

## BLOCKHOUSE RENOVATION: SOME INSIGHTS FROM PILOT SURVEY OF HOUSEHOLDS IN KAUNAS CITY

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**Abstract.** Growing demand for energy is one of the main problems causing environmental burden. As households are one of the largest energy end-users, increasing energy efficiency in the household sector can contribute significantly to the overall energy efficiency and environmental impact reduction. Renovation of old multifamily blockhouses and improvement of their thermal behaviour is one of the options to increase energy efficiency in household sector. The study aims to estimate the pros and cons of renovation as well as to identify main determinants for willingness of the households in Kaunas to invest in renovation. In overall terms 28% of final energy is consumed in Lithuanian households. Though considerable potential for energy saving is foreseen in household sector, only 720 multifamily blockhouses took part in the Renovation Program over 2005 – 2008. According to investment distribution, approximately 15% of the renovation projects were realized in Kaunas district. On the basis of larger quota sample survey 100 households from multifamily blockhouses were interviewed. Households from renovated blockhouses mainly have focused on the insulation of outer walls of the house (100%) and the roof (76.3%). Majority of the households committed to invest in blockhouse renovation because of comfortable indoor temperature (89%) and money saving (81%). Relatively older respondents ( $\chi^2=11.12$ ,  $p<0.05$ ) and those from older blockhouses ( $\chi^2=11.25$ ,  $p<0.05$ ) more often lived in renovated houses. As the main advantages these respondents indicated increased indoor temperature (93.2 %) and reduced payments for the heating (84.7%). Respondents living in not renovated blockhouses were willing to renovate it (80%), hence high prices for renovation services and materials was the main impediment for renovation.

**Keywords:** energy consumption, households, renovation, attitudes.

### 1. Introduction

Energy production and use has the greatest impact on the increase of carbon dioxide (CO<sub>2</sub>) emissions. Hence, both energy consumption and CO<sub>2</sub> emission increase should be controlled in order to meet international commitments (Míguez *et al.* 2006). Therefore, European Union is aiming to achieve 20/20/20% targets for energy consumption and greenhouse gas emission reductions, and an increased share of renewables by 2020 (European Action Plan for Energy Efficiency, 2006). European Action Plan for Energy Efficiency (2006) emphasizes the need to move from the market energy-inefficient products, to inform consumers about the most efficient products and transform the market to more energy efficient one (Action Plan for Energy Efficiency 2006).

In European countries energy consumption in buildings amounts to 40% of overall final energy consumption: one-third of this amount - industrial, commercial and public buildings (offices, schools, hospitals, hotels, etc.), the rest is used by the residential homes (Míguez *et al.* 2006). By reducing the energy requirements of build-

ings, less fossil fuel and other energy resources are used and money is saved. This also reduces the country's dependence on imported fuels, positively effects economy, reducing input in climate change and environmental pollution (Gurskis *et al.* 2008).

To have sustainable, competitive and secure energy system, energy efficiency is one of the major Lithuanian energy policy objectives. Household sector is the second largest final energy consumer in Lithuania - household sector accounts for 28.1% of all final energy consumed in Lithuania recently. All final energy in households is consumed to fulfil electricity and thermal energy needs. Almost 70% of final energy in particular is consumed as a thermal energy (EEA, 2005). Of cause fluctuations of thermal energy consumption depends much on weather conditions. As stated by Miskinis and others (2004), thermal energy consumption depends on climatic conditions and in warmer winters to maintain the same indoor temperature about 30% less of thermal energy is needed than during the cold winters. It should be noted that in general energy consumption in household sector is rather constant, even during energy blockade in the beginning of

1990s energy consumption in household sectors declined only 12 % while energy consumption of other sectors of economy and the whole economy dropped significantly (Dagiliūtė and Juknys 2009).

The European Parliament and the Council approved the Energy Performance of Buildings Directive (2002/91/EC), which included building insulation provisions. Provisions of the Directive are primarily based on caring for the environment in conjunction with the Kyoto Protocol commitments. The directive also requires member states to establish a certification system in order to carry out building energy consumption monitoring. Directive applies to both new and old buildings with some restrictions (Energy Performance of Buildings Directive 2002). On 18 March, 2010 recast version of this directive (2010/31/EU) has highlighted and strengthened some energy performance requirements.

According to the European Parliament and Council Directive 2002/91/EC and draft projects of standards the Lithuanian Construction Technical Regulation STR 2.01.09-2005 "Energy Performance of Buildings. Energy performance certification" was adopted (2005). Regulation aims to take into account environmental protection requirements, economically rational use of energy resources (oil, natural gas, solid fuel and etc.), which is the main sources of carbon dioxide. Regulation also seeks to create preconditions for more efficient energy consumption and energy demand management, to reduce energy consumption in the residential and service sector and to ensure the comfort of residents at the lowest energetic cost.

Renovation of multifamily houses and increasing energy efficiency is one of the priority goals of the state in expressed in the National Energy Strategy (2007) and in the Lithuanian Housing Strategy (2004). According to the National Energy Strategy (2007) about 75% of residential buildings are heated by district heating systems. Currently in Lithuania predominant district heating for a variety of economic, technical and social reasons is not sufficiently effective. Another major reason for inefficient energy consumption in Lithuanian household sector and public buildings is the fact that thermal performance of many old houses and public buildings is very poor and they need a lot of thermal energy (Energijos efektyvumo veiksmų planas 2008). More than 60% of multifamily houses in Lithuania are built during the last four decades of the last century. These flats are inefficient in terms of energy consumption and expensive to operate during the heating season. Therefore a programme for multifamily building modernization was approved in 2004. Afterwards, to speed up the modernization process, the Government has introduced some changes in multifamily building modernization programme several times and quite recently.

According some others authors (Denafas and Sitnikovas 2002) insulated building walls up to the normal levels could help to save even from 53 to 57% of energy used for heating. This could not only lead to energy savings, but to significant reduction of CO<sub>2</sub> emissions and other related environmental impacts. European Action

Plan for Energy Efficiency (2006) indicates about 30% potential for energy savings in residential buildings, with greatest opportunities in retrofitted walls and roof insulation.

However, Lithuanian multifamily building programme is stagnating recently and no significant achievement in energy saving is observed. Therefore paper aims to overview ongoing Renovation programme and to estimate the pros and cons of renovation as well as to identify main determinants for willingness of the households in Kaunas to invest in renovation. Paper is structured as follows. First, we discuss some methodological issues, then trends in household energy consumption and renovation volumes. In section 5 results of survey are presented and discussed. And finally, some conclusions are drawn.

## 2. Data and methodology issues

Paper presents main trends in final energy consumption in Lithuanian household sector, as well as a course of implementation of Multifamily Building Renovation Programme. Data on final energy consumption over the period of 2000-2008 is obtained from the Department of Statistics to the Government of the Republic of Lithuania, and the details of the implementation of Multifamily Buildings Modernization Programme - from the Housing and Urban Development Agency. To reveal on going changes year 2000 was chosen as the base year.

Data on the attitudes towards apartment house modernization (renovation) in Kaunas city have been collected by questionnaire method - the interview at the respondent's home. Questions related to the renovation constituted a part of a larger survey on the adoption of energy efficient/saving products and technologies, conducted in Kaunas during 2009 May - 2010 January. Questionnaire was prepared by the authors; questions were presented in two groups: the socio-economic expertise (possible determinants) and energy and renovation related issues. Questions were presented with fixed responses; the respondent could choose one of two or more response options, depending on the question. In accordance with the principles of quota surveys, 200 respondents were interviewed. 100 respondents were from multi-family block-houses and 100 - from detached houses. This number of respondents is sufficient credibility to the results of nearly 7% to ensure accuracy at the 95% confidence interval (calculated according Kardelis (2005)).

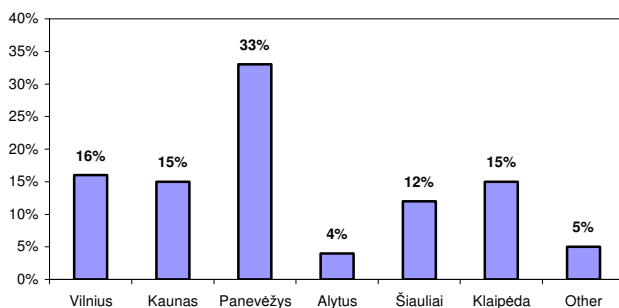
In this paper views and attitudes of respondents living in multifamily buildings is presented (100 flats/respondents). In order to find out consumers' opinions and attitudes on building insulation, 50% of respondents living in the multi-family apartment houses were chosen from insulated or renovated apartment houses.

In order to determine the socio-economic factors having an impact on consumer interest and choice of energy saving (renovation), we calculated chi-square ( $\chi^2$ ) statistical criteria with the confidence level 0.05. Results of the survey data were processed using the statistical package SPSS (Statistical Package for Social Sciences).

### 3. Results and discussion

#### 3.1. Implementation of multifamily building modernization programme

Despite estimated benefits of building renovation, Multifamily Building Renovation (Modernization) Programme is rather inactive, though significant state finance was allocated to promote this programme. According investments distribution, the most active multifamily blockhouse renovation (modernization) took place in Panevėžys region (Fig 1). For the period of 2005-2008 only 720 households or 2.1% of the total potential participated in the programme (Rogoža *et al.* 2008; Daugiabučių namų... monitoringas 2009), and only 279 renovation projects were completed over this period. Only 29 multifamily buildings were renovated in Kaunas.



**Fig 1.** The distribution of investments in multifamily building modernization in the country (Source: *Housing and Urban Development Agency*)

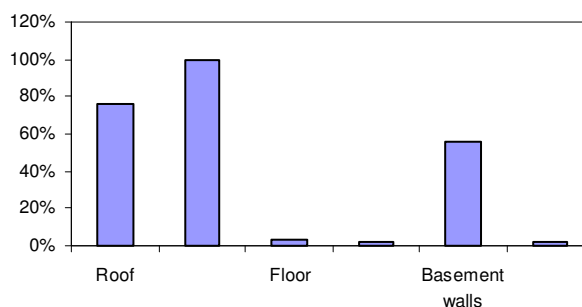
Despite growing pace of housing renovation in order to achieve the stated objectives (by 2020 to renovate 70% of multifamily blockhouses), the volume of works is necessary to increase about 10 times. Given that these houses are built according to typical projects, it is necessary to move from individual to group-home renovation, as well as to look for new, cheaper technologies (Juknys 2008). Hence, thermal energy efficiency of old apartment houses remains important problem. Most users should be encouraged to be more interest in energy saving in the household and the use of energy efficient products (technologies) in order to achieve greater energy efficiency. It is important to determine attitudes of the final energy consumers to energy efficiency and to find out the factors that determine their behaviour.

#### 3.2. Renovation: experiences and perceptions of inhabitants of multifamily buildings

During survey respondents from renovated and respondents from not renovated multifamily buildings were interviewed.

Survey results reveal that, households from renovated blockhouses mainly have focused on the insulation

of outer walls of the house (100%) and roof (76.3%) (Fig 2), which appears to be efficient tool to save heating energy (Denafas and Sitnikovas 2002). Insulation of the walls and the roof were also most popular (except window/door replacement) in Lithuania and were applied in 47% and 41% of all renovation projects in Lithuania (respectively in Kaunas in 55% and 28% of projects) (Rogoža *et al.* 2008; Daugiabučių namų... monitoringas 2009).

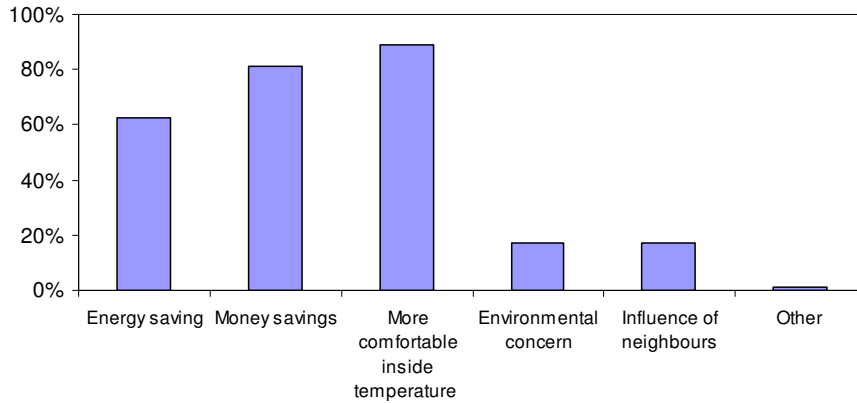


**Fig 2.** Insulation of different segments of the building (Survey results)

Majority of the households under survey committed to invest in blockhouse renovation because of more comfortable indoor temperature (89%) and money saving (81%) (Fig 3). Reports of Renovation Programme Monitoring (2008; 2009) suggest some similar results: reduced energy consumption and related bills, as well as a wish to live more comfortable were the main motives of inhabitants for renovation. These could be highly influenced by relatively high prices for the district heating. Only over the period of 1995-2006 the price for the district heating increased more than 4 times and this enforced residents to save energy. However, increased energy efficiency could not always lead to the energy savings, but higher indoor temperature (EEA 2005; Herring 2005). As study of Caird and others (2008) reveals the main drivers for insulation for UK respondents also were energy saving, reducing cost for the heating, concern for the environment and warmer home. However these authors indicated 4% rebound effects then all saved energy was used to have higher room temperatures in the interviewed households.

Relatively older respondents ( $\chi^2=11.12$ ,  $p<0.05$ ) and those from older blockhouses ( $\chi^2=11.25$ ,  $p<0.05$ ) more often lived in renovated houses (Table 1.). Other possible factors like incomes, household size and education had no statistically significant impact on whether the respondents lived in renovated buildings.

Younger respondents less than 30 years old mostly lived in not renovated (not insulated) buildings; this could be a result of lower incomes of these respondents. Another reason could be that usually the younger ones were leasing the flats they lived and the owners were not interested in renovations as far as the flats are rented.



**Fig 3.** Motivation to invest into renovation of the building (*Survey results*)

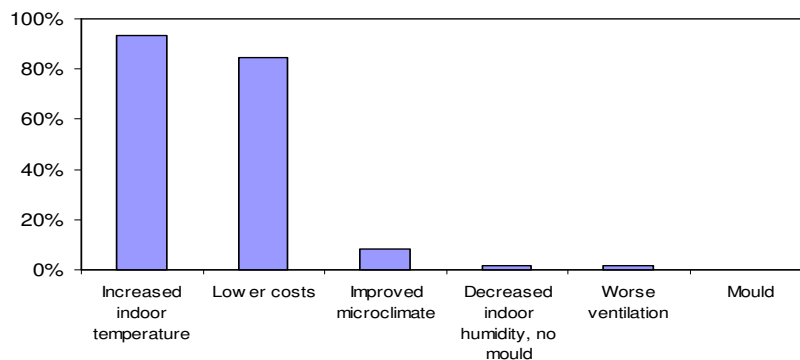
**Table 1.** Some factors for multifamily building renovation. *Survey results, marked differences are significant at p=0.05*

	$\chi^2$	p
Education	0.146	p>0.05
Incomes	2.12	p>0.05
Age	<b>11.12</b>	<b>p&lt;0.05</b>
Household size	5.28	p>0.05
Age of the building	<b>11.25</b>	<b>p&lt;0.05</b>

As the main advantages respondents who lived in renovated buildings indicated increased indoor temperature (93.2 %) and reduced payments for the provided

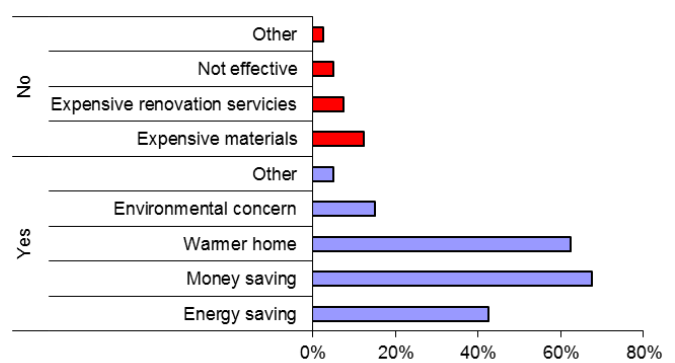
heating (84.7%) after renovation (Fig 4). 1.7% of the respondents have noticed worsen ventilation, however no mould was observed (Fig 4). These positive experiences could be efficiently used for promotion and increased confidence in renovation programme.

Renovation Programme Monitoring (2008; 2009) also indicates significant increase in indoor temperature and reduced energy cost after the renovation. Some similar results were for UK households, there 58% indicated warmer room temperature and about third stated to have lower energy consumption or/and lower bills for the heating after insulation (Caird *et al.* 2008).



**Fig 4.** Changes after the renovation of the building (*Survey results*)

Respondents living in not renovated blockhouses were willing to renovate it (80%). The main incentives for willingness to renovate were money saving (67.5%) and warmer home (62.5%). Hence high prices for renovation services and materials were the main impediment for renovation (Fig 5). There were some doubts about efficiency of renovation in general, too. Then estimating some possible factors influencing willingness to renovate building no significantly differences were estimated, hence it could be noticed that respondents with higher education and from older houses were more likely to express will to renovate the building. Only one respondent confirmed that her/his apartment had a certificate of building energy performance, thought 27.1% of respondents were aware about such certificate in general.



**Fig 5.** Incentives to renovate or not expressed by respondents from not renovated multifamily buildings (*Survey results*)

These results suggest rethinking existing policy on multifamily building renovation; especially on its promotion and management, including revision of subsidising schemes and minimizing bureaucracy. According Harmeling and others (2008) whatever would be the energy efficiency instruments (in our case - building renovation) their efficiency depends much on the informing target groups about benefits, obligations and so on.

Lack of information, hassle, disruption and high costs are the dominating barriers for energy efficiency improvements (Caird *et al.* 2008). Especially having in mind that building renovation is a highly costly (thought cost-effective) instrument and penetrates rather slowly. Hence, wider spread of positive experiences (implemented projects, surveys) could be efficiently used for promotion and increased confidence of renovation programme.

#### 4. Conclusions

1. Thermal insulation of buildings is one of the alternatives, helping to increase energy efficiency in households. However, working Multifamily Building Renovation Programme is ineffective, since only 720 buildings were renovated during five years. Nevertheless, 80% of respondents living in not insulated buildings expressed wish to insulate the building, while indicating a high price for necessary materials and works as one of the major discourage.
2. Respondents who already are living in an insulated building, as the main changes indicated higher indoor temperature (93%) and lower heating bills (85%) after the renovation of the house. It was found that older respondents ( $\chi^2=11.12$ ,  $p<0.05$ ) and respondents from older multifamily houses ( $\chi^2=11.25$ ,  $p<0.05$ ) were more inclined to invest in the apartment renovation.
3. Majority of the households under survey committed to invest in blockhouse renovation, because of more comfortable indoor temperature (89%) and money saving (81%). They mainly have focused on the insulation of outer walls of the house (100%) and roof (76.3%)
4. Revision of subsidising schemes, minimizing bureaucracy together with wider spread of positive experiences could be efficient tools for promotion of renovation programme.

#### References

Caird, S.; Roy, R.; Herring, H. 2008. Improving the energy performance of UK households: results from surveys of consumer adoption and use of low- and zero-carbon technologies. *Energy Efficiency*, 1, 149 – 166

Commission of European Communities. 2006. *Action Plan for Energy Efficiency: Realising the Potential*. COM(2006)545 final, Brussels.

Dagiliūtė, R.; Juknys, R. 2009. Sustainability of Household Consumption in Lithuania. *Environmental Research, Engineering and Management*, 1(47), 63-68

*Daugiabučių namų atnaujinimo (modernizavimo) programa* [Multifamily Building Renovation (Modernisation) Pro-

gramme]. 2004. Government of the Republic of Lithuania. December 23, Decision No.1213, Vilnius

*Daugiabučių namų atnaujinimo (modernizavimo) programos monitoringas* [Monitoring Multifamily Building Renovation (modernisation) Programme]. 2009. VŠĮ "Kompetencijų centras", 72 p.

Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the Energy Performance of Buildings. *O. J. of the E. Communities*, L1/65, 4.1.2003

EEA. 2005. *Household consumption and the environment*. 2005. EEA Report, No.11/2005, Copenhagen, 68 p.

*Energijos efektyvumo veiksmų planas* [Energy Efficiency Action Plan]. 2008. Ministry of Economy of the Republic of Lithuania. 4 December, 2008, No. 4-620, Vilnius.

Gurskis, V.; Heinzmannas, M.; Kaulakys, R.; Kleštornas, R.; Mažintas, A.; Milutienė, E.; Surkys, D.; Venckus, N.; Žilinskas E. 2008. *Efektivaus energijos vartojimo pastatuose vadovas* [Guide for energy efficient consumption in buildings]. Kaunas: Ministry of Economy of the Republic of Lithuania, 93 p.

Harmelink, M.; Nilsson, L.; Harmsen, R. 2008. Theory-based policy evaluation of 20 energy efficiency instruments. *Energy Efficiency*, 1, 131 – 148

Herring H. 2005. Energy efficiency: a critical view? *Energy: an International Journal*, 32, 10-20

Juknys, R. 2008. *Nacionalinės darnaus vystymosi strategijos įgyvendinimo ataskaita:2005-2007 metai*. [National Sustainable Development Strategy: Implementation Report 2005-2007]. Vilnius, 81 p.

Kardelis, K. 2005. *Mokslinių tyrimų metodologija ir metodai* [Methodology and methods of scientific research]. Šiauliai: Lucilijus. 398 p.

*Lietuvos būsto strategija* [Lithuanian Housing Strategy]. 2004. Government of the Republic of Lithuania, January 21, 2004, decision No. 60, 20 p.

Míguez, J. L.; Porteiro, J.; López-González, L. M.; Vicuña, J. E.; Murillo, S.; Morán, J.C.; Granada, E. 2006. Review of energy rating of dwellings in the European Union as a mechanism for sustainable energy. *Renewable and Sustainable Energy Reviews*, 10, 24-45

Miškinis, V.; Konstantinavičiūtė, I.; Norvaiša, E.; Deksnys R. 2004. Energijos poreikių namų ūkio sektoriuje prognozės [Forecast of energy demand in the household sector]. *Energetika* [Power Engineering], 1, 17-24

*Nacionalinė Energetikos Strategija* [National Energy Strategy]. 2007. Seimas of the Republic of Lithuania, January 18, 2007, No. X-1046

Rogoža, A.; Šiupšinskas, G.; Martinaitis, V. 2008. *Daugiabučių namų modernizavimo programos monitoringas (2 etapas)* [Monitoring Multifamily Building Modernisation Programme (2<sup>nd</sup> stage) 2008 m.]. VGTU. 125 p.

Sitnikovas, D.; Denafas, G. 2002. Aplinkos oro taršos pokyčių prognozė mažinant šilumos nuostolius daugiabučiuose namuose [Air Pollution Change Forecast during Reduction of Heating Energy Losses in the Blocks of Flats]. *Environmental research, engineering and management*, No.4 (22), 18-23

*Statybos techninis reglamentas STR 2.01.09:2005 Pastatų energinis naudingumas. Energinio naudingumo sertifikavimas* [Lithuanian Construction Technical Regulation STR 2.01.09-2005 Energy Performance of Buildings. Energy performance certification]. Law of the Ministry of Environment, 20 December, 2005, No. D1-624