (Cholewa i Siuta-Olcha, 2015)*

Action	Single heat cost allocator	Heat cost allocators in the flat (4 heat cost allocators)	Heat cost allocators in the part of the building (20 flats)
Installation of heat cost allocators	€3.6	€14.4	€288
Annual reading and maintenance of heat cost allocators	€3.2	€12.8	€256

Results

average savings: €1608

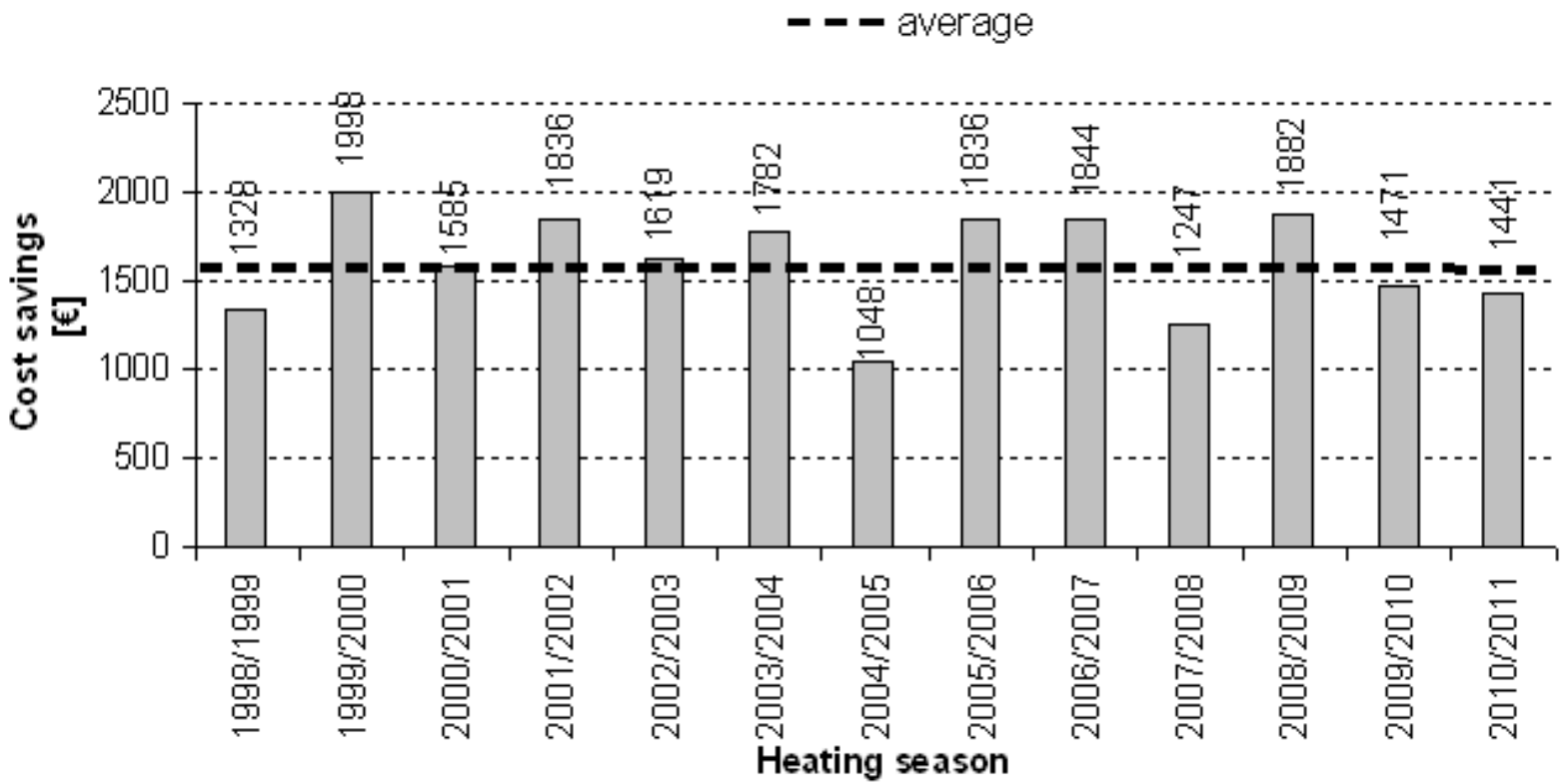

Fig. 7. *Cost savings achieved in heating seasons thanks to the use of heat cost allocators (Cholewa i Siuta-Olcha, 2015)*

Conclusions

• The use of the heat cost allocators on radiators may generate energy savings in flats (averagely, at the level of 26.6%); in comparison to flats, where charging heating fees are based on a square metre of floor surface area.

• It was also noticed that thanks to the insulation of the external walls, higher energy savings (for analysed case - 7% more) may be achieved in the part of the building with the heat cost allocators, than in the one without such devices.

• The payback time of cost of installing the heat cost allocators does not exceed one heating season.

• The costs of reading and maintaining of heat cost allocators amount to about 15% of the average cost of heat savings.

References

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[2] S. Siggelsten, S. Olander, Individual metering and charging of heat and hot water in Swedish housing cooperatives, Energy Policy 61 (2013) 874–880.
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Thank you for attention

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