GovernEE – Good Governance in Energy Efficiency
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WP 3.1.2.

POTENTIAL ESTIMATION REGARDING ENERGY EFFICIENCY

[Hódmezővásárhely, Hungary]

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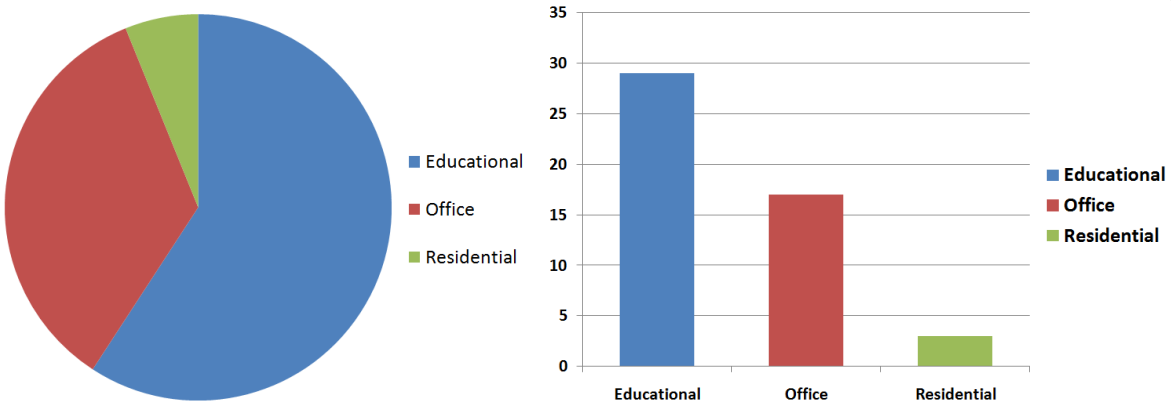


Figure 1. Number of the different public buildings' functions [p.]

Table 1. Structure of the public building stock in Hódmezővásárhely

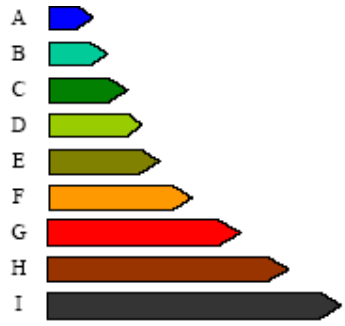
		Hódmezővásárhely
		LP
Total number of public buildings	**number of the buildings**	49
Number of public educational buildings	number of the buildings	29
Number of public office buildings	number of the buildings	17
Number of public residential buildings	number of the buildings	3
Number of other public buildings	number of the buildings	-

2. METHODOLOGY OF THE POTENTIAL ESTIMATION CALCULATION

Legal context

The EPBD based Ministerial Decree TNM 7/2006 has been published in May 2006.

The content of the regulation has been published in January 2006 too. Nevertheless, the original proposal is under discussion since late 2006 and may be rejected. Originally, an asset method had been chosen, based on the average climatic data and the "standardised" users' behaviour (the last deducted from statistics in case of residential, office and school buildings). The proposed asset method is simply the repeat-calculation of the design with the input data of the real building (existing or under commissioning). This method has been accepted in January 2006 by the professional society as well, as by the State Office of Housing and Building, being responsible for the implementation of EPBD.



In summer 2006 the State Office has been dissolved, a few of its staff members continued their activity in the Ministry of Local Governments and Regional Development. In the new administrative environment, the ready to publish regulation became a subject of concern because of the expected reaction of the general public, since a new service is spoken of, which is compulsory and should be paid, although it was not asked for. New ideas have been raised by the Ministry: the certification of existing buildings should be based on the energy bills, the cost of certification should not exceed the equivalent of about 50 € in the case of single family houses and individual flats, the advises aiming at energy saving measures should be optional only. There is no information who is developing or will develop the new protocol – at least the team which developed the original proposal is not involved. It is hoped by the administration that the new rules will be issued, new guides and software will be published, training courses run, exams completed and the certification activity will be launched by January 2009. With regard to the remaining time and the fact that the notification can be started in the best case in April 2008, the realisation seems to be a great challenge.

Regarding Article 10, the Chamber of Engineers and the Chamber of Architects agreed early 2006 that a common examination board will issue the licences for the experts. This agreement has been approved by the State Office of Housing and Building. The Chamber of Engineers was about to start the exams already in 2006, however, due to the lack of the regulation, the exams have been postponed, although more than 1000 potential experts queued waiting this possibility.

The regulation covering the Articles 8 and 9 is the responsibility of the Ministry of Economy and Transport. The text is under discussion due to some formal objection, e.g. whether a Decree may include equations.

Status of the implementation

Certification of buildings

Although the method of the certification became subject of discussion, the rating system and the numeral values of the requirements are in force since September 2006.

In the Hungarian rating systems 10 categories are used. Each category is marked with a letter and characterised by words, too. The buildings which meet the new requirements of 2006 are in the category C, whilst A^+, A and B include those which are better (see the attached table). The categories below C are used for buildings of energy consumption beyond the limitations of the new requirements – theoretically and mostly for existing buildings.

The labelling is documented in the energy certificate, which have several pages but the final result is shown on the eye-catching scheme on the front page. As many other schemes, it consists of a set of coloured arrows, the length of which is proportional to the annual primary energy consumption of the average building in the given category. This scheme illustrates the system of categories at the first sight.

A specific feature of the scheme is that non-linear scale has been chosen. The annual primary energy consumption of existing buildings may be 3 - 6 times higher than that of a new one. It seems to be more favourable if the width of the categories is narrower in case of good quality buildings and increases continuously with the annual energy consumption (e.g. the width of the category B is 20 kWh/m^{2}a only, but may be as high as 60 – 80 kWh/m^{2}a for category F). In such a system the ends of the arrows are on a hyperbole-like curve. As a result a limited number of categories is enough to cover the full scale from the low energy houses to the worst quality of existing buildings.

The decreasing widths towards the good quality buildings expresses well the necessary efforts to achieve the next better label: whilst a few centimetre of added insulation on a non-insulated brick wall has a dramatic effect, that of the same measure is hardly recognisable in the case of a well insulated building. It is easy to achieve a 20 kWh/m^{2}a decrease of the annual consumption if the original was 200 but tremendous effort is necessary if the original was 50!

With regard to the procedure of the certification itself it should not be forgotten that in the case of newer buildings the input data are more reliable, calculation, drawings are available, whilst the input data of existing buildings, built 40 – 70 years before may frequently be estimated only, so the result are less precise in the last case. Having narrow categories in the case of old existing buildings the error of the labelling may be more categories up or down, due to the unreliable input data, while having wide categories the error could be maximum one category.

Calculation procedures

The calculation procedures (Article 3) are defined in the Annex of the Ministerial Decree TNM 7/2006 in details.

For residential, office and school buildings “standardised” users’ behaviour has been defined. It consists of the number of habitants/users per floor area, the number of hours of their presence per week, the necessary air change rate and luminance level and the hot water consumption. For other and mixed use buildings the above input data are to be defined complying with standards or the State of the Art for all separate units of the building (e.g. for the guest rooms, kitchen, restaurant, gymnasium, conference hall, swimming pool, etc. in the case of a wellness hotel).

MSz-EN standards (CEN standards adopted in Hungary), being in force in 2005 and some working documents of CEN, available in 2005 have been considered, nevertheless no direct references are included in the regulation in order to provide “stable situation”. According to the EPBD the national regulation will be reviewed

every five year and modified, if necessary, according to the new standards, but within the five year period changes should be avoided. Moreover it must not be forgotten that the scale of a design, submitted for building permit does not facilitates to take into account constructional details, changes in the final design and during the execution are possible, too, thus simplified calculation is not only rational but quasi inevitable.

Requirements for new buildings and major renovations

The new requirements are mandatory for building permits requested after 1 September 2006. Building permit must be asked for new buildings as well as for major renovation. In the last case the 1000 m^2 rule is recently applied. The main concept of the requirement system is the separation of the components of energy need into distinct categories: components, depending mainly on the building and those, depending mainly on the users.

Although the distinction could not be "absolute" it is self intended that – at prescribed indoor temperature and climatic conditions – the net heating energy need to cover the transmission losses depends on the thermal envelope of the building whilst e.g. the net energy need to cover the domestic hot water consumption relates to the users.

According to this concept the requirement system has three different levels: the building and its service systems must comply with all of them. The levels are the followings:

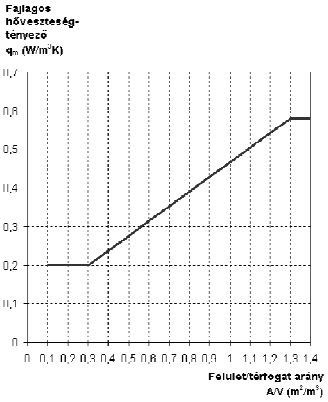
- Building elements
- Building
- Building and service system together

The proof of compliance must be made at two steps: when requesting the building permit and after completion of the building.

Regarding the building elements the U values of wall, flat roof, attic floor slab, window, entrance gate, etc. are limited (see a sample in the table). Whatever the case of the requirements on the level of the buildings the required U values must not be exceeded. At the same time it is to be emphasised that the compliance with the requirements of building elements *does not guarantee* the compliance with the requirements of the building as a whole!

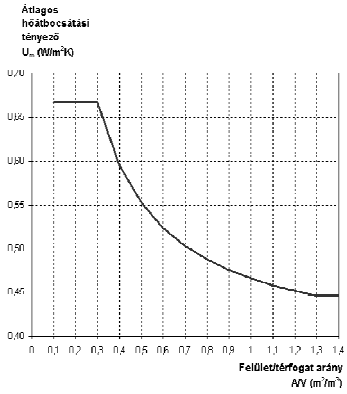
Regarding the building as a whole a specific heating load requirement and the risk

of sumer overheating must be checked.



Specific net heating energy demand W/m3K vs surface to volume ratio

The specific heat load includes all building related components of the energy balance, namelly:
transmission heat losses including thermal bridge losses,
utilised solar gains.



The unit of this specific value is W/m^{3}K, its range is 0,20 – 0,58. The requirement depends on the surface to volume ratio (in other terms on the form factor) of the building. This requirement must be met, whatever building use is spoken of. Regarding the utilised solar gains there are more options: they can be neglected (in this case better insulation should be applied), or the gains can be taken into account with a conservative value for shadowed facades or the gains can be taken into account with differentiated values for the different orientations if solar access is proven using shadow mask calculator. The more the utilised solar gains, the lower insulation level can be accepted, however no U value of any building elements may exceed the limit, given in the table.

It is important to mention that the fulfilment of the requirements for the building elements does not guarantee the fulfilment of the specific net heating need requirement – it depends on the surface to volume ratio, on the solar gains and on the ratio of the area of different elements. On the other hand, the fulfilment of the specific heat load requirement does not guarantee that the requirements regarding the building and the services systems together will be fulfilled

At the first sight the diagram may suggest that the requirement for larger and more compact buildings is very strict, however the reality is the opposite: the higher the surface to volume ratio, the more strict thermal insulation must be applied. Providing the solar gains are neglected, the overall average U value (including windows, doors and thermal bridges) must not exceed the limit, shown in the diagram. The range of the overall average U value is 0,44 – 0,67 W/m^{2}K. It is less by about 40% of the value, prescribed in the previous building regulation, issued in 1993.

With regard to the risk of summer overheating the regulation aims at the limitation of the expected daily average indoor-outdoor temperature difference – thus the consequences rather than the solar gains are checked. Self intended, several times the solar gains may be the reason of the summer overheating. Design values of glabal radiation intensity per orientation are based on climatic data: shadowing by opposite building or protruding elements must be proven by shadow mask calculator. The role of the g value of glazing and movable devices is unambiguous. In case of natural ventilation the air change rate is conventional design value, depending on the position of openable windows and on the possibility of night ventilation. The tolerated temperature difference is 3 K for heavy and 2 K for light weight building construction. The parameters refer to the design measures, influencing the risk of overheating. Certainly the consequences of the internal gains cannot be easily eliminated.

The third level of the regulation includes the building and the service systems together. It is expressed in kWh/m^{2}a primary energy need. Gross energy need of heating, cooling, ventilation, domestic hot water and – excepting residential buildings – artificial lighting is taken into account. For residential, office and school buildings the limitation is prescribed as a function of the surface to volume ratio (see the attached graphs). Numeral values of the efficiency and the specific self-consumption of the service systems can be taken from the Tables of the Annex unless reliable and more precise figures can be given and proven by the designer. For other buildings and buildings of mixed use a reference value ("notional building") is calculated case by case in the following way:
- it is supposed that the specific heat load complies with the requirement;
- net energy need is calculated according to the standards or to the State of the Art (e.g. set indoor temperature, air change rate, internal gain in the gymnasium, in the kitchen, in the restaurant, in the swimming hall and so on of a wellness hotel);
- whilst calculating the gross energy need, given types and efficiency values of equipment and service systems and natural gas should be taken into account – the

result is the reference value.
Whatever building and service systems will be applied the primary energy need must not exceed the above reference value.

It is to be mentioned that the compliance with the specific heat load requirement does not guarantee that the annual primary energy requirement will be fulfilled: it depends on the service systems and on the energy carriers. Would be the last ones less favourable, the negative consequences must be compensated by better building.

The rating is based on the ratio of the actual specific primary energy consumption and the prescribed or reference value.

Providing the floor area of the building exceeds 1000 m^2 the rationality of use of alternative energy or cogeneration should be checked. It means that the primary energy use should be calculated taking into account the alternative sources and the other intended service system: the better one should be applied.

Requirements for existing non-residential buildings larger than 1000 m^2

In the case of major renovation of any building larger than1000 m^2 the same requirements are to be applied as in the case of new buildings. The definition of major renovation is based on the value of the building (excluding that of the building site): if the costs of the renovation of the building envelope and/or the mechanical systems exceed 25%, the requirements should be fulfilled.

Public Buildings – periodic certification

The definition of public buildings is still under discussion, the intention is that it will include only state-owned buildings, in order to decrease the cost of certification.

Qualified Experts

Although about 1500 practicing engineers and architects joined the training courses, run by universities and other bodies and the Chamber of Engineers made preparation for the exams already in 2006 no licences have been issued till date, due to the lack of the relevant regulation on the certification. Providing the certification method will be changed, the actions should be restarted.

The intention that certification may be issued by energy supplier companies makes disputable the independence of experts.

Quality control

The originally proposed procedure may be implemented as a commercial initiative, namely experts can join on voluntary basis to a system, run by RAMSYS which has a long term experience in the field of data collection and elaboration. It means that the data of the certification can be uploaded on-line to a central server. During the process the consistence of the data and the accuracy of the calculations are checked: in case of any problem the user will receive an alert. Data are saved safely, can be downloaded by those who have access, data can be filtered and selected for statistical purposes, etc. The system has been checked, the action has been announced, its success will be influenced by the regulation, to be issued in 2008. At present the system is ready to use, but - disregarding some tests – the system is empty, since the method of the certification became questionable.

Till date no other ("official", compulsory) registration and quality control measures have been regulated - although the RAMSYS company declared its intention to take the responsibility of a central obligatory registration at no cost to the central administration, no response from the Ministry have been received.

Inspection of boilers and air conditioning

The regulation is still under discussion, due to formal problems, e.g. whether a regulation may include equations, etc. It is expected that the regulation will be issued in 2008.

3. ENERGY CONSUMPTION AND SAVING POTENTIALS OF ENERGY EFFICIENCY IMPROVEMENTS

The energy savings research analysis calculation of this estimation was based on the hungarian energy efficiency programme. 70 buildings were analyzed before and after the renovation. From this energetic point of view the final amount of the energy saving was approximated.

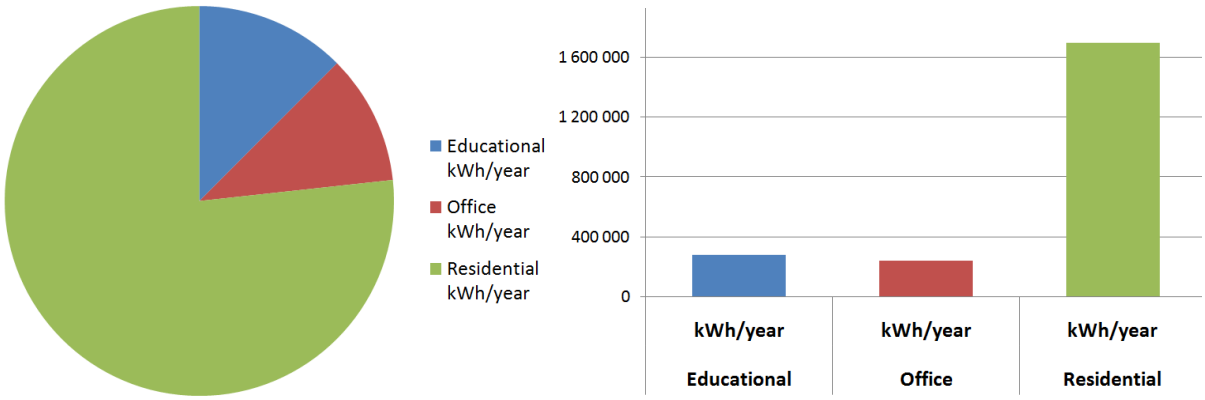
The main results of the heating energy consumption analysis of Hódmezővásárhely:

Number of public buildings:	49	buildings
Total heating energy consumption:	17 160 315	kWh/year
Total floor area of the buildings:	115 273	m2
Average heating energy consumption:	350 211	kWh/year public building
Average floor area of the buildings:	2 353	m2/average public building

Table 1. Average and summarized result values from the total public building database

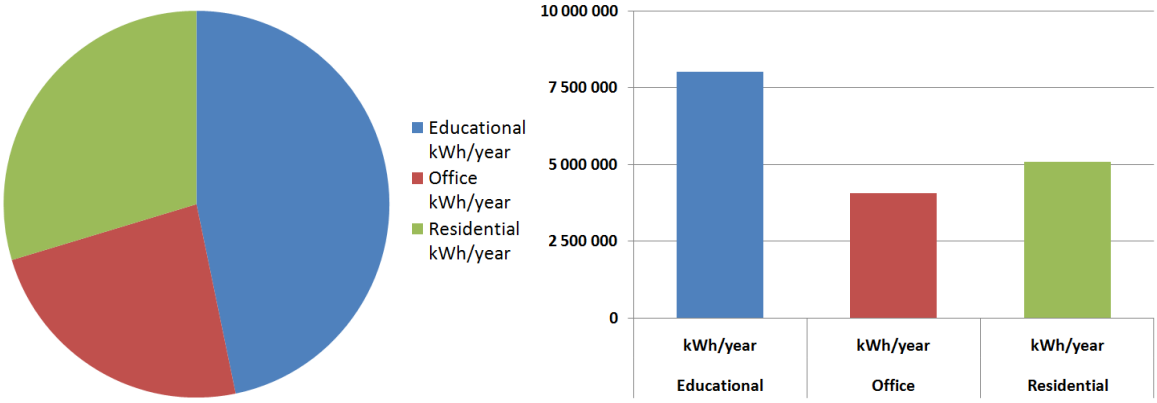
	Floor area	Heating energy consumption
	m2	kWh/year
Average	2 353	350 211
Summa	115 273	17 160 315

Figure 02. Average heating energy consumption of the different public buldings' functions [kWh/year]



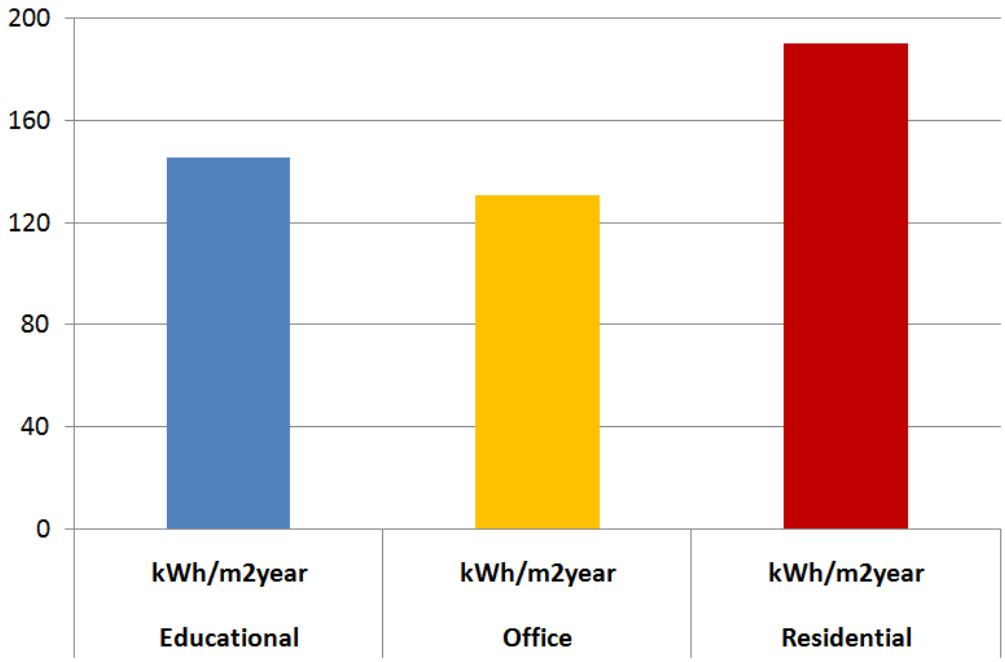
Function	Educational	Office	Residential
	kWh/year	kWh/year	kWh/year
Average	276 592	238 175	1 696 719

Figure 03. Summarized heating energy consumption of the different public buldings' functions [kWh/m2year]



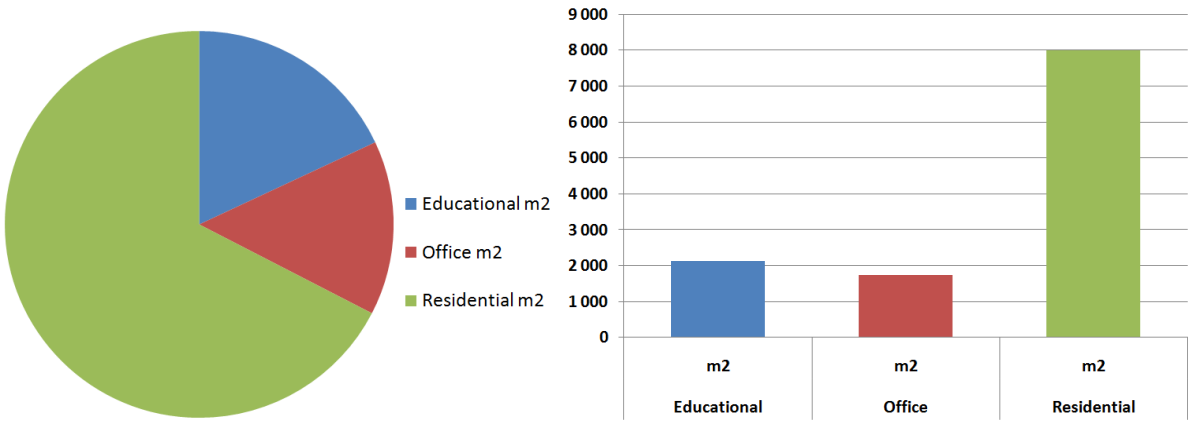
Function	Educational	Office	Residential
	kWh/year	kWh/year	kWh/year
Summa	8 021 175	4 048 982	5 090 158

Figure 04. Average specific heating energy consumption of the different public buldings' functions [kWh/(m2year)]



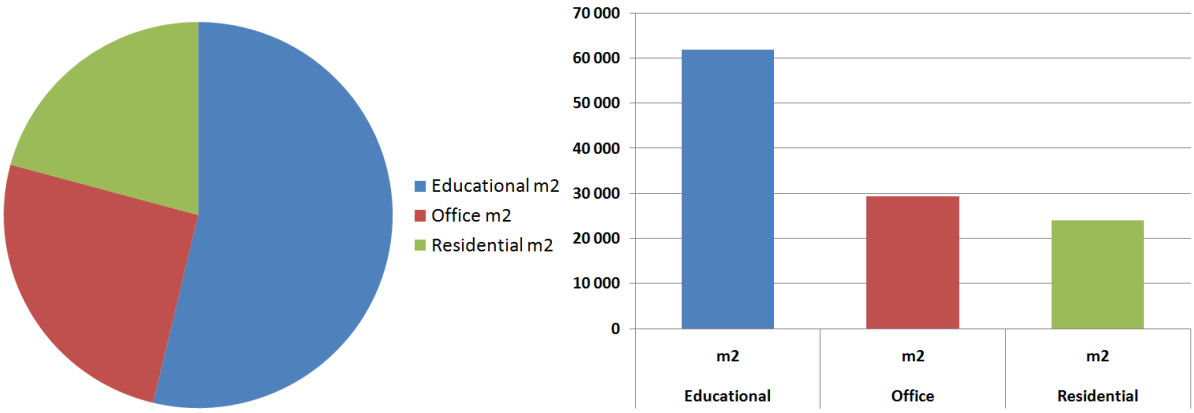
	Educational	Office	Residential
	kWh/m2year	kWh/m2year	kWh/m2year
Average	145	131	190

Figure 05. Average floor area of the different public buldings' functions [m2]



	Educational	Office	Residential
	m2	m2	m2
Average	2 136	1 728	7 990

Figure 06. Summarized floor area of the different public buldings' functions [m2]



	Educational	Office	Residential
	m2	m2	m2
Summa	61 931	29 373	23 969

(**References:** Attila Talamon, Tamás Csoknyai, *Monitoring of a Performance-oriented Policy Model for Retrofitting "PANEL Buildings" [2011]*)

I. renovation: 55% savings from heating energy consumption in residental buildings
II renovation: 45% savings heating energy consumption in educational and office buildings
III. better users' habits: 5% savings heating energy consumption in educational and office buildings

Function	Educational	Office	Residential	SUM
	kWh/year	kWh/year	kWh/year	kWh/year
Present consumption:	8 021 175	4048982	5090158	17160315
After renovation:	4 411 646	2 226 940	2 290 571	8 929 157
Savings:	3 609 529	1 822 042	2 799 587	8 231 158

Function	Educational	Office	Residential	SUM
	kWh/year	kWh/year	kWh/year	kWh/year
Present consumption:	8 021 175	4048982	5090158	17160315
After changing users habits:	401 059	202 449	254 508	858 016
Savings:	7 620 116	3 846 533	4 835 650	16 302 299

Heating energy savings potential potential from renovation: 8 231 158 kWh/(m2a)

Heating energy savings potential potential from users habit: 858 016 kWh/(m2a)

Heating energy savings potential potential summ: 9 787 173 kWh/(m2a)

COMPARABLE SUMMARY TABLE:

		Hódmezővásárhely
		LP
Total number of public buildings	**number of the buildings**	49
Number of public educational buildings	number of the buildings	29
Number of public office buildings	number of the buildings	17
Number of public residential buildings	number of the buildings	3
Number of other public buildings	number of the buildings	-
Total heating energy consumption	**kWh/year**	17 160 315
Total heating energy consumption - Educational	kWh/year educational buildings	8 021 175
Total heating energy consumption - Office	kWh/year office buildings	4 048 982
Total heating energy consumption - Residential	kWh/year residental buildings	5 090 158
Total heating energy consumption - other pulic buildings	kWh/year public buildings	-
Total average heating energy consumption	**kWh/year average public building**	350 211
Average heating energy consumption - Educational	kWh/year average educational building	276 592
Average heating energy consumption - Office	kWh/year average office building	238 175
Average heating energy consumption - Residental	kWh/year average residental building	1 696 719
Average heating energy consumption - Other	kWh/year average other building	-
Total floor area of the buildings	**m2**	115 273
Floor area of the educational buildings	m2 educational	61 931
Floor area of the office buildings	m2 office	29 373
Floor area of the residental buildings	m2 residental	23 969
Floor area of the other buildings	m2 other	-
Average floor area of the buildings	**m2/average public building**	2 353
Average floor area of the buildings - Edicational	m2/average educational building	2 136
Average floor area of the buildings -	m2/average office	1 728

Office	building	
Average floor area of the buildings - Residental	m2/average residental building	7 990
Average floor area of the buildings - Other	m2/average other building	-
Average specific heating energy consumption	**kWh/(m2year) average public building**	149
Average scecific heating energy consumption - Educational	kWh/(m2year) average educational building	145
Average specific heating energy consumption - Office	kWh/(m2year) average office building	131
Average specific heating energy consumption - Residental	kWh/(m2year) average residental building	190
Average specific heating energy consumption - Other	kWh/(m2year) average other building	-
Total estimated heating energy saving potential - Renovation	**kWh/year public buildings**	8 231 158
Estimated heating energy saving potential - Renovation - Educational	kWh/year educational buildings	3 609 529
Estimated heating energy saving potential - Renovation - Office	kWh/year office buildings	1 822 042
Estimated heating energy saving potential - Renovation - Residental	kWh/year residental buildings	2 799 587
Estimated heating energy saving potential - Renovation - Other	kWh/year other buildings	-
Total esimated heating energy saving potential - Changing users habits	**kWh/year public buildings**	858 016
Estimated heating energy saving potential - Changing users habits - Educational	kWh/year educational buildings	401 059
Estimated heating energy saving potential - Changing users habits - Office	kWh/year office buildings	202 449
Estimated heating energy saving potential - Changing users habits - Residental	kWh/year residental buildings	254 508
Estimated heating energy saving potential - Changing users habits - Other	kWh/year other buildings	-