Study of frequency and characteristics of public institutions in the researched territory

GREEN FUTURE

The study of frequency and characteristics of public buildings, possibilities of the introduction of means and technologies using RES at the provision of energetic needs of public buildings represents a complex material presenting the opportunities of the utilisation of renewable sources of energy at supplying public buildings on one hand and the categorisation of public buildings according to selected characteristics on the other.

Feasibility Study on the Instruments and Technologies Enabling the Use of Renewable Energy Resources to Satisfy the Energy Requirements of Public Buildings

http://www.greenfuture-husk.eu/

This publication is intended to support the below project:

Hungary-Slovakia Cross-border Co-operation Programme 2007-2013

Project Title: **Green Future**
Project Registration Number: **HUSK0901/2.1.2/0232**

The objective of the project has been to assess the possibilities of the use of renewable energy resources in public buildings, to develop a typology of buildings and investment objectives and to develop the basic investment models. It is possible to effectively reduce the energy consumption of buildings through the use of renewable energy resources such as solar energy, geothermal energy, wind energy, hydro power and energy from biomass. The developed studies have included the analysis of the results of the research carried out in the sphere of public buildings, descriptions applicable in practice, as well as a set of concrete examples, which may become an important tool for all those who wish to reduce their energy costs taking into account economic and environmental aspects, and who want to prepare or substantiate their decisions relating to the planned investments in this area. The studies can be used for example by local authorities and/or other organizations administering public buildings, which anticipate using renewable energy resources in their institutions and which intend to apply for funding for this purpose.

The project has been implemented by the following organisations:

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Hungary-Slovakia Cross-border Co-operation Programme 2007-2013

European Union
European Regional Development Fund

„Building partnership…"

Content

1 Introduction

The basic idea of the study of frequency and characteristics of public buildings is aimed at the use of renewable sources of energy for the energetic supply of public buildings in the researched territory. The concerned territory comprises the Komárno, Nové Zámky and Šaľa districts. Through the questionnaire survey all the self-governments of the concluded territory were involved in the subject of research, since the self-governments are its primary beneficiaries. The study itself focuses on the identification of public buildings in the ownership of self-governments and on the categorisation of these buildings concerning the opportunities of utilisation of the renewable energy sources (hereafter referred to as RES) for the energy supply of these buildings. The aim of the study is not solving of the autonomous energy supply of buildings for the provision of heating and hot service water (hereafter HSW) using renewable sources, but creating a proportional system utilising renewable and non-renewable sources of energy.

2 National action plan for the energy acquired from renewable energy sources of the 6th October 2010

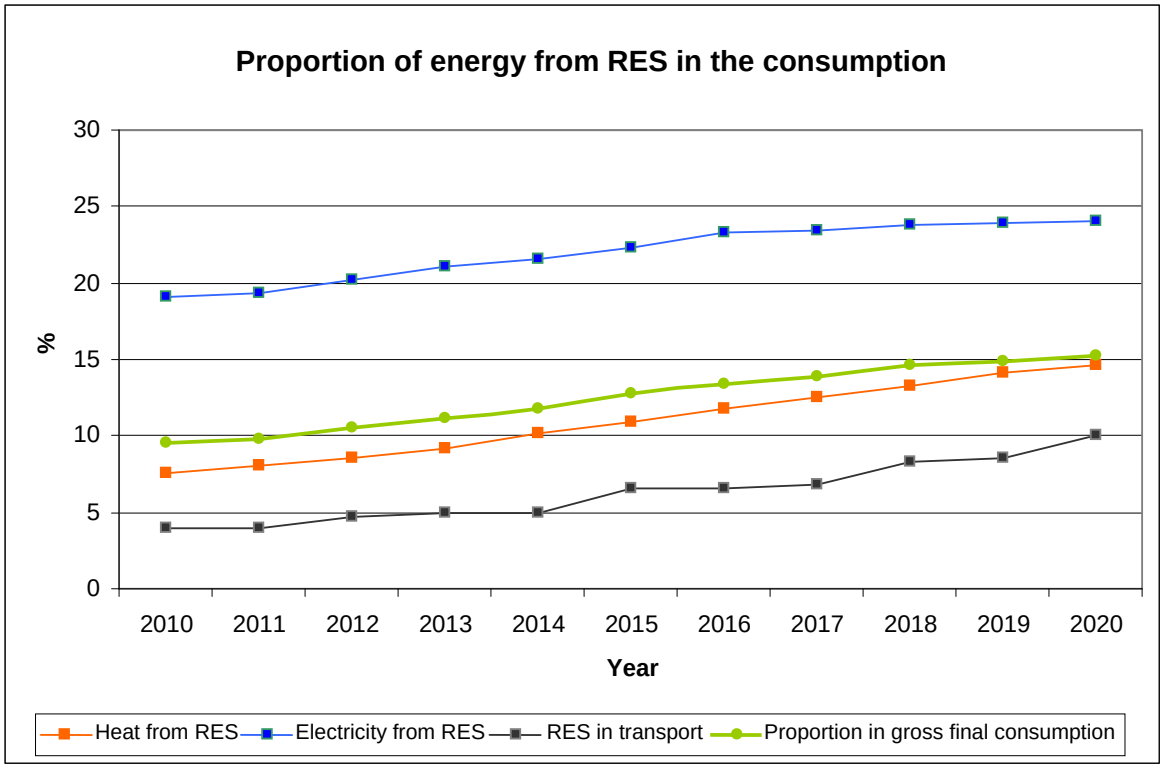
The national action plan for energy acquired from RES summarises the attained legislative frame, existing support systems, the actual proportion of the individual renewable sources and extrapolates the tendencies for the future on the basis of defined and suggested measures in accordance with the energy policies of the Slovak Republic.

The starting point of the situation is that the increasing price of fossil non-renewable fuels, which was reflected in the highest price of core oil ever in 2008ktorej, shifted biomass as an alternative source of energy into the focus of economic and political attention. In the heat production sector a significant increase of its utilisation has been recorded in the recent years, which implies that it will be the most used RES in the forthcoming years. Moreover, in Slovakia there are huge production capacities for the production of pellets and briquettes, and the producers must sell most of their production at foreign markets. This guarantees that even in case that the number of installed furnaces using biomass will rapidly grow, there will be no problems providing the needed amount of biomass fuels.

At the planning of the utilization of renewable energy sources the principle of minimization of expenses was taken into consideration, an integrated approach of using RES and reducing the emission of greenhouse gases. This means that by the suitable combination of RES and low-carbon technologies the consumption of fossil fuels will decrease so will the emission of greenhouse gases. Technologies use of which lead to energy prices close to market prices concerning the sustainable end-price of energy will have priority.

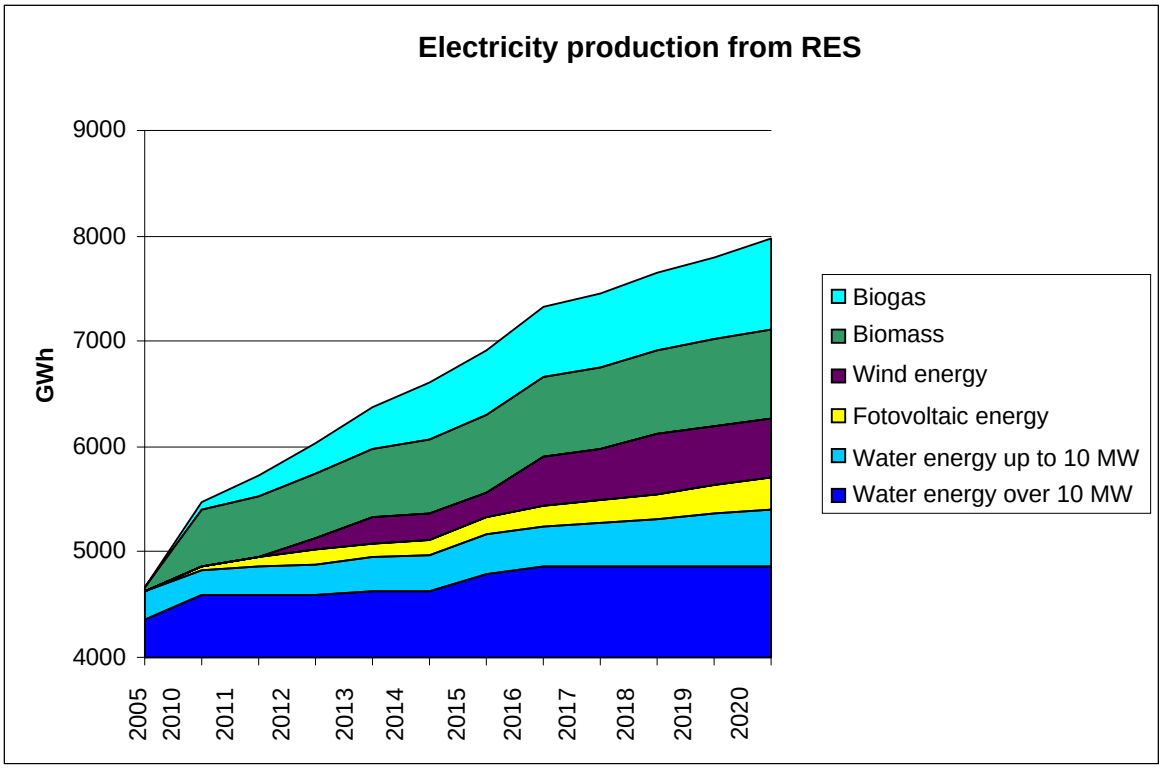
Those types of biomass are preferred, the utilization of which produces prices competitive to the price of fossil fuels. The increasing use of biomass, energy savings **and also the use of geothermal and solar energy** leads to the decrease of the use of natural gas for heating.

Diagram No. 1: ***Proportion of RES in the sectors of heating, electricity, transport and at the gross energy consumption***



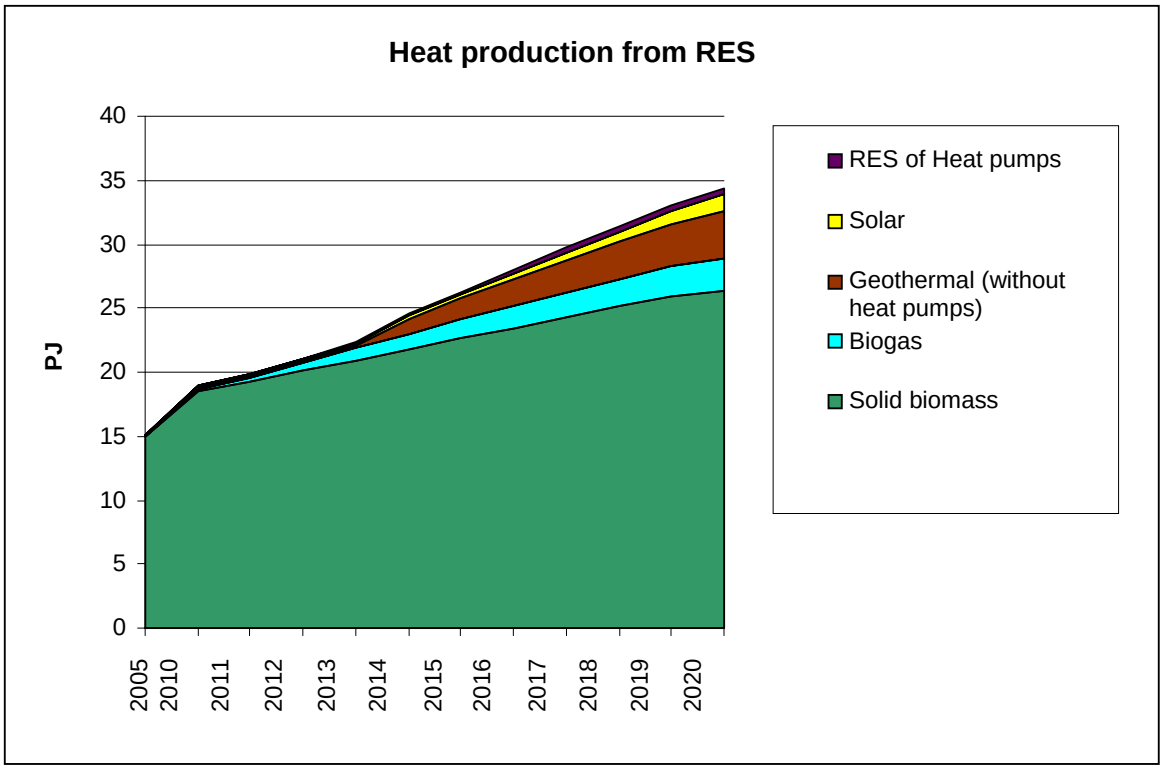
Source: *National action plan for energy produced from RES*

Diagram No. 2: ***Projection of electricity production from RES***



Source: *National action plan for energy produced from RES*

Diagram No. 3: ***Projection of heat production from RES***



Source: *National action plan for energy produced from RES*

The action plan points out that the present situation in central heat supply in Slovakia is characterised by a well-developed system of centralized heat supply (CHS), which represents more than 58 % of all heat demand. It accounts for about 116 000 TJ of heat production.

In the CHS systems prevails (approx. 54 %) the production of heat in heating plan systems (utilising the advantage of combined production of electricity and heat). The additional heat production is supplied mainly in local, precinct sources of heat (boiler houses, heating plants) with own heat distribution systems in the corresponding heat precincts.

2.1 Measures for buildings

From the point of view of public buildings the action plan specifies the summary of existing and planned measures on regional and local level:
For new buildings, in case of availability of RES it is ensured, that the environmental and economic benefits of the realisation of alternative systems are considered before the start of construction works, such as:

1. decentralised systems of energy supplies from RES;
2. co-generations;
3. block heating or centralised supply of heat or cold, mainly in case that energy from RES is used completely or partly;
4. heat pumps.

There are tightened requirements at construction regulations: starting from 31st December 2020 all new buildings have to be constructed as buildings of almost zero energy consumption and after 31st December 2018 public institutions which have their seats in new buildings and

own the new building have to ensure that the given building is of almost zero consumption of energy.

The minimal levels of the use of energy from RES are not specified in the construction regulations neither on national, nor local level. The construction offices must respect t*he Conceptions of municipal development in the field of heat energetic*.

Measures ensuring the increase of share of RES in building industry

- introduction of the system of energy audits for selected types of buildings of specific conditions (except from detached houses) and their interlacing to the support programs
- generation of methodology for the utilisation of RES on the level of buildings, its obligatory application for new and significantly reconstructed buildings, integrated planning and designing of buildings
- generation of methodology for the utilisation of RES on the level of urban areas on regional and local self-government level on the basis of price-effectiveness of heat supply concerning the individual types of fuel and energy
- provision of the actualisation and control of fulfilling the *Policy of municipal development in heat energetic*
- generation of methodology for the calculation of minimal needs for energetic effectiveness of buildings with optimal price levels and its compulsory application for new buildings and relevant application for existing buildings
- institutionalization of the system of professional training of plumbers, such as the system of EUCERT.HP and other systems for different kinds of RES (solar collectors, biomass boilers) and projectors and architects to be able to consider the suitable combination of RES and the measures of energy effectiveness at planning, projection, design and reconstruction of buildings with the use of new, highly effective technologies and centralized heat supply and air conditioning
- propagation of energetic services utilising RES at buildings
- support programs for biomass boilers and solar collectors in households including the defined technical conditions and specifications (minimal guaranteed energy gain at normalised conditions + Solar Keymark of solar collectors, requirements for the effectiveness and emissions of biomass boilers).

Concerning the energy policies, the obligation of the use of minimal amounts of energy coming from RES for new and newly reconstructed buildings are not defined presently. The updated energy policy, the ratification of which is expected in 2011, makes provisions for the possibility of defining the minimum amount of energy from RES in such buildings.

Taking into consideration the obligation of using a minimum amount of energy from RES for the buildings of the public sector:
The buildings of the public sector on a national, regional and local level must be examples of utilising facilities for energy production from renewable sources of energy by the fact that starting from 2012 they become buildings with zero energy consumption.

As the first step, the certification of selected buildings will be realised in cooperation with all sectors, which will serve as examples. On the basis of the analysis of opportunities leading to effective solutions measures will be chosen, which will ensure significant savings in energy consumption and the use of RES. Energy savings and consequently reducing the operational costs of public buildings will be priorities in the forthcoming years. [22]

3 Renewable sources as the instrument of autonomous energy supply of public buildings

At the rationalization of the energy consumption of older, existing buildings there are pre-conditions and in most cases the duty of reaching minimal requirements stated by new, presently valid regulations, which are significantly stricter than the standards valid at the time of construction of the buildings. Therefore the second phase after the monitoring of the actual state of consumption has been realised, is the proposition of suitable architectural modifications leading to radical cut-down in primary energy consumption, or to the fulfilment of presently valid regulations at least. There are presumptions that the standards which are valid presently will be revised and gradually tightened in order to reach the highest possible standards of consumption.

Heat isolation

Isolation represents the biggest potential of energy savings from the point of view of energy needed for heating. Generally reached levels of savings after the heat isolation of the external cladding and of the roof has been realised and the windows and doors have been replaced vary from 15 to 60 % depending mainly on the original state before reconstruction. The appropriate technological methods and the thickness of isolation are proposed by specialist designers or they are recommended in the energy audit of the building. From the point of view of long-term price optimisation it is necessary to choose variants with the thickest possible isolation. The price of heat isolation does not increase as fast as the levels of energy savings. It is given by the fact that the price of work basically does not change with the thickness of the isolation, but the savings rise directly, in proportion to the selected thickness of isolation.

Reconstruction of the heat distribution systems

The term heat distribution includes both distribution systems, i.e. the distribution of central heating and the distribution of hot service water. In the case of decentralized production of hot water they are not only the distribution pipes themselves, but the through-flow heaters used mainly in smaller buildings. Considering the practices, where it is obvious that many times the distribution systems of hot water does not show the efficiency required by the standards, therefore there is a significant potential of savings of energy loss in the hot water circulation. By the isolation of old distribution systems the savings of circulation loss should reach about 50 %, so the standards can be met. By the heat isolation of hot water distribution systems 20-40 % of savings are generally reached at the expenses of hot water production.

Lighting

The classic light bulbs reach a light intensity of 10 Lumens/Watt. The energy saving fluorescent lamp bulb produces approximately 55 Lumens/Watt. The highest quality LED sources of light nowadays can produce around 100 Lumens/Watt. Bad quality LED bulbs can have a light flux of 35 Lumens/Watt, which is below the quality of classical energy saving bulbs. The economics of replacing classical bulbs for energy saving ones shows that it is not worth waiting till the old ones ”burn out“, it is more efficient to replace them right away.

3.1 The potential of renewable sources

The quantification of the individual renewable sources in comparison with their real opportunities and limits in the frame of the proportion of the supposed benefits of the renewable source compared with the overall demand of the given energy is very important for the considered architectural object. Autonomous energy supply of public buildings is the desired goal, which practically cannot be achieved by the use of only one renewable source alone. There is a high probability that energetic autonomy can be achieved or approximated by the combination of renewable sources. Often it is necessary to complement the renewable source by conventional sources, which in some cases can be equipped with a store of fuels or is able to accumulate energy. The achievement of total energetic autonomy of buildings can fall beyond economically bearable in terms of investment or maintenance expenses.

Chart No. 1: ***Informative prices of renewable sources counted for 1 installed kW heat or electric performance (maximum performance at ideal conditions)***

Biomass boiler up to 1 MW	100 – 500 € / kW
Solar warm-water system for HSW	350 – 1200 € / kW
Heat pumps A/W, W/W	500 – 1500 € / kW
Wind power plant up to 1 MW	1000 – 3000 € / kW
Small hydro-electric power plant do 1 MW	4000 – 12000 € / kW
Photovoltaic system up to 100 kW	2100 – 3800 € / kW
Geothermal energy	2000 – 8000 € / kW
Micro – cogeneration	1000 – 5000 € / kW

Source: *research of the author*

4 Financial mechanisms supporting the energy efficiency of buildings

The ways and means of increasing the energy efficiency of buildings and approaching the autonomy in energy supply as the final goal of introducing local renewable sources in case of appropriate energetic measures should belong to the category of returnable investments. However, it does not mean that it is simple to ensure. There is an enormous demand on grant supports, where several operation programs financed by the structural funds of the EU dominate. But these are not the only sources of financing such goals. Among the best-known and most frequently used there are:

1. EPC Projects (Energy Performance Contracting)
2. MUNSEFF Program MUNSEFF (Municipal Energy Efficiency Finance Facility)
3. Structural funds of the EU – Regional operation program
4. Environment fund
5. EkoFond, n.f.
6. Structural funds of the EU - Operation program Natural Environment
7. Other sources of financing

Other sources of financing can seem simple and available. These methods of financing are closer to the business sphere. They are as follows:

- Leasing models or external management (they are often used abroad e.g. at public lighting abroad)

- New products of commercial banks focusing mainly on energy efficiency of buildings (advantageous loans for municipalities and towns)
- Investments into remunerative activities or properties, financed from more accessible sources, which subsequently can cover the finances needed for the energy efficiency of buildings by their profits (e.g. photovoltaic power plant after the period of economic return and so on)
- Consortiums of citizens with a common interest, lending/providing their own funds in advantageous conditions, since they are convinced of the correctness of the investment (e.g. 2 year interest-free loan from the parents/volunteers for the realisation of affordable economy measures for more efficient heating of the kindergarten or school, in case it is evident that the loans can be repaid from the savings in a short time)

5 Questionnaire survey

The strategic part of the study in question deals with the mapping of frequency and state of the public buildings belonging to the services and facilities on the territory of the municipalities in the Nové Zámky, Komárno and Šaľa districts. The main goal was the identification of the types of buildings in terms of their age, dispositions and material design and operational costs. To fulfil this goal the questionnaire survey was realised in April 2011. The questionnaire focused on obtaining the listed information. The questionnaire survey was created electronically through the Google Documents™ services. The whole process of the survey went on in an electronic form, which means that the respondents filled in the questionnaire electronically and consequently after mailing the questionnaire was recorded in the system. In the aspect of increasing the relevance and number of responses the questionnaire survey was supplemented by so called direct interviews. The person realising the direct interview called the attention of respondents to the need of filling in the questionnaire, explained the methods and process of filling, pointed out the data structure necessary for completing the questionnaire. The purpose of the direct interviews was to achieve as relevant answers as possible, at the same time the propagation of the project and its activities was pursued. The material gained this way was used for the elaboration of the strategic part of the Study of frequency and characteristics of public institutions in the researched territory.

5.1 The structure of the questionnaire

The questionnaire was conceived as the tool of obtaining the most accurate data necessary for the elaboration of the study. At the elaboration of the questionnaire the following principles were observed: setting of the goal of the questionnaire, logic sequence of questions, simple formulation and comprehensibility. The questionnaire contained close questions, simple and manifold multiple choice questions and open-ended questions in a smaller extent, which enabled the respondents to describe the surveyed phenomenon. The basic concept of the questionnaire consisted of introduction and detailed description of the individual buildings within public services and facilities. In the first part the questionnaire deals with a short description of the project, instructions for the filling of the questionnaire, identification of the respondent (subject of self-government) and indication of types of public buildings owned by the self-government. The second part dealt with the detailed technical-economical description of concrete buildings. Regarding the great number of public buildings belonging to services and facilities the questionnaire preferably focused on the buildings of village/town halls, community centres and primary school buildings as the most frequently occurring types. The

methodological process of the research of these types of buildings was based on the complex survey of three fields of primary topics at the selected types of buildings:

I. basic data of the building,
II. technical data of the building,
III. operation characteristics of the building.

The remaining types of building were questioned only in terms of their age, attendance and operational costs. The questionnaire compiled according to these principles surveyed the frequency and technical-economic characteristics of the individual types of public buildings in the ownership of the self-governments and created basis for the classification of buildings into categories in terms of certain external and internal characteristics.

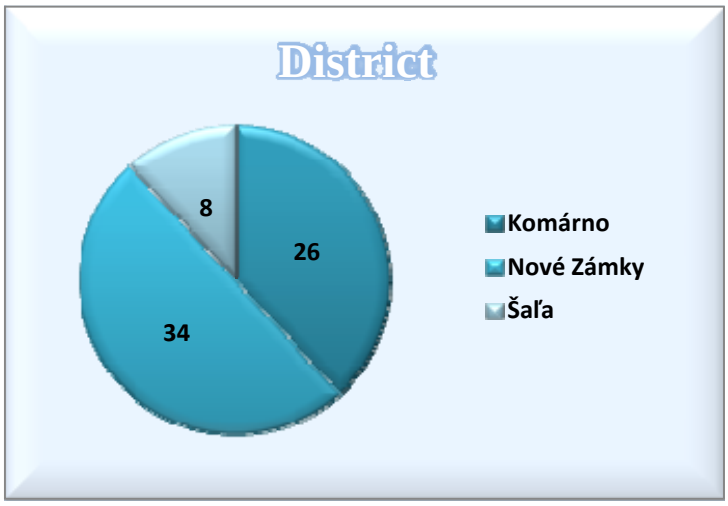
6 Evaluation of the questionnaire survey

117 self-governments of the Komárno, Nové Zámky and Šaľa districts were addressed by the questionnaire. From the total number of 117 addressed self-governments the rate of the respondents was 68 self-governments (58,2 %). (Note: for the statistical evaluation the number 68 was considered as basis. This is a numeric value in absolute and percentage formulation as well, that is 68 = 100,00 %).

From the number of 68 self-governments the participation in the questionnaire survey according to the districts was as follows:

- from the district of Komárno 26 self-governments participated (38,24 %),
- from the district of Nové Zámky 34 (50,00 %) self-governments and
- from the district of Šaľa 8 (11,76 %) self-governments.

Diagram No. 4: ***Structure of the answers according to the districts of the self-governments participating in the questionnaire survey***



Source: *elaboration of the author according to the results of the questionnaire survey*

The second part of the survey focused on data collection about the category of the researched institutions of services and facilities, which are situated directly in the municipal residential area of the responding self-governments. 12 types (building categories) were surveyed:

1. village/town hall,
2. community centre/house of culture,
3. primary school,

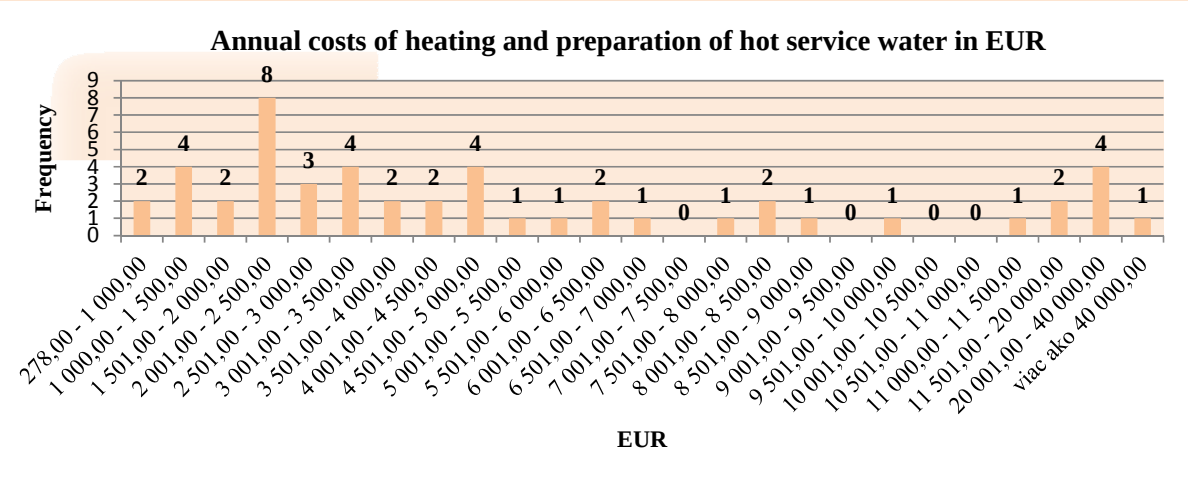
4. kindergarten,
5. nursery,
6. sport facilities (gymnasium, fitness centre),
7. fire station,
8. farm out-building,
9. home of social services,
10. retirements home,
11. health centre,
12. other.

The outputs of the questionnaire survey offer a complex range of data concerning the chosen buildings starting from the basic technical data up to operation costs. Therefore in the frame of the resume of the survey evaluation we only watch the data which affect the creation of the categories and types of buildings in the biggest extent.

6.1 Village/Town hall

The results of the questionnaire survey show that the annual consumption of heating media in the case of wood is around 5 $m^{3,}$ in the case of electric energy around 19 391 kWh, thermo-cable 30 000 kWh, natural gas from 3 052 m^3 to 36 064 m^3 and in the case of coal around 24 tonnes.
The annual costs of heating and preparation of hot service water in Euros varied from 278,00 (municipality of Bajč – district of Komárno) to 46 272,00 € (Kolárovo town – district of Komárno). For the sake of transparency and comparability of the results we prepared diagram No. 5, which summarises the annual financial costs of heating and preparation of hot service water in the buildings of village/town halls in intervals.

Diagram No. 5: ***Annual costs of heating and preparation of hot service water in EUR in the buildings of VH/TH***

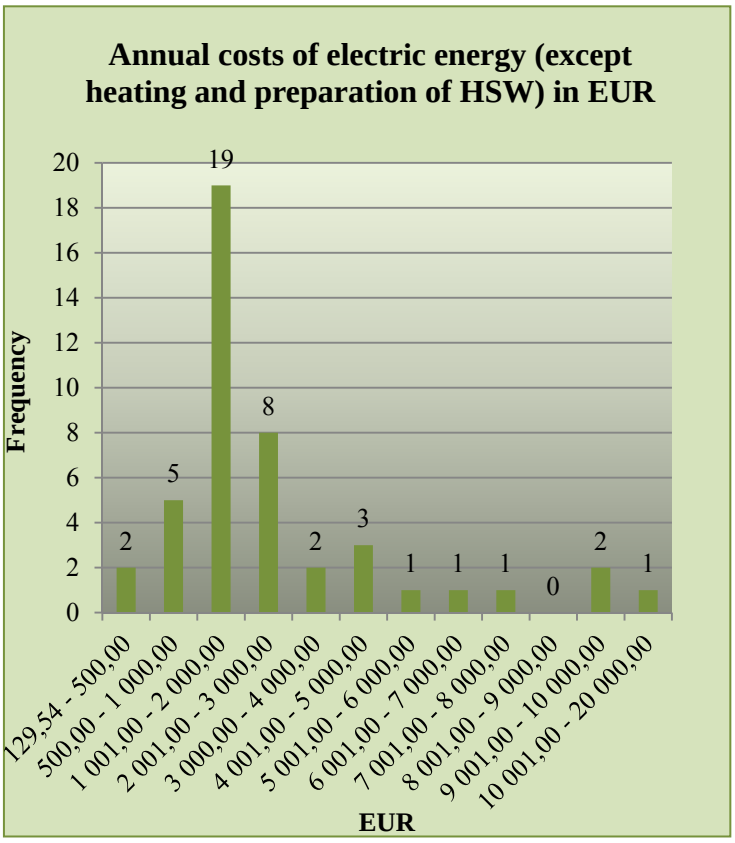


Source: *elaboration of the author according to the results of the questionnaire survey*

The questionnaire also monitored the annul consumption of electric energy (except for heating and preparation of HSW), which in kWh varied from 148 kWh (Brestovec municipality – Komárno district) to 88 000 kWh (Komárno town – Komárno district).
The annual costs (in intervals) for electric energy (except heating and preparation of HSW) in Euros is shown in chart No. (the results of diagram No. 6 can be statistically incorrect,

because the respondents could explicate the question so that also the costs of public lighting ensured by the self-governments are also included).

Diagram No. 6: ***Annual costs of electric energy (except heating and preparation of HSW) in Euros for the village/town hall buildings***



Source: *elaboration of the author according to the results of the questionnaire survey*

The aggregate table of the annual consumption of media (natural gas and electric energy) for heating and HSW and the annual costs are shown in chart No. 2. The chart also contains the data of annual energy consumption (except heating and preparation of HSW) in kWh in relation to the financial indicators. (The data shown in the chart belong to the selected village and town halls and self-governments.)

Chart No. 2: ***Correlation data for heating media "natural gas and electric energy" in the village/town hall buildings in selected municipalities***

Heating medium	Municipality (district)	Ground area of the building on terrain (in m2)	Annual consumption of media for heating and preparation of HSW (m3 - gas, kWh – electric en.)	Annual costs for heating and preparation of HSW (EUR)	Annual consumption of electric energy (except heating and preparation of HSW) (kWh)	Annual costs for electric energy (except heating and and preparation of HSW) (EUR)	Price of gas - 1 m3 (EUR)	Price of electric energy 1 kWh (EUR)
Gas	Virt (KN)	161 - 190	15000	5000,00	18000	2 400,00	0,33	0,13
	Čechy (NZ)	371 - 400	3979	2 255,00	8533	2 633,00	0,57	0,31
	Šarkan (NZ)	not specified	3768	2 007,70	1751	288,00	0,53	0,16
	Bodza (KN)	191 - 220	4800	2 600,00	3830	1 200,00	0,54	0,31
	Bajtava (NZ)	more than 490	19391	3 448,00	4894	1 349,00	0,18	0,28
	Patince (KN)	not specified	4000	2 000,00	6500	1 100,00	0,50	0,17
	Ľubá (NZ)	101 - 130	7200	2 700,00	4890	1 640,00	0,38	0,34
	Brestovec (KN)	161 - 190	2585	1 143,00	2 366	856,00	0,44	0,36
	Pozba (NZ)	281 - 310	7219	1 200,00	not specified	not specified	0,17	-
	Dedinka (NZ)	371 - 400	12000	6 112,00	6189	1 670,00	0,51	0,27
	Jatov (NZ)	more than 490	11289	6 617,00	15970	2 948,00	0,59	0,18
	Bardoňovo (NZ)	461 – 490	13976	6132,00	7834	1 392,00	0,44	0,18
	Rastislavice (NZ)	341 – 370	4656	2718,00	7000	1840,00	0,58	0,26
	Šaľa town	more than 490	36064	15278,02	88005	14537,79	0,42	0,17
	Kolárovo town	more than 490	50000	46272	48157	9015,33	0,93	0,19
	Marcelová (KN)	221 – 250	11 946	7323,00	11 127	1 549,00	0,61	0,14
electric energy	Leľa (NZ)	131 – 160	23533	4 040,00	6058	1 040,00	0,17	0,17
	Holiare (KN)	up to 100	30000	3 500,00	not specified	not specified	0,12	-

Source: *elaboration of the author*

6.2 Community centre /House of culture

An identical structure of questions in the survey, as for the village/town halls, was set for the community centres/houses of culture.
The annual media consumption for heating and preparation of HSW in the buildings of CC/HC according to the responds of the self-government in the questionnaire survey varies between 756 m^3 and 17 700 m^3 for gas, in the case of wood it is 3 015 t and by electricity it is 33 000 kWh.
The annual financial costs for heating and preparation of HSW in the buildings of CC/HC varies from 170,0 € to 3 156,51 € (for all types of heating media).
The annual consumption of electric energy (except for heating and preparation of HSW) measured in kWh in the buildings of CC/HC varies from 2000 to 18000 kWh. (One of the municipalities specified that the measurement is not separated.)
Chart No. 3 complements the information of the price of 1 m^3 gas and price of electric energy in kWh.

Chart No. 3: ***Correlation data for heating media „natural gas and electric energy" in the buildings of community centres/houses of culture***

Municupality (district)	Ground area of the building on terrain (in m2)	Annual consumption of media for heating and prep. of HSW - m^3	Annual costs for heating and preparation of HSW (EUR)	Annual consumption of electric energy (except heating and preparation of HSW) -kWh	Annual costs for electric energy (except heating and and preparation of HSW (EUR)	Price of gas -1 m3 (EUR)	Price of electric energy 1 kWh (EUR)
Obec Dulovce (KN)	more than 490	756	416,33	10008	2 163,40	0,55	0,22
Obec Okoličná na Ostrove (KN)	more than 490	1345	800,00	2000	500,00	0,59	0,25
Obec Pozba (NZ)	251 - 280	2500	2 000,00	not specified	500,00	0,80	-
Obec Kmeťovo (NZ)	341 -370	4064	2 339,38	2879	665,58	0,58	0,23
Obec Veľké Kosihy (KN)	431 - 460	9600	3 800,00	6700	1 600,00	0,40	0,24
Obec Virt (KN)	161 190	12000	6 500,00	18000	2 400,00	0,54	0,13
Obec Marcelová (KN)	more than 490	17632	8 440,00	11022	1 587,00	0,48	0,14
Obec Mužla (NZ)	more than 490	17700	10 280,00	not specified	3 800,00	0,58	-

Source: *elaboration of the author according to the results of the questionnaire survey*

6.3 Primary school

The self-governments could answer questions concerning primary schools twice, in the case that there are two primary schools in the town/village, they filled in the question twice. The investigated municipalities lie in the border region with Hungary and in most of them there lives a significant proportion of Hungarian minority population, therefore in many of the municipalities there are two or even more primary schools with different language of teaching. Many of them though form a single unit, i.e. they function in the same building next to each other. Concerning their legal status, they can be united or work independently.

The annual costs of heating and preparation of hot service water in the buildings of PS varies from 770,00 € to 47 585,07 € according to the data provided by 22 self-governments.
The annual electric energy consumption (except heating and preparation of HSW) varies from 1200 kWh to 83 696,96 kWh (municipality of Dulovce - Komárno) according to the answers of 20 self-governments.
The annual costs of electric energy (except heating and preparation of HSW) in the buildings of PS varies from 250,00 € to 15 433,72 €.

6.4 Other types of buildings

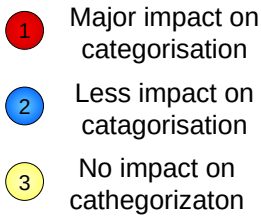
In the questionnaire survey the other types of buildings were investigated from four aspects only. Concerning the fact that only few answers were given by the respondents, no complex, integrated and objective outputs could be created.

7 Categorisation of groups of objects

The categorisation refers to the evaluation of the questionnaire survey. At the categorization of the buildings as individual entities we not only needed to classify the individual answers to the questions, but also use a logical grouping of questions aiming at one category of the features of the building.

The basic logical model of categorization determines the priorities of individual data obtained by the survey from 1 to 3 as follows:

Picture No. 1: ***Impact of the obtained data on the category of the building***



Source: *elaboration of the author*

Priority of questions No. 3 means that the goal of these data was to complement the given description of the building, but it is not necessary to divide the given category to further sub-categories on the basis of this lowest priority or to increase the number of overall categories on the basis of these data. By exceeding 20 as the number of categories the communicative value and transparency of categorization would decrease.

The questionnaire survey by its structure presupposed two basic types of buildings, see chart No. 4.

Chart No. 4: ***Classification of public buildings***

Main types of buildings - the data are detailed	village/town hall community centre/house of culture primary school
Other types of buildings - the data are basic	kindergarten day nursery building for sports (gymnasium, fitness c.) firehouse outbuilding home of social services retirements home health centre

Source: *elaboration of the author*

The logic model of grouping of the questions into themes for the evaluation of **main types of buildings** and the subsequent assignment of priorities for the individual themes is shown in scheme No. 1.

The themes for the main types of buildings are listed in chart No. 5.

Chart No. 5: ***Themes for main types of buildings***

Basic data:	Year of construction Size of building Visit rate Height segmentation
Technical data:	Quality of roof Quality of perimeter walls Quality of windows (resp. doors) Energetic quality
Energetic data:	Type of heating Energy consumption Water and sewerage Installed RES

Source: *elaboration of the author*

The logic model of grouping questions into themes for the evaluation of **other types of buildings** and the subsequent assignment of priorities is shown in scheme No. 2.

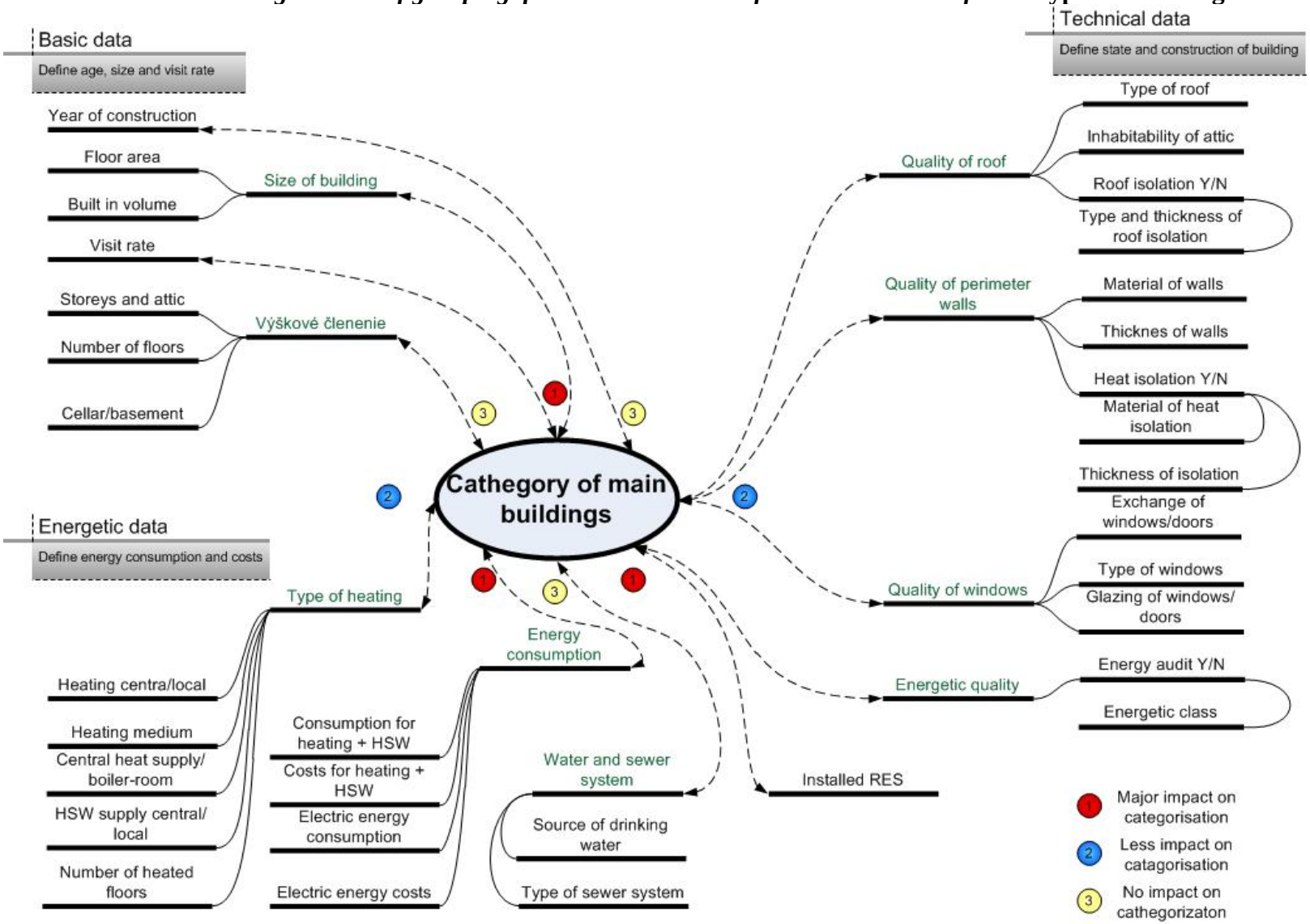
Themes for other buildings are listed in chart No. 6:

Chart No. 6: ***Themes for other types of buildings***

Basic data:	Year of construction Visit rate
Energetic data:	Energy consumption

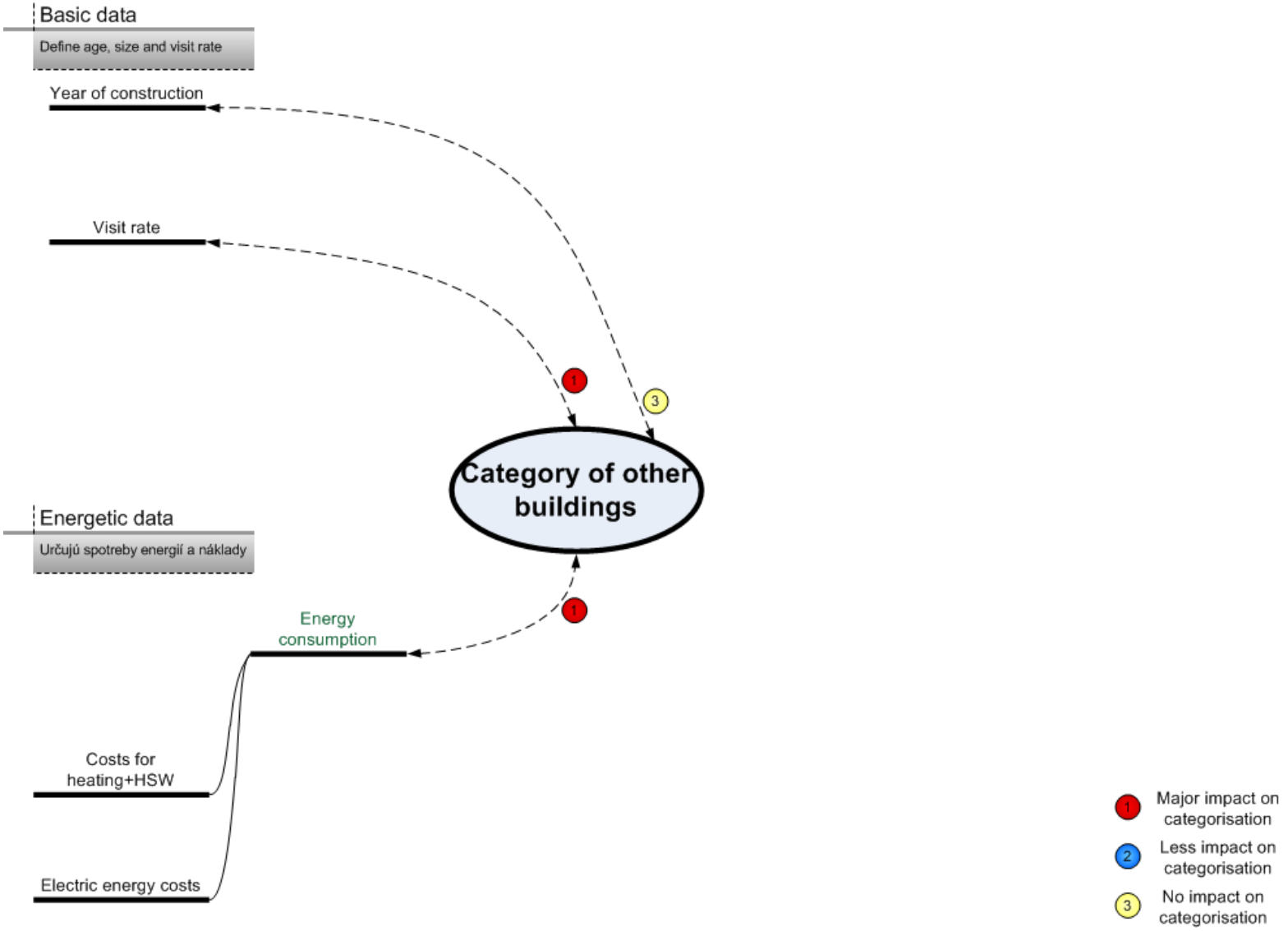
Source: *elaboration of the author*

Scheme No. 1: ***Logic model of grouping questions into themes for the evaluation of main*** **types of buildings**



Source: *elaboration of the author*

Scheme No. 2: ***Logic model of grouping of questions for the evaluation of other*** **types of buildings**



Source: *elaboration of the author*

For correct division of buildings into categories a point rendering methodology was created. The total maximum amount of points, which can be rendered to a building of highest priority, i.e. a building which is most suitable for the implementation of measures is 20.
The priorities of influence for classification were assessed by coefficients of importance as follows (chart No. 7):

Chart No. 7: ***Share of coefficients of importance on the basis of influence priorities***

Priority of parameters	Coefficient of importance at classification
1 Major impact on categorisation	80 % - basic parameters
2 Less impact on catagorisation	20 % - parameters for taking into account
3 No impact on cathegorizaton	0 % - parameters which are only informative

Source: *elaboration of the author*

7.1 Evaluation of main types of buildings and classification into categories

The subject matter is to render points into individual buildings and subsequently choose a suitable scale for classification into categories according to the obtained point results. At the categorisation of main types of buildings a choice of categories was taken into account, which respects the kind of building.

7.1.1 Categorisation of Village/Town Hall buildings

For the first kind of buildings Village/Town hall the 3 categories were chosen as follows:

VH/TH1 – number of points 10 and more – greatest potential
VH/TH 2 – number of points 5 and more – medium potential
VH/TH 3 – number of points less than 5 – least potential

The individual *Village/Town Hall buildings* reached their overall point evaluation using the coefficients of importance and the results are listed in chart No. 8. At the same time the chart shows the classification of buildings under one of the three categories VTH1, VTH2 or VTH3.

Chart No. 8: ***Classification of Village/Town Hall buildings under categories***

Municipality/Town	District	Overall assessment	Category
Komjatice	Nové Zámky	15,8	VH/TH1
Vlčany	Šaľa	14,6	VH/TH1
Komárno	Komárno	14,0	VH/TH1
Šaľa	Šaľa	13,8	VH/TH1
Kolárovo	Komárno	13,2	VH/TH1
Nová Veska	Nové Zámky	12,6	VH/TH1
Palárikovo	Nové Zámky	12,6	VH/TH1
Bátorove Kosihy	Komárno	12,4	VH/TH1
Hul	Nové Zámky	10,6	VH/TH1
Kamenica nad Hronom	Nové Zámky	9,8	VH/TH2
Kravany nad Dunajom	Komárno	9,4	VH/TH2

Hájske	Šaľa	8,6	VH/TH2
Bruty	Nové Zámky	6,4	VH/TH2
Gbelce	Nové Zámky	6,4	VH/TH2
Mužla	Nové Zámky	6,4	VH/TH2
Horná Kráľová	Šaľa	6,2	VH/TH2
Bardoňovo	Nové Zámky	6,0	VH/TH2
Dulovce	Komárno	6,0	VH/TH2
Svodín	Nové Zámky	6,0	VH/TH2
Diakovce	Šaľa	5,8	VH/TH2
Imeľ	Komárno	5,8	VH/TH2
Zemné	Nové Zámky	5,8	VH/TH2
Mojzesovo	Nové Zámky	5,6	VH/TH2
Číčov	Komárno	5,4	VH/TH2
Nesvady	Komárno	5,4	VH/TH2
Selice	Šaľa	5,0	VH/TH2
Okoličná na Ostrove	Komárno	5,0	VH/TH2
Bodza	Komárno	4,6	VH/TH3
Rastislavice	Nové Zámky	4,6	VH/TH3
Veľké Kosihy	Komárno	4,6	VH/TH3
Zemianska Olča	Komárno	4,6	VH/TH3
Iža	Komárno	4,4	VH/TH3
Čechy	Nové Zámky	4,2	VH/TH3
Kameničná	Komárno	4,2	VH/TH3
Rúbaň	Nové Zámky	4,2	VH/TH3
Pozba	Nové Zámky	4,2	VH/TH3
Jatov	Nové Zámky	4,0	VH/TH3
Bajč	Komárno	3,8	VH/TH3
Kráľová nad Váhom	Šaľa	3,8	VH/TH3
Patince	Komárno	3,8	VH/TH3
Tôň	Komárno	3,8	VH/TH3
Búč	Komárno	3,6	VH/TH3
Trávnik	Komárno	2,6	VH/TH3
Nána	Nové Zámky	2,6	VH/TH3
Leľa	Nové Zámky	2,4	VH/TH3
Andovce	Nové Zámky	2,2	VH/TH3
Dlhá nad Váhom	Šaľa	2,2	VH/TH3
Marcelová	Komárno	2,2	VH/TH3
Bajtava	Nové Zámky	2,0	VH/TH3
Chľaba	Nové Zámky	2,0	VH/TH3
Vlkas	Nové Zámky	2,0	VH/TH3
Holiare	Komárno	1,8	VH/TH3
Belá	Nové Zámky	1,8	VH/TH3
Dedinka	Nové Zámky	1,8	VH/TH3
Kmeťovo	Nové Zámky	1,8	VH/TH3
Maňa	Nové Zámky	1,8	VH/TH3
Virt	Komárno	1,8	VH/TH3
Ľubá	Nové Zámky	1,6	VH/TH3
Obid	Nové Zámky	1,6	VH/TH3
Dedina Mládeže	Komárno	1,4	VH/TH3
Brestovec	Komárno	0,6	VH/TH3
Kamenný Most	Nové Zámky	0,4	VH/TH3
Pribeta	Komárno	0,4	VH/TH3

Bodzianske Lúky	Komárno	0,2	VH/TH3
Šarkan	Nové Zámky	0,0	VH/TH3
Štúrovo	Nové Zámky	0,0	VH/TH3

Source: *elaboration of the author*

In building category VH/TH1 with the greatest potential for utilising the measurements of increasing the proportion of renewable sources of energy 9 buildings were classified. In category VH/TH2 with medium potential 18 buildings can be found. In the last category VH/TH3 there are 39 buildings with little potential.

7.1.2 Categorization of Community centre /House of culture buildings

For the second type of buildings - community centre/house of culture the 3 categories were chosen as follows:

CC/HC 1 – number of points 10 and more – greatest potential
CC/HC 2 – number of points 5 and more – medium potential
CC/HC 3 – number of points less than 5 – least potential

The individual buildings of community centres reached their overall point evaluation using the coefficients of importance and the results are listed in chart No. 9. At the same time the chart shows the classification of buildings under one of the three categories CC/HC1, CC/HC2 or CC/HC3.

Chart No. 9: ***Classification of CC/HC buildings under categories***

Municipality/Town	District	Overall assessment	Category
Šaľa	Šaľa	14,6	CC/HC1
Marcelová	Komárno	14,4	CC/HC1
Bešeňov	Nové Zámky	14,2	CC/HC1
Kameničná	Komárno	13,6	CC/HC1
Maňa	Nové Zámky	13,6	CC/HC1
Mužla	Nové Zámky	13,6	CC/HC1
Bátorove Kosihy	Komárno	11,8	CC/HC1
Komárno	Komárno	11,4	CC/HC1
Gbelce	Nové Zámky	8,0	CC/HC2
Palárikovo	Nové Zámky	7,8	CC/HC2
Bruty	Nové Zámky	7,6	CC/HC2
Zemné	Nové Zámky	7,4	CC/HC2
Diakovce	Šaľa	6,6	CC/HC2
Okoličná na Ostrove	Komárno	6,6	CC/HC2
Číčov	Komárno	6,2	CC/HC2
Vlčany	Šaľa	6,2	CC/HC2
Dulovce	Komárno	5,8	CC/HC2
Kravany nad Dunajom	Komárno	5,8	CC/HC2
Kráľová nad Váhom	Šaľa	5,6	CC/HC2
Mojzesovo	Nové Zámky	5,4	CC/HC2
Nesvady	Komárno	5,4	CC/HC2

Selice	Šaľa	5,4	CC/HC2
Svodín	Nové Zámky	5,2	CC/HC2
Zemianska Olča	Komárno	5,0	CC/HC2
Hájske	Šaľa	4,8	CC/HC3
Kolárovo	Komárno	4,6	CC/HC3
Nová Veska	Nové Zámky	4,0	CC/HC3
Veľké Kosihy	Komárno	3,8	CC/HC3
Imeľ	Komárno	3,6	CC/HC3
Pozba	Nové Zámky	3,4	CC/HC3
Rastislavice	Nové Zámky	3,4	CC/HC3
Rúbaň	Nové Zámky	3,4	CC/HC3
Kamenica nad Hronom	Nové Zámky	3,0	CC/HC3
Sikenička	Nové Zámky	3,0	CC/HC3
Dedina Mládeže	Komárno	2,6	CC/HC3
Dlhá nad Váhom	Šaľa	2,6	CC/HC3
Búč	Komárno	2,4	CC/HC3
Hul	Nové Zámky	2,4	CC/HC3
Jatov	Nové Zámky	2,4	CC/HC3
Kmeťovo	Nové Zámky	2,4	CC/HC3
Štúrovo	Nové Zámky	2,4	CC/HC3
Andovce	Nové Zámky	2,2	CC/HC3
Brestovec	Komárno	2,2	CC/HC3
Obid	Nové Zámky	2,0	CC/HC3
Iža	Komárno	1,8	CC/HC3
Virt	Komárno	1,8	CC/HC3
Bajč	Komárno	1,6	CC/HC3
Vlkas	Nové Zámky	1,6	CC/HC3
Holiare	Komárno	1,4	CC/HC3
Kamenný Most	Nové Zámky	1,4	CC/HC3
Bodzianske Lúky	Komárno	1,2	CC/HC3
Bodza	Komárno	1,0	CC/HC3
Leľa	Nové Zámky	1,0	CC/HC3
Belá	Nové Zámky	0,8	CC/HC3
Nána	Nové Zámky	0,8	CC/HC3

Source: *elaboration of the author*

In building category CC/HC1 with the greatest potential for utilising the measurements of increasing the proportion of renewable energy 8 buildings were classified. In category CC/HC2 with medium potential 16 buildings were placed. In the last category CC/HC3 there are 31 buildings with little potential.

7.1.3 Categorization of Primary School buildings

For the third type of buildings – primary school - 3 categories were chosen as follows:

PS1 – number of points 10 and more – greatest potential
PS2– number of points 5 and more – medium potential
PS3 – number of points less than 5 – least potential

The individual primary school buildings reached their overall point evaluation using the coefficients of importance and the results are listed in chart No. 10. At the same time the chart shows the classification of buildings under one of the three categories PS1, PS2 or PS3.

Chart No. 10: ***Classification of PS buildings under categories***

Municipality/Town	District	Overall assessment	Category
Gbelce	Nové Zámky	15,8	PS1
Šaľa	Šaľa	13,2	PS1
Maňa	Nové Zámky	12,4	PS1
Marcelová	Komárno	12,4	PS1
Okoličná na Ostrove	Komárno	12,2	PS1
Bešeňov	Nové Zámky	12,0	PS1
Hájske	Šaľa	11,8	PS1
Vlčany	Šaľa	11,8	PS1
Dulovce	Komárno	11,4	PS1
Čičov	Komárno	11,2	PS1
Bajč	Komárno	11,0	PS1
Selice	Šaľa	7,4	PS2
Mojzesovo	Nové Zámky	7,0	PS2
Palárikovo	Nové Zámky	6,8	PS2
Kolárovo	Komárno	6,4	PS2
Svodín	Nové Zámky	6,0	PS2
Zemianska Olča	Komárno	6,0	PS2
Štúrovo	Nové Zámky	6,0	PS2
Diakovce	Šaľa	5,6	PS2
Kravany nad Dunajom	Komárno	5,4	PS2
Zemné	Nové Zámky	5,4	PS2
Kráľová nad Váhom	Šaľa	4,6	PS3
Mužla	Nové Zámky	4,4	PS3
Búč	Komárno	4,0	PS3
Jatov	Nové Zámky	4,0	PS3
Kameničná	Komárno	3,8	PS3
Pozba	Nové Zámky	3,6	PS3
Nesvady	Komárno	3,4	PS3
Bruty	Nové Zámky	3,4	PS3
Rastislavice	Nové Zámky	3,4	PS3
Dedina Mládeže	Komárno	3,0	PS3
Tôň	Komárno	2,4	PS3
Hul	Nové Zámky	2,2	PS3
Nová Veska	Nové Zámky	2,0	PS3
Bodzianske Lúky	Komárno	1,8	PS3
Andovce	Nové Zámky	1,8	PS3
Rúbaň	Nové Zámky	1,8	PS3
Trávnik	Komárno	1,4	PS3
Veľké Kosihy	Komárno	1,4	PS3

Source: *elaboration of the author*

In the PS1 building category with the highest potential for utilising the measurements of increasing the proportion of renewable energy 11 buildings were classified. In the PS2 category with medium potential 10 buildings were classified. In the last category, PS3 there are 18 buildings with little potential.

7.2 Evaluation and classification of other types of buildings

Similarly to the main types of buildings the categorization for other types of buildings was created. At the categorization of other types of buildings the categories were chosen according to the attained point results directly, where not the type of buildings as such is important, but their arrangement on the basis of their potential. The following building categories were concerned: kindergarten, nursery, building for sports, firehouse, outbuilding, house of social services, retirement home, health centre. The following 3 categories were chosen:

OB1 – number of points 10 and more – greatest potential
OB2 – number of points 5 and more – medium potential
OB3 – number of points less than 5 – least potential

Chart No. 11 presents all other buildings, which attained more than 0 points.

Chart No. 11: ***Classification of other buildings***

Municipality/Town	District	Type of building	Points 3B	Points 3A	Overall assessment	Category
Bátorove Kosihy	Komárno	KG	15	5	20,0	OB1
Gbelce	Nové Zámky	KG	15	5	20,0	OB1
Marcelová	Komárno	KG	15	5	20,0	OB1
Mužla	Nové Zámky	KG	15	5	20,0	OB1
Nesvady	Komárno	KG	15	5	20,0	OB1
Šaľa	Šaľa	KG	15	5	20,0	OB1
Štúrovo	Nové Zámky	KG	15	5	20,0	OB1
Trávnik	Komárno	KG	15	5	20,0	OB1
Šaľa	Šaľa	Nursery	15	5	20,0	OB1
Šaľa	Šaľa	FH	15	5	20,0	OB1
Kolárovo	Komárno	RH	15	5	20,0	OB1
Kolárovo	Komárno	HC	15	5	20,0	OB1
Nesvady	Komárno	HC	15	5	20,0	OB1
Palárikovo	Nové Zámky	HC	15	5	20,0	OB1
Andovce	Nové Zámky	KG	0	5	5,0	OB2
Bardoňovo	Nové Zámky	KG	0	5	5,0	OB2
Búč	Komárno	KG	0	5	5,0	OB2
Diakovce	Šaľa	KG	0	5	5,0	OB2
Dulovce	Komárno	KG	0	5	5,0	OB2
Hul	Nové Zámky	KG	0	5	5,0	OB2
Kamenica nad Hronom	Nové Zámky	KG	0	5	5,0	OB2
Kameničná	Komárno	KG	0	5	5,0	OB2
Kamenný Most	Nové Zámky	KG	0	5	5,0	OB2
Kmeťovo	Nové Zámky	KG	0	5	5,0	OB2
Kolárovo	Komárno	KG	0	5	5,0	OB2
Kráľová nad Váhom	Šaľa	KG	0	5	5,0	OB2
Ľubá	Nové Zámky	KG	0	5	5,0	OB2

Maňa	Nové Zámky	KG	0	5	5,0	OB2
Mojzesovo	Nové Zámky	KG	0	5	5,0	OB2
Obid	Nové Zámky	KG	0	5	5,0	OB2
Okoličná na Ostrove	Komárno	KG	0	5	5,0	OB2
Rúbaň	Nové Zámky	KG	0	5	5,0	OB2
Selice	Šaľa	KG	0	5	5,0	OB2
Sikenička	Nové Zámky	KG	0	5	5,0	OB2
Svodín	Nové Zámky	KG	0	5	5,0	OB2
Zemianska Olča	Komárno	KG	0	5	5,0	OB2
Bátorove Kosihy	Komárno	Nursery	0	5	5,0	OB2
Kolárovo	Komárno	Nursery	0	5	5,0	OB2
Nesvady	Komárno	Nursery	0	5	5,0	OB2
Diakovce	Šaľa	FH	0	5	5,0	OB2
Gbelce	Nové Zámky	FH	0	5	5,0	OB2
Kolárovo	Komárno	FH	0	5	5,0	OB2
Marcelová	Komárno	FH	0	5	5,0	OB2
Nesvady	Komárno	FH	0	5	5,0	OB2
Palárikovo	Nové Zámky	FH	0	5	5,0	OB2
Svodín	Nové Zámky	FH	0	5	5,0	OB2
Zemianska Olča	Komárno	FH	0	5	5,0	OB2
Nesvady	Komárno	Outbuilding	0	5	5,0	OB2
Bešeňov	Nové Zámky	HC	0	5	5,0	OB2
Diakovce	Šaľa	HC	0	5	5,0	OB2
Dulovce	Komárno	HC	0	5	5,0	OB2
Hul	Nové Zámky	HC	0	5	5,0	OB2
Kameničná	Komárno	HC	0	5	5,0	OB2
Maňa	Nové Zámky	HC	0	5	5,0	OB2
Marcelová	Komárno	HC	0	5	5,0	OB2
Mojzesovo	Nové Zámky	HC	0	5	5,0	OB2
Mužla	Nové Zámky	HC	0	5	5,0	OB2
Selice	Šaľa	HC	0	5	5,0	OB2
Svodín	Nové Zámky	HC	0	5	5,0	OB2
Zemianska Olča	Komárno	HC	0	5	5,0	OB2

Source: *elaboration of the author*

Marking of building types in chart No. 11:
KG – kindergarten
Nursery – nursery
FH – firehouse
RH – retirement home
Outbuilding – outbuilding
HC – health centre

All other buildings reached zero points and therefore they are classified into the IB3 category.

7.3 Evaluation of the building categorization

Using the chosen methodology all buildings were classified into 12 categories. Categories VTH1, CC/HC1 and PS1 deserve the closest attention. As buildings suitable for the realisation of measurements also VTH2, CC/HC2, PS2 and OB1 can be selected, too. The

remaining categories represent buildings which are the least suitable, or the least gain of the measurements could be expected. At judging of the buildings those ones should be preferred, which are concentrated at one locality if more of them are classified in the first two suitable groups of categories. At concentration there is a good precondition of the use of synergy and reduce of the total costs in case the concentration of buildings will be considered already in the projection phase of the measurements for such buildings.
By the chosen methodology of categorization basically 3 types were created, in which several categories can be classified. The following buildings are concerned:

a) buildings with the greatest potential (VH/TH1, CC/HC1, PS1)
b) buildings with medium potential (VH/T2, CC/HC2, PS2, OB1)
c) buildings with the least potential (VH/TH3, CC/HC3, PS3, OB2)

as for the application of measures utilising renewable energy sources.

The closer description of the individual types or categories is complicated, concerning the amount of input variables affecting the classification (number of storeys, material of the support constructions, heat isolation etc.). Concurrently, identical values of the same variables occur in several categories, respectively types.
From the point of view of classification into types the most important aspect of the potential of buildings is mainly the amount of finances spent on energy consumption. The further data are bound to these finances. The data referring to the construction materials, type of roof etc. do not play such an important role. As far as we are interested in the general description of the individual types, they can be described as follows:

The buildings with the greatest potential are buildings with high financial costs spent on energy consumption. Usually they are one storey buildings with an attic, respectively buildings with several storeys with a great built-in area and volume. They generally have their original windows and the external walls and construction has no heat isolation. Investments into technologies utilising RES for the energy supply of these buildings would produce a high financial return.
Buildings with medium potential are buildings, which have been completely or partly valorised technically – windows and doors on external walls exchanged or the perimeter walls and constructions heat-isolated, or both. Bearing in mind that the buildings in question are usually buildings with great ground areas and built-in volume have average energy costs thanks to the completely or partially realised measures aiming at the reduction of their energy demands. Investments into measures aiming at the use of RES would produce savings in energy costs. However, the financial return would be of a more long-term character.
Buildings with the least potential are buildings with low costs of energy. These are usually smaller in size and with one storey, technically valorised by the exchange of doors and windows in the perimeter constructions of the buildings, which are also heat-isolated. Investments into RES at this type of buildings would not be economically profitable from the point of view of the reduction of energy costs.

Conclusion

The study of frequency and characteristics of public buildings, possibilities of the introduction of means and technologies using RES at the provision of energetic needs of public buildings represents a complex material presenting the opportunities of the utilisation of renewable sources of energy at supplying public buildings on one hand and the categorisation of public buildings according to selected characteristics on the other. The introduction of the study describes the types of institutions residing at public buildings and the legal regulations connected with the use of RES and with the increase of energetic self-sufficiency of Slovakia. These are important legal documents representing the basis of gradual dismantling of the exclusive use of non-renewable sources of energy and a rising interest towards renewable sources, including their utilisation at the energetic supply of buildings. In the next part of the study we describe the concrete use of RES at establishing the autonomous energy supply of public buildings. This is a description of the potential of RES on the territory of the Slovak Republic, as well as a description of the most frequently used concrete technologies in buildings, which use RES directly for energy production. An important part of the analytic part of the study is outlining the possibilities of financing of project plans aiming at the reduction of energy demands of public buildings as well as the creation of their autonomous energy supply through RES. The strategic part investigates the quantity, technical and economical characteristics of public buildings by the means of a questionnaire survey emphasis laid on the most frequent objects (buildings of municipality/town halls, community centres and primary schools), which can be found in the defined region of the Komárno, Nové Zámky and Šaľa districts. Lower priority is laid to other types of buildings. The last part of the study is devoted to the categorization of buildings in the aspect of establishing categories of buildings helping the planning of future investments.

The results of the questionnaire survey pointed out to three facts. The first is the very low degree of utilising RES for the energy-supply of public buildings (only one investment). This can be explained by the high investment costliness of the equipments utilising renewable sources, as well as by the inadequate level of information. The second fact is the relatively high potential of public buildings for the use of RES. Their localisation in South Slovakia, where there is a great potential for the use of several types of RES, is of key importance. The third fact is the identification that autonomous energy-supply of buildings produced exclusively from local renewable sources is not possible by the given circumstances, since in many cases the costs of energetic operation of buildings are rather high.

The identification of these facts is of key importance concerning the goals of the study. The goal of the study- categorization of public buildings for the need of their matching with the concrete investment opportunities- is fulfilled by the creation of 12 categories in the frame of three basic types determining the suitability of the use of any renewable source for the energy supply of the buildings. These categories mainly reflect the costs of energy within the individual types of buildings. The categorization serves the purpose of future projection of the use of devices using renewable sources of energy, mainly solar and geothermal energy and energy from biomass. The long-term sustainability of the energy-supply of buildings, reduction of energy costs and not less importantly the reduction of the amounts of CO_2 emissions are benefits of the use of RES.

It is important to emphasize the contribution of the study to the success of future RES investments. The study represents the groundwork for the analysis of opportunities, objectives and financing for all municipalities not only in the defined region, but in all Slovakia as well. It is a practical manual surveying the opportunities of utilising renewable sources at the energy supply of public buildings in a comprehensible way; mainly from the point of view of

heating and preparation of HSW. In this aspect it is a benefit not only for the self-governments, but for the entrepreneurs´ sector, non-profit organizations, citizens and state institutions as well.

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