The Case study on Building Renovation Project in Lithuania funded by Housing and Urban Development Fund

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The study, composed from 3 sections is based on public information, available in the website of HUDF in Lithuania http://www.hudf.lt, various publications and reports as well as published proceedings of Klaipeda and Vilnius conferences.

In the first section general information on HUDF activity and actual projects is presented. The second one is based on information and evaluations of HUDF specialists /14/, while the results and recommendations of independent monitoring are presented in the third section on renovation results of schools /15/. Such approach allowed presenting of comprehensive analysis of Fund activity, achievements as well as shortcomings and necessary corrections.

1. AN OWERVIEW OF HUDF ACTIVITY

1.1 Status of the Fund

The Housing and Urban Development Foundation (HUDF) is an agency, established by the Lithuanian Ministry of Finance which seeks to ensure sustainable financing for municipal infrastructure development, housing and energy efficiency improvement projects.

1.2 The Goals of the Housing and Urban Development Foundation:

- Establish funding and crediting system for housing and urban development, acting in market conditions;
- Promote energy conservation and private initiative in implementation of energy conservation and housing renovation projects;
- Establish institutional services infrastructure for elaborating and implementation of housing and urban development projects.

Foundation arranges and administers the provisions of loans to municipalities, homeowners associations and individual homeowners for the implementation of investment projects in the following sectors:

- Environmental;
- Weather proofing and energy saving in residential and public buildings;
- district heating;
- water supply and wastewater treatment;
- solid waste management;
- transport infrastructure;
- and other sectors in urban infrastructure development.

The Housing and Urban Development Foundation provides full support to its clients in all stages of project implementation:

- project preparation;
- identification of financial sources;
- appraisal of projects viability;
- tendering procedures;
- evaluation of project implementation;
- capacity building.

1.3 Partners for Housing and Urban Development Foundation:

Ministries and other governmental organizations;
Municipalities and Association of Local Authorities in Lithuania;
The World Bank / International Bank for Reconstruction and Development (IBRD);
Nordic Investment Bank (NIB);
European Investment Bank (EIB);
Governmental and financial institutions of Denmark, Sweden, Finland, Netherlands and Japan;
Consulting, design and construction companies, including relevant sector associations, universities, other scientific and training institutions.

1.4 The Housing and Urban Development Foundation at the moment implements the following projects:

A. Municipal Infrastructure Development Program 2000–2004;

B. Matra, European Union Directives Implementation program;
C. Energy Efficiency Housing Pilot Project;
D. Mortgage crediting system establishment project.

1.4.1 Energy Efficiency Housing Pilot Project

While promoting of private initiative and energy efficiency in public and residential buildings the Government of Lithuanian Republic (GLR) has signed loan agreement with the World Bank (Loan No. 4064 LT, signed on 08/06/1996) and in 1996 has started implementation of Energy Efficiency Housing Pilot Project. Municipalities, housing associations and individual house owners could receive soft loans for funding implementation of energy efficiency measures. Project administration and other activity related to project implementation was trusted to HUDF.

The purposes of the project

- To promote private initiatives in improving household energy consumption efficiency;
- To promote public initiatives in improving energy consumption efficiency in educational institutions;
- To promote housing privatization by supporting private initiative in maintenance of the buildings.

Project financing

For financing of the project the GLR has signed 10 mill USD Loan agreement with the World Bank (Loan no 4064 LT, signed on 08/06/1996):

1. 4.7 mill USD loans were allocated to municipalities for renovation of schools;
2. 5.3 mill USD loans were allocated for implementation of energy conservation measures in residential buildings.
3. 30 % of required funding for implementation of the project was allocated by the GLR.
4. The Danish Ministry of Housing and Urban Development Affairs and Dutch Ministry of Economics delivered the main part of technical support for implementation of the project.

Loans

Housing association can receive soft loans for implementation of energy conservation measures in their buildings. Loans are given for the period of 10 years with 11% interest rate. Not less that 10% of the value of investment project should be funded from the means of the housing association. State gives 30% grant to associations, participating in the project, and also VAT exemptions are applied.

The outcome of the project

1. Project has improved public awareness in the issues of house maintenance and efficiency of energy consumption and also demonstrated that well coordinated efforts of municipalities, contractors, energy consultants, banks and house owners can ensure successful renovation of residential and public buildings;
2. Successful implementation of schools renovation projects forced municipalities to find additional means for implementation energy conservation measures;
3. Making funding, wide support network available, also improved awareness of the residents in energy efficiency issues formed improved demand for loans for housing renovation and implementation of energy conservation measures;
4. Implemented energy conservation measures allowed to save from 10% to 50% of heat and improved the age of renovated buildings;
5. EEHP project added to capacity improvement of the companies, institutions and organizations, which participated in the project. Over 150 engineers-consultants participated in training program, prepared by Danish and Dutch experts. Most active participants of the project have established the Association of Energy Consultants in 2001;
6. The inquiry of housing associations, which participated in the project, showed, that it is not difficult to repay the loans for nearly 2/3 of households. This may be confirmed by

repay of loans in advance: 12 mill Lt was repaid in April 2002 instead of planned 8 mill Lt.;

7. 56 % of inquired mentioned that implemented measures have reduced their monthly heating bills, 48 % - mentioned improved living standards, 38 % - better heat distribution among the apartments and 30 % - improved exterior of the building. Most inquired notified the importance of total support in implementation of energy conservation projects.

Project in figures

Energy Efficiency Housing Pilot Project was prepared for implementation in 1996 and successfully finished on June 30, 2001.

- 53 schools and kindergatrtens were renovated in 12 municipalities, which have nearly 27,000 of pupils and kids;
- 700 housing associations and individual house owners participated in the project;
- Over 300 investment projects were prepared;
- 30 mill Lt was invested into renovation of residential buildings;
- 260 loan agreements were signed with housing associations and owners of individual houses;
- 113 substations were rehabilitated in residential buildings, changed and renovated windows in 144 buildings, roofs of 41 buildings and walls for 26 buildings were weatherproofed;
- Average amount of 24% of energy is saved in renovated residential houses;
- Average investment period into energy conservation measures reach 10.5 years;
- None of participating housing association have significant debts in returning loans on the data of April, 2002.

From the data of May 2002, 82 loans were given to Housing associations from returning means after the end of the project.

1.5 Municipal Infrastructure Development Program 2000–2004

With regard to improve Municipal infrastructure development, to improve the quality of the services of municipal utilities, to improve municipal capacities in implementation of investment planning and financial management, the GLR have started Municipal Infrastructure Development Program 2000–2004 (MIDP) at the end of 1999.

Implementation of this program is funded by the following investment loans: 18.89 mill Euro from International Reconstruction and Development Bank, 20 mill Euro from Nordic Investment Bank and 15 mill Euro from European Investment Bank. Besides technical support is provided by Danish, Swedish, Dutch and Japan Governments.

MIDP program funds environmental, district heating, water supply and wastewater treatment, solid waste management, transport infrastructure development and also other urban infrastructure development projects.

7 projects were approved in 2000, related to wastewater treatment and streets lightening for a common sum of 20 mill Euro (including 10.7 mill Euro loans). In 2001 more than 20 mill Euro were allocated for renovation of schools and total investment into urban infrastructure development project should reach 60 mill Euro.

MIDP program also delivers technical and financial support for municipalities in preparing and implementing investment projects, funded from the loans of international financial institutions and means of technical aid, delivered by bilateral or multilateral collaboration. Training courses were also arranged on the issues of municipal and institutional management and also investment projects management

1.6 Matra, European Union Directives Implementation program

The purpose of this program – harmonization of Lithuanian laws and regulatory documents, regulating energy efficiency in the buildings, with respective EU directives, and also help to establish able institutions for implementation of mentioned legislation. Implementations of the program foresees:

- To perform comparative analysis of Lithuanian and EU legislation;
- To prepare the program of energy certification of the buildings;
- To prepare implementation program for installation heat allocators in multi-apartment houses;
- To prepare transparent procedures for implementation of EU directives and strengthen organizational capacities;
- Establish Internet informational system.

Implementation of this program is supported by Dutch ministry of Foreign Affairs and Center International agency. Together with the staff of HUDF and Household consultations agency, representatives from Ministries of Environment, Economy and Foreign Affairs of LR participate in the program. Project implementation started on January 1, 2001. With the help of experts from Energieonderzoek Centrum Nederland and other Dutch consultants and research institutes, the following jobs were performed during the first half-year:

1. Report on implementation of the first stage of the program;
2. Detailed plan for implementation of the program;
3. Working groups are established, formed of Lithuanian and Dutch experts, representatives of participating ministries and other institutions;
4. Inception reports on each item of the program for further discussions of working groups.

1.7 Mortgage crediting system establishment project

Ministry of Finances of LR and Ministry of Economic of Danish Kingdom have signed and agreement on 09/25/1998 concerning "Implementation of Mortgage Crediting System Establishment Project". During implementation of this agreement:

- Representatives from private companies and state institutions were inquired on establishment of mortgage crediting system in Lithuania;
- Several seminars were arranged for all interested institutions (banks, insurance companies, state institutions, research institutes, etc.) on mortgage crediting system establishment and functioning issues;
- Tender winners lawyers office "Lideika, Petrauskas, Valiunas & partners" together with "Arthur Andersen" have prepared a study "Way to available mortgage financing: report on establishment of commercially viable mortgage crediting system in Lithuania".

On the basis of data presented in the study and comments and suggestions, received during discussions, one can state that mentioned study gives mortgage-crediting model, which should be acceptable for Lithuania and considered as the initial basis for further improvement and establishment of the system. The tasks for the nearest future:

- Prepare housing development concept, in which mortgage crediting system model would be an integrated part;
- Prepare implementation plan for housing development concept and housing financing system (stages, terms, contractors, etc.);
- Arrange existing legislation and draft new necessary laws.

2. FINANCING EXPERIENCE AND PROSPECTIVES FOR RENOVATION OF PUBLIC BUILDINGS IN LITHUANIA

2.1 Introduction

Since establishment in 1996 HUDF is active in renovation projects for state public buildings. Most experience is accumulated in renovation and rehabilitation of educational institutions.

Nearly 600,000 pupils are studying at 2300 schools. Nearly ¾ of Lithuanian schools were built till 1980. Every 15 -20 years renovation had to be performed in them, however in practice such requirement was not implemented. Based on the data from HUDF in 1999, the schools were renovated averagely 27 years ago, and 13 % of schools buildings were not renovated for 40 years (HUDF, 2001). The buildings of all schools (except several renovated ones) are not energy efficient – not weatherproofed walls, roofs, windows and doors area too big, windows not tight, as are old and made of wood 99 %. Schools to which heat is supplied from autonomous boiler houses (inside schools) use average 310 kWh / m^2 per year, for district heating – 140 kWh / m^2 per year. This difference does not show the preference of one or another type of heating. It shows the differences in comfort, system technical level and even fuel accountancy (wood, coal) precision.

Based on the results of inquiry of competent staff in schools in 1999, the need for renovation is related with renovation jobs for segments of system renovation:

Windows –	70 points;
Roof –	65 points;
Heating system -	65 points;
Walls -	35 points;
Tap water system –	30 points;
Hot water system –	15 points.

It is evident that delay to perform necessary schools renovation jobs cause danger not only to buildings, but also to teachers and pupils inside. Existing buildings not only does not ensure proper hygienic conditions, but its operation is related to big costs for energy resources.

2.2 Renovation jobs during 1991 – 2000

Schools and municipal education departments made efforts to maintain the buildings and equipment during 1991 – 2000. However the study prepared by HUDF initiative on schools renovation needs show, that means for buildings repairs and maintenance are insufficient (HUDF, 2001).

E.g., during 1994 – 1999 such means were as follows: 15 % schools have not received anything at all, 38 % have received 1 – 10 thousand Litas annually, 19 % - 10 – 20 thousand Litas annually and 28 % more than 20 thousand Litas annually. Thus municipal means for school budgets had no impact to renovation.

During the period 1997 – 1999 the GRL has allocated 4.7 mill USD for weatherproofing and renovation investment projects of municipal educational institutions. These means – are part of state loan for implementation of Energy Efficiency Housing Pilot Project (Kazakevicius, Vitkauskas, Mikkelsen, 2002). Housing and Urban Development Fund was empowered to administrate the loans. By the decrees of the Government of Lithuanian Republic loans were given to 12 municipalities. 43 schools and 10 kindergartens were renovated, which are attended by nearly 27 pupils and kids. Monitoring for 18 renovated schools showed that energy conservation measures, which were implemented, permitted to save nearly 24 % of heat by keeping higher temperature. Average payback period for

investment is 12 years. Successful renovation of schools and kindergartens forced municipalities to ask for additional loans.

In the limits of available opportunities Housing and Urban Development Fund give loans for renovation of social buildings through commercial banks. During 1998 – 2001 years 16 mill Litas loans were given for renovation of 32 municipal schools. During 1998 – 1999 the program on promotion of sanitary improvement of state and municipal institutions, was performed. 40 mill Litas was used for this purpose.

2.3 Secondary schools renovation program in year 2001

In year 2001 The Government of LR has allocated 80 mill Lt of loans, which were received in the name of the state, from the sources of Municipal Infrastructure Development Program 2000–2004 for renovation of the buildings of secondary education institutions. HUDF was empower to administrate the loans.

60 municipalities participated in the program. They have renovated 121 secondary schools. Based on municipal projects, the following sums were allocated:

(a) 49 mill Litas for renovation of windows and doors,
(b) 25 mill Litas for renovations of roofs,
(c) Appr. 12 mill Litas for rehabilitation of heating systems,
(d) Appr. 7 mill Litas for works inside buildings, and
(e) Appr. 6 mill Litas for repair and weatherproofing of walls.

The ministry on Education and Science of LR has prepared and adopted schools selecting criteria and also defined the loan amount for each municipality with regard to the number of pupils and total area of the schools. Loans to municipalities were not included into crediting limits. Including municipal input, total investment into schools renovation was approximately 104 mill Litas.

31 design and consultancy companies were providing energy auditing and investment and technical projects for schools. Tendering of services and materials were performed following the requirements of the World Bank. HUDF has arranged three seminars for municipalities on the tendering procedures of the World Bank and helped them to arrange tender documentation.

155 tenders were called for schools (98 closed, 57 open), for which 76 general contractors have presented 620 proposals. Because of competition between contractors, renovation was performed for the lower price than expected, thus instead of 112 planned schools, 121 schools were renovated. Technical project performance supervisions was performed in all schools. Municipalities could chose on of two options: supervision could be performed by the staff of municipalities, having adequate qualification, or by hired companies or persons. For 79 % of projects technical supervision was performed by municipal staff, , 15 % - by the staff of design companies, and 6 % - by other companies or physical persons.

From initial data energy consumption at renovated schools reduced by 25 – 30 %, climate conditions were improved, the age of the buildings and installations was improved. At the beginning of October, 2001 primary assessment of renovated schools was performed by the managers of schools by answering the questionnaire of HUDF. 76 school managers provided their attitude to implementation of the program as well as job performed. Most of them were positive towards the program itself as well as it's implementation. 59 % of inquired were satisfied with schools renovation, 24 %, were partly satisfied, and 17 % not satisfied. This is partly related with very busy project implementation time-schedule, as the decree of The GLR on program implementation was adopted on February 8, 2001, and main renovation jobs had to be finished till September 1. The quality of jobs performance and materials was satisfactory to 60 % of inquired, 24 % - partly satisfactory, and 10 % - not satisfactory. Defects were removed during the performance, and when new defects appeared – guarantee obligations were made for contracts performance. The assessment of the activity of projects participants (designers, contractors, HUDF, etc.) was considered as good or excellent by 72 % of school managers. 24 % inquired considered it as satisfactory and 4 % - as bad. Negative assessment was explained by not sufficient participating of educational staff in preparing and implementing renovation projects, rather limited means of the program (part of the teachers wished to

have more investment into schools) and sometimes not always satisfactory work of contractors and technical supervisors. All these problems should be regarded in preparing future schools renovation programs.

52 school managers confirmed their resolution to continue heat saving policy after implementation of the project, by performing qualified management of energy consumption. However only 36 schools have skillful staff for such management. Thus there is still need to improve qualification level for this staff, to arrange seminars and training courses, to use the services of private energy consulting companies.

2.4 Lessons from schools renovation

Implemented projects showed that municipalities, schools and contractors are capable to master huge investment fast in case management of the whole process (administration, consulting) is good and financing is continuous. This requires adequate preparatory work for renovation work, i.e. planning of the use of means, well performed energy and technical audits for the buildings as well as well prepared investment and technical projects, qualified contracting works and materials tenders.

The amounts of investment should be justified with regard to technical state of and economic benefit for specific buildings. To ensure satisfactory jobs performance quality systematic and qualified technical supervision of renovation work. Schools, where technical supervisors were working systematically and with a heavy hand, the outcome is rather good.

Buildings renovation projects force the staff of schools and municipalities maintain the buildings in a better way and take care of saving consumption of energy resources. Most inquired school managers have especially highlighted social and educational impact of the programs.

2.5 The future projections for renovation funding of public buildings

Till 2002 over 200 schools and kindergartens were renovated and total investment was nearly 200 mill Litas. However this makes less than 10 % of total number of educational institutions through the country. In case schools renovation process will continues with existing rates, the 2000th school will be renovated in 2047 only. It is evident that funding amounts should be higher. Over 3 bill Litas should be necessary for renovation of all schools.

This year already the Government of LR plans to sign loan agreement with the World Bank on Implementation of Schools Improvement Program. Till the end of 2005 it is planned to invest approximately 37 mill Euro and implement energy conservation measures in the buildings of 62 schools. After reduction of energy consumption in participating schools, saved measures could be used for improvement of education quality and it’s availability.

On application of the Government of LR European Bank of Reconstruction and Development this year has confirmed the loan of 20 mill Euro for Lithuania for Public Buildings Renovation Program. With the means of the loan heating equipment of public buildings will be rehabilitated, thermal characteristics of fencings will be improved, ventilating and lightening systems will be modernized, other energy conservation measures will be implemented. It is planned to fund projects, which reduce costs, related to energy providing and it permits to pay the loan from saved funds, i.e. pay-back period for investment is 6 – 7 years. This project also includes study, including methods to ensure long-term financing for renovating of public buildings based on funding opportunities of local and foreign financial markets. Study should investigate funding models in EU and other developed countries, their application opportunities in Lithuania and implementing order for most proper models.

2.6 The guidelines for funding system development for renovation of public buildings

While developing financial market of the country and reducing direct funding from the state, the owners of public buildings should have wider offer of financial services. HUDG participates in preparing and implementation of financial programs for renovation of public buildings. With regard to limited lending opportunities of municipalities and state, new programs discuss optional funding models:

(a) projects financing through Energy Service Companies, ESCO's,

(b) various leasing schemes, and

(c) so called Public Private Partnership, PPP, which becomes more and more popular.

Study, funded by Public buildings renovation program will assess adequacy of optional financing models to our country and will draft suggestions on its implementation. Which financial model will be applied most frequently will be seen in future, however it is important for the owners of public buildings to have the vide variety of financial services for choice.

3. THE OUTCOME OF LITHUANIAN SCHOOLS RENOVATION PROJECTS MONITORING DURING THE FIRST STAGE

3.1 Introduction

Actual renovation of schools buildings started in Lithuania since the end of 1996, when HUDF started administrating Energy conservation/Housing pilot project (1996 – 2000) and Energy conservation project for educational and health protection institutions (1997 – 2000). During 1996-2000 24 Lithuanian municipalities participated in these projects, which implemented buildings renovation with the purpose of energy conservation in 73 educational institutions, of which - 61 secondary schools. The total sum of municipal investment was 43.4 mill Litas. Average sum of investment per object reached nearly 600 thousand Lt. the most expensive renovation – 2.8 mill Lt. Implemented energy conservation measures included heat production and supply systems, heat consumption regulation and management, fencing of schools buildings.

3.2 Goal and object of the work

Monitoring of Lithuanian schools renovation project was performed by the order of the Ministry of Education and Science of LR, to investigate the experience of renovated schools till 2001. The main goals – to evaluate technical and economic efficiency of energy efficiency measures for the projects of renovated schools, to analyze projects documentation on energy efficiency at schools and renovation implementation procedures with the aim to rationalize the use of education means and resources giving recommendations for further implementation of schools buildings renovation projects, seeking for efficient energy consumption, satisfying educational needs of the pupils and reaching better hygienic standards inside buildings.

Because of limited terms, restricting monitoring possibilities, comprehensive monitoring couldn't be expected. Based on criteria prepared by the ministry 10 secondary schools (of 61), were selected at 9 municipalities, renovated during 1996-2000, the renovation of which could provide the most precise and detailed information on efficiency of energy conservation measures and would show various implementation experience.

Table 1. The summary of initial data for 10 renovated schools, selected for monitoring

No	Secondary school	Municipality	School construction year	Actual number of pupils	Heated area, sq.m	Number of implemented renovation measures for loans through (of total implemented measures)	Investment sum Lt/pupil	Investment, per 1 sq.m of heated area, Lt/m^2
1	A.Rubliovo	Klaipeda	1969	712	5617	5(5)	636	80,65
2	Tuskulenų	Vilnius	1969	1500	6951	6 (9)	1846	398,42
3	A. Baranausko	Anyksciai	1980	1098	6241	14 (15)	1831	322,15
4	"Sauletekio"	Panevezys	1977	1300	6273	10 (13)	1538	318,83
5	Zelvos	Ukmerges reg.	1939	250	2612	1(1)	782	74,80
6	Raguvos	Panevezys reg.	1970	359	2758	13 (15)	5077	660,85
7	L.Stuokos-Guceviciaus	Sirvintai reg.	1938	851	7001	9 (12)	558	67,83
8	Panocių	Varena reg.	1961	170	2779	8 (12)	1222	74,76
9	"Ryto"	Varena town	1978	950	6277	8 (15)	571	86,35
10	Daugų	Alytus reg.	1958	500	5916	5 (8)	657	55,53
Average values per school				770	5243	8(11)	1548	213,02

3.3 Methodological background

During monitoring, after having collected basic data from HUDF, municipal and school administrations, technical supervision of selected schools buildings was performed, providing definition of renovation benefits and problems. Analysis of accumulated information data consisted of technical (renovation amounts, energy consumption and savings), economic (prices and investments amounts as well as means sources) and procedure (documentation preparing) indicators definition. Technical indicators were received after having performed balance estimations for actual heat costs at investigated schools before and after renovation based on test schools consumption audit, the goal of which – to define the efficiency of applied heat conservation measures and compare it with projected one on the background of uniform methodology for selected schools. Estimations were performed in following stages:

- Regulated heat costs before renovation are defined;
- Regulated heat costs are compared with estimated heat demand before renovation;
- Projected heat savings and future heat demand;
- Regulated heat costs after renovation are defined;
- Regulated heat costs are compared with estimated heat demand after renovation;
- Technical (energy saving) efficiency of each renovation measure, applied in given school is defined.

Economic indicators are received comparing investment of renovation measures, projected in the investment project and sums with those actually implemented; defining actual efficiency of economic measures. Schools renovating implementation procedures are evaluated by defining adequacy of renovation projects to procedure requirements, renovation process and new or old problems left after renovation.

3.4 Main school problems before renovation

The main problems of all schools before renovation: huge glass areas and low quality (leaky) windows; water permeable roofs, not tight, not fully closing outside doors with much glass; damaged outside fencings; old and not automatic substations; inside air temperature fluctuations in the limits 6-15^{o}C ribose, depending on orientation of the premises towards cardinal points and prevailing winds; different surface temperatures of heating equipment, significantly different temperature of incoming heat carrier, the state of WCs not adequate to hygienic norms, not satisfactory state of heating system, water supply, sewerage cleaning main pipelines, electricity grid and installations, not adequate to technical regulations, disorderly basements, not safe stairs to the schools, lack of drive for disables pupils, etc.

3.5 Priorities of implemented energy efficiency measures and technical efficiency

The most popular renovation measures based on frequency of implementation and volumes: installation of the new boiler-house, reduction of glass windows area, including insulated screens, new windows, weatherproofing of outside fencings made of glass blocks, renovation of substations. Every School under investigation has implemented various measures of different volume, which improved energy saving, construction of the building and sanitary hygienic situation.

Based on average technical efficiency, expressed per kWh per 1 sq. meter of renovated fencing area, energy saving measures, related to renovation of outside fencings, are distributed as follows:

- Reduction of windows area by insulated screens–248 kWh/m2;
- Weatherproofing of outside walls glass blocks – 217 kWh/m2;
- Change of new doors – 155 kWh/m2;
- New windows - 140 kWh/m2;
- Repairs and tightening of windows - 133 kWh/m2;
- Installation of the third glass into windows - 80 kWh/m2;
- Weatherproofing of outside walls from outside – 52 kWh/m2;
- Weatherproofing of outside walls from inside – 32 kWh/m2;
- Weatherproofing of flat roof – 28 kWh/m2;
- Weatherproofing of pitched roof – 26 kWh/m2.

Installation of the new boiler-house saved 97 kWh/m2 of heated area, installation of new fully automatic substation– 90 kWh/m2 of heated area. New boiler-house and automatic substation will be paid-back respectively in 9.3 and 0.6 years, while weatherproofing of pitched roof – in 119.2 years, weatherproofing of outside walls from outside – in 51.5 years, weatherproofing of flat roof – in 48.1 years.

3.6 Investment and economic efficiency of renovation means

Average allocated investment for implementation of the renovation of one school is 1.08 mill Lt. Total investment for energy efficiency measures - 83%, average investment - 213 Lt/m2 of heated area, 1548 Lt/pupil. Simple payback of investment 3-53 years (see Table 2).

Table 2. Investment and economic efficiency of implemented 10 schools renovation projects

No	School	Total investment mill Lt.	Part of investment for implementation of energy efficiency measures, %	Heat savings, kWh/m^2	Heat savings, %	Simple pay-back of total investment period, years	Simple pay-back of investment into energy efficiency measures period, years
1	Klaipeda A.Rubliovo	453038	53	128	46	5,6	3,0
2	Vilnius Tuskulenu	2769412	95	178	72	18,0	16,9
3	Anykscių A. Baranausko	2010521	70	126	61	33,7	23,7
4	Panevezio "Sauletekio"	2000000	76	89	55	23,5	17,9
5	Ukmerges reg. Zelvos	184867	100	*	*	*	*
6	Panevezio reg. Raguvos	1822620	85	159	54	52,7	44,8
7	Sirvintu L.Stuokos-Guceviciaus	474930	92	60	28	3,5	3,2
8	Varenos reg. Panociu	207796	78	181	60	3,5	2,8
9	Varenos "Ryto"	542008	95	63	58	8,4	8,0
10	Alytus reg. Daugu	328550	97	86	39	3,4	3,3
Average values:		1079374	83	118	53	16.9	13.4

*Zelvos secondary school renovation was the most unsuccessful. In order not to distort average values, data is not given in the table.

The expediency of implementation energy efficiency measures at schools can be best reflected in economic efficiency of the measure. In all cases the best effect was received by rendering to order of school heat source (heat substation or boiler-house). The expediency of implementation of such measures as weatherproofing of outside walls, installation of new windows, weatherproofing of pitched roofs was evaluated from the principle of double benefit from renovation with regard to the age of separate units or time after the last renovation.

Economic efficiency of implemented measures is evaluated on the basis of technical efficiency (energy saving) and actual investment of each renovation measure applied in

every school, and it was analyzed using simple pay-back period, living period of the measure and the price of saved energy (SEK), Lt/MWh, which does not depend on existing and future energy price and just shows, what is cheaper – to save energy or to consume it with regard to the living period of certain measure as well as interest rate (see Figure 1).

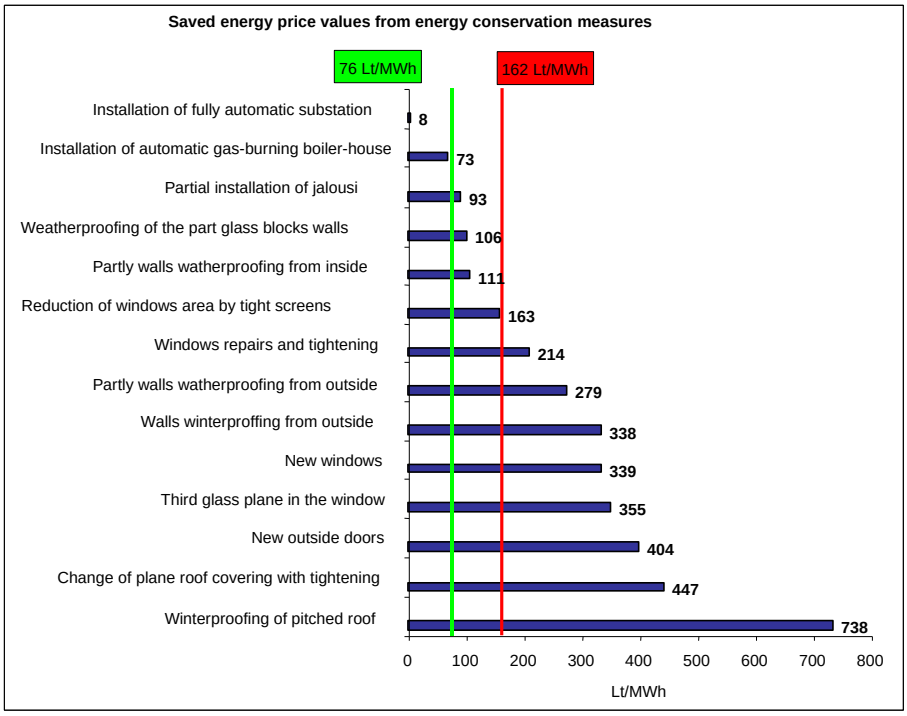

Figure1. SEK values for energy conservation measures

Note: vertical lines show lowest and highest heat prices in schools under investigation. E.g., in Varena town district heating price (incl. VAT) is 162 Lt/MWh. This means that implementation of first 5 measures for such school should be extremely attractive from economic point of view.

As we see in the figure below that payback period is lower than 10 years for investment, where value per school did not reach 100 Lt/m^2 of heated area. Payback period is much higher for investment over 300 Lt/m^2 of heated area.

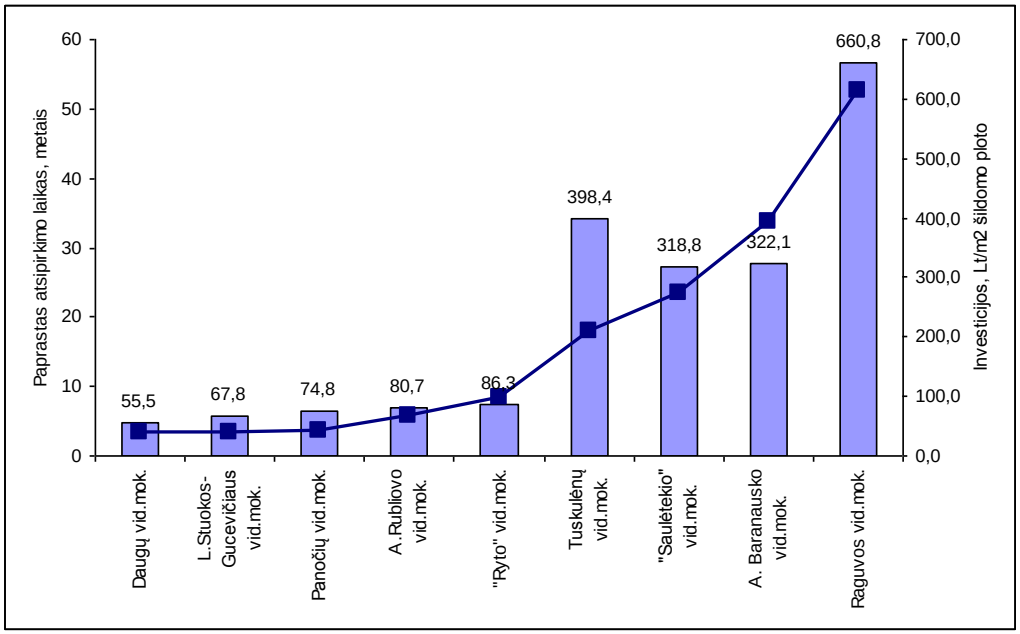

Figure 2. Simple payback of the renovation versus investment value

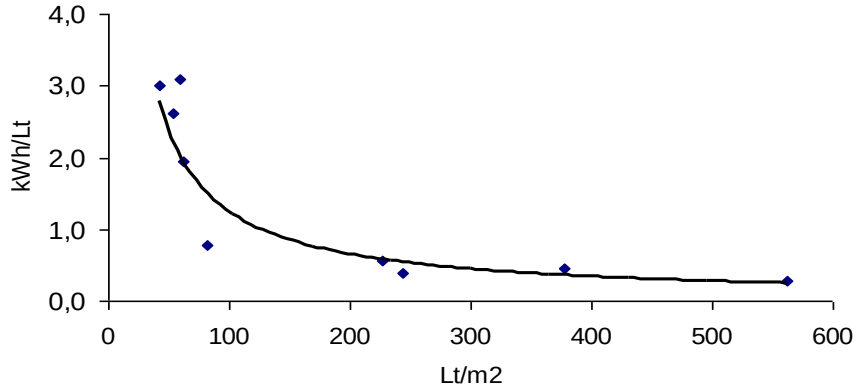

Figure 3. The saved energy by 1 Litas investment versus comparative investment value

3.7 Assessment of preparing documentation on renovation projects

Overview of formal procedures on preparing energy efficiency measures, applied for all schools, and after having reviewed all documentation for schools renovation (energy audits, investment projects, technical projects, graphics with specifications, tender on works, activity time schedule, contracting agreements, technical monitoring for construction and project accepting as exploitable), the greatest shortcomings in preparing documentation were fixed in energy audits (EA) reports. One of the goals was to evaluate EA, performed before renovation on the basis of monitoring data. Without elaboration of methodology, the figure below shows generalized outcome. Notations show the title of school and consultant.

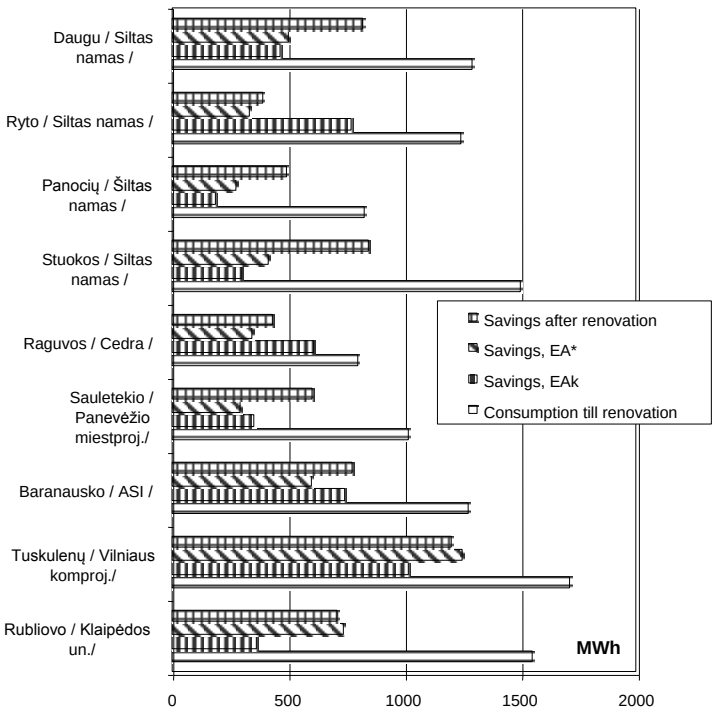

Figure 4. Outcome of energy audits assessment

"Savings EAk" are data from consultants audit. "Savings EA*" are data from energy saving measures, estimated by consultants with uniform methodology, approved by

Lithuanian Association of Energy Consultants. "Savings after renovation" are savings based on actual consumption from more than one heating season at normative conditions.

3.8 Assessment of implementation of schools renovation projects

Positive impact of renovation to the state of building construction elements

Construction years of investigated secondary schools range from year 1938 to 1980. The complexes of most schools are formed of buildings and constructions built in different periods. Evaluating that living period of each fencing is shorter that living period of the whole buildings, and that till the beginning of renovation main fencings (roof, walls, windows, outside doors) were not repaired, we can just guess about the state of investigated buildings. Renovation at schools improved construction, technical and energy state of the buildings, reduced shabbiness of outside fencings. The schools in which roofs renovation was performed, roofs shabbiness reduced by 29%. After implementing windows renovation measures at schools, the difference of windows shabbiness before and after renovation (school by school) varied 14% to 59%. Total walls shabbiness in all investigated schools was reduced by 0,3- 8%. In most schools doors and windows were changed and shabbiness grew from 100% to 0%.

Positive impact of renovation to schools comfort level

The whole of correctly selected and implemented energy conservation measures had to improve comfort level of internal promises, depending upon inside temperatures and sufficient amount of fresh air. After renovation of premises internal comfort improved significantly in 9 of 10 schools. After renovation of substations air temperature inside premises grew from 6-15^{o}C to 15-20^{o}C or even to 22^{o}C.

Implementation of fencings outside buildings and weatherproofing had positive impact not only for technical state of constructions, but also improved comfort level. Reduction of school windows area, there were no claims on lack of light, as windows area was reduced mainly in the lobbies, halls and sports premises.

Positive impact of renovation to schools energy consumption

Improvement of heat transmission characteristics of outside fencings in investigated schools and reduction of air infiltration, modernization of heat supply systems as well as change of other existing projects solutions have reduced heat costs by average value of 53% (see table 2) and reach nearly 120 kWh/m^2. After renovation of school heat source opportunity appeared for heating systems to operate following outside air temperature and lowered temperatures schedule during nights and weekends, which also had impact to energy saving.

Problems of schools buildings after renovation

After implementation of renovation projects in schools, some problems were solved irreversibly, however others have changed in content and volume. After renovation the following problems are mentioned most frequently:

Concerning tightness of new windows and weatherproofing of outer fencings (besides solution of ventilating problems) the air is stuffy, windows are weeping, walls are dripping wet;

After reduction of windows area by bricking gaps, the foundations of the schools and outer walls received additional loadings, thus gaps in brick walls and foundations setting cases can be located;

Schools in which repairs and tightening of old windows was performed, the quality of repaired and tightened windows returned to the initial state after several years of operation, comfort level has not improved;

Installation of the third glass plane into old windows have debased the state of old window frames, frames were deformed;

While changing of plane roof covering, roof pitch equaling layer was not applied, water is constantly gathering on the roof and rainwater tubes were not repaired;

Though substations have hot water preparing heat exchangers, hot water circulation line is not projected;

Some schools have no heat meters in substations;

People operating new substations or boiler-houses do not understand and do not use all automatic and regulation opportunities, which should give better heat savings at the same comfort level;

Different heating level in the premises of different buildings, there is no facade heat regulation for long shape buildings;

After exchange of pipes in the main pipeline, underground channels were covered and the floors of ground floor was fully changed thus leaving no under-floor manholes for revision of channels;

After partial or full arranging of sanitary units (new equipment, full finish of toilet premises), old pipes were left.

3.8.1 Recommendations for future renovations

On the background of the problems, which appeared after renovation, and general conclusions after monitoring, we recommend:

For decision-making on schools selection for renovation and investments amounts accepting process, to regard technical and economic efficiency indicators for renovation measures, investigated in the project, especially evaluating "double benefit" criterion;

To improve activity procedures for renovation projects, with regard to the experience of schools renovation projects during period 1996-2000;

To form qualification requirements and implementation procedures for consultants by formation of procedures separately for buildings repairs/reconstruction and improvement of the efficiency of energy consumption activities (training, providing methodologies, certification, etc.);

To form quality control system for documentation preparing (especially for energy audits and investment projects).

3.8.2 Conclusions

From the attitude of energy consumption efficiency the Ministry of Education and Science and other international institutions collaborating in the field initiated the studies, which are important in methodological and practical sense. However as ministry itself lacks qualified staff, it managed to use only part of studies content and conclusions. We may say that non-professional understanding on management of such kind of investment projects will certainly influence the efficiency of the project outcome.

Based on results of monitoring, performed in 10 schools, the following conclusions can be made:

Though HUDF administrated all 61 projects on renovation of secondary schools, by applying the same implementation procedures, however implementation of renovation project in 10 selected schools was different, which influenced renovation and achieved benefit.

Most (6 of 10) Energy audits (EA), performed in Lithuanian schools did not meet the requirements for such type of documents because of not comprehensive content as well as not satisfactory quality.

The greatest shortcomings were made in the initial part of EA, which lacked certain characteristics of the buildings, constructions and systems (as well as it's definitions).

Rare EA contained actual energy (and hot water) consumption, there was lack of actual and normative comfort levels, on the basis of which estimations had to be provided.

The description of energy conservation measures is not always comprehensive, savings are sometimes not justified.

For most schools ventilating issues were not solved in EA.

The mistakes on summary energy savings were made in EA packages of measures, there were no various options of packages, and solutions of selected packages were not explained.

The capacities of heating and hot water systems were not provided in EA.

Renovated secondary schools have allocated investment, which reached nearly 1550 Lt./pupil or about 215 Lt/m^2 of heated area. The bigger part (83%) of all renovated means was invested into implementation of energy saving measures.

Simple payback period for investment into 10 schools renovation is between 3 and nearly 53 years, depending upon the school. Average payback of investment for school renovation is 17 years.

The most popular renovation measures according to the frequency and volumes of implementation are installation of new boiler-houses, reduction of windows area, weatherproofing of glass blocks walls, renovation of heat substation.

For evaluation of energy conservation measures certain criteria for technical and economic efficiency (i.e. living age, energy savings, simple pay-back period, living age for certain measure and price of saved energy) for most efficient energy conservation measures are: installation of new boiler-house (heat savings reach 97 kWh/m^2 of heated area) and reduction of windows area by tightened screens (respectively 248 kWh/m^2 of renovated fencing area).

For various schools shabbiness of renovated outer fencings reduced from 0,3 to 100%.

Average schools have saved 120 kWh/m^2 of heated area or 53% of heat after renovation.

Installation of the third glass plane for existing windows and repairs and tightening of old windows (over 20 years) are not recommended and not justified for renovation.

Suggestions:

- To improve project activity procedures with regard to the experience of renovation project 2001;
- To present quality control system for documentation in projects activity procedures (especially for Energy audits, Investment projects, acts of objects acceptance as exploitable);
- To form qualification requirement and implementation procedures for consultants – separately for efficiency improvement of buildings repairs/reconstruction and energy consumption activities (training, providing of methodology, certification, etc.);
- With regard to big range and intensity of buildings renovation, comprehensive projects monitoring should be introduced;
- To permit, and where necessary attract schools managers and responsible schools maintenance staff to be active in schools renovation process. These people are those who know schools problems best and are eager to participate in solving them.

Above consequences appeared during preparation period for the forth schools renovation stage, which was initiated by the Ministry of Education and Science, and this renovation was considered as sub-program of state program "Reorganization and renovation of Lithuanian network of educational institutions".

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