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PROJECTS FOR FAMILY HOUSES WITH REGARD TO ENERGY EFFICIENCY

The greatest potential for energy savings can be achieved in the residential sector, where nearly 40% of final energy consumption is spent in all types of buildings. Even though the buildings with nearly zero energy consumption consume 80% less energy for heating and cooling, compared with the conventional ways of energy gains for new buildings and 90% less energy than existing ones, their construction in our country is not very extensive yet. The main reason is high initial investment at the beginning of house construction, although with a guaranteed financial return.

Another factor is lack of public trust, or rather lack of information for the future homeowners about the details of buildings with low energy consumption. One way to solve it is through financial bonuses given to future homeowners during house project selection.

Keywords: residential sector, energy efficiency, financial bonuses

INTRODUCTION

To measures taken in 2007 on the European energy and climate change, the European Union has set mandatory and ambitious “20-20-20” targets, that is to say, reducing greenhouse gas emissions by 20%, increasing renewable energy consumption to 20% and improving energy efficiency by 20%, all by 2020. As pointed out by the Commission in 2010, the European Union’s target of saving 20% of its primary energy consumption to 2020 will not be made with the present progress.

The greatest potential for energy savings can be achieved in the residential sector, where nearly 40% of final energy is being consumed in homes, public and private offices, shops and other buildings. Two thirds of this energy is used only for heating where the main share of energy comes from fossil fuels. In most developed countries the construction sector is the largest contributor of greenhouse gas emissions with an estimated average of 33%.

Construction of buildings with extremely low or almost zero energy consumption and very high energy efficiency appears as crucial to achieve the objectives of the “20-20-20”. As a result, the European Union focuses on these types of buildings as an important element towards achieving these objectives and it requires

that by 2018 all new buildings must have almost zero energy consumption, which means that energy must be achieved by important expansion of renewable energy sector.

Buildings with nearly zero energy consumption spend 80% less energy for heating and cooling compared with conventional ways of the energy gains for new ones and 90% less energy than existing ones. Construction of such buildings is an essential tool to increase energy efficiency by 20% and reduce greenhouse gas emissions by 20% in 2020. These types of buildings must be also safe, salubrious, functional and comfortable, as well as aesthetically integrated into the existing urban structure [1].

1. BACKGROUND

Energy performance of buildings is determined on the basis of calculated or actual annual energy consumption spent to meet different needs associated with its routine use and reflects the energy needs for heating and cooling (i.e. energy needed to prevent overheating and maintain the specified temperature conditions of the building) and the needs for domestic hot water.

Energy performance of buildings is expressed in a transparent manner and includes the energy performance indicator and numeric indicator of primary energy consumption based on primary energy factors of energy carriers, which may be based on national or regional weighted averages or a specific value for the on-site production.

The methodology for calculation of energy performance should take into account the European standards and be in accordance with the relevant EU legislation [2]. With regard to the circumstances of reducing energy and energy efficiency the European Union has consistently supported research and development in architecture of energy-efficient buildings and adopted the necessary legislation: Directive on Energy Performance of Buildings (Revised 2010/31/EU) and the Directive on the Promotion of the Use of Energy from Renewable Sources (2009/28/EC).

Both directives are focused on the crucial role of low energy buildings and public sector involvement, the significant integration of highly efficient buildings with the use of renewable energy systems and the importance of management and trainings with the aim to achieve the “20-20-20” targets.

The directives also support the exemplary role of the public sector, proposing fast track reconstruction of public sector buildings through the introduction of mandatory regulations and setting standards for energy efficiency in public spending.

If these recommendations are applied more broadly, the Commission suggests that public authorities should take major principles to make buildings highly effective and this system should be systematically applied when buying e.g. IT equipment, services (e.g. energy) and works (e.g. reconstruction of a building) [1, 3, 4].

While it is possible to save nearly 80% of the total energy in buildings with very low power consumption only through design and construction proposal, real estate market is still limited. In Europe, there has been only built a total of 20 000 low-energy buildings, of which about 17 000 are located in Germany and Austria [5]. Figure 1 shows the approximate percentage distribution of total energy consumption of house operations.



Fig. 1. Share of energy to house needs

2. STATE SUPPORT IN THE EPB (ENERGY PERFORMANCE OF BUILDING) FIELD

With reference to adopted EU Directives on Energy Performance of Buildings Directive, Member States should compile lists of existing and proposed actions, including their financial aspect.

The existing and proposed actions in the proposed lists of Member States may mainly include measures that aim to reduce existing legal obstacles and market barriers and encourage the investments and/or other activities to improve the energy efficiency of new and existing buildings.

Those actions could also include free or subsidized technical assistance and advice, direct grants, subsidized credit programs or low interest loans, grant programs and loan guarantees.

Public authorities and other institutions which provide these financial actions, could link the application of them to the energy performance and the recommendations given in the energy certificates [1].

There are selected government actions of the financial measures from 2011 to 2013 for the building sector (for residential houses) in Table 1.

Table 1. Summary of selected actions taken by the government in house field, from 2011 to 2013

Nr.	Action	Specification	Financial mechanism	Responsible	Frc. savings 2011 - 2013	Financing (Th. EUR)					
						(TJ)	EU	SB	Cofinancing from SB	HTU	Privat sources
1.1	Improving the therm. performance of building	Houses	Privat source	-	818	0	0	0	0	500 000	500 000
			Gov. programe of insulation II.	MDVRR SR	33	0	3 000	0	0	17 000	20 000
1.4	Construction of buildings with low energy and passive buildings	Houses	Comercial banks	-	46	0	0	0	0	18 363	18 363
			Residentia houses	Comercial banks	-	3	0	0	0	0	4 284
TOTAL					897	0	3000	0	0	535 363	539 260

2.1. Government program of insulation

This is a support through soft loans to cover the costs for insulation of houses and apartment buildings. This program provides soft loans (with maturity of 15 years and a zero interest rate) up to 100% of eligible construction costs, but mostly for:

- ✓ Homes: 50 euro per m² of insulated surface,
- ✓ Residential buildings: 80 euro per m² of insulated surface.

The program aims to encourage households to carry out a project to improve the thermal performance of buildings for housing, which was given final approval decision before 1989.

In 2010 the State Housing Development (SHD) received applications under the government program of insulation, more than 17 million euro in total value. However, there were not allocated eligible funds to the program and all the applications were rejected.

In 2011 10 million euro was allocated for the program. To the 3rd March 2011 the SHD listed 6 applications for houses and 50 for apartment buildings with a total requested amount of over 10.9 million euro. Applications for 2012 should have been submitted in the beginning of 2012 [6].

2.2. State Housing Development Fund (SHDF)

These are soft loans for housing reconstruction. Support for this purpose may be granted only if the floor area in an apartment building or in multifunctional house does not exceed 80 m² or the floor area of living and non-living space in a family house belonging to one apartment does not exceed 160 m² without garage space and half of this floor area is intended for housing.

The SHDF noted for I.Q of 2012 a large number of applications for credit support mainly in scope of reconstruction and thermal insulation for residential buildings, where the requirements of applicants exceeded the amount of funds allocated in the budget of the SHDF. Increased demand for credit support had been observed also for the purpose of buying an apartment. In order to facilitate financing of all mentioned supports for other applicants, the SHDF asked ministry for approval of changes in the budget no. 01/2012, which is listed in Table 2 [7]. This change was approved on 4th April, 2012.

Table 2. SHDF modified budget 2012 [7]

Purpose of support	Type of support		change 2.4.12
	credit	non-repayable contribution	
Construction of an apartment in RB, FH or multifunctional building	15 000 000	91 521	
Construction of social service buildings	3 000 000	0	
An apartment purchase	15 000 000	40 000	+ 5 000 000
Reconstruction of residential buildings	50 000 000	0	+20 000 000
Construction of rental apartment	48 162 785	300 000	-25 000 000
Reconstruction of social service buildings	300 000	0	
Thermal insulation of residential buildings	14 000 000	0	
<i>Total for types</i>	145 462 785	431 521	
TOTAL	145 894 306		

2.3. Government grants for households' solar panels and biomass boilers

Grants for that purpose are:

- ✓ 200 euro for 1 m² of solar collectors installed in a house, ranging up to 8 m² of surface,
- ✓ 100 euro for 1 m² of solar collectors installed in an apartment building, but the maximum grant is 300 euro for each apartment in an apartment building that uses hot water from installed solar collectors,
- ✓ grants for the use of biomass can be provided up to 30% of the purchase price of a biomass boiler installed in the family house of the applicant, but not more than 1,000 euro.

Applications for grants were given by the Slovak Innovation and Energy Agency to the November 2011, grants are provided by the Ministry of Economy [8]. Grants

are approved by the Commission. In 2011 there was 2,675,200 euro allocated for that purpose. These resources have been spent by 27th October, 2011.

The budget for 2012 has been revised to 31st January, 2012 to the amount of 753,084 euro, what is nearly 2 million less in comparison to 2011 [6].

The greatest potential for energy savings in the residential sector is in the improvement of thermal properties. From abovementioned incentives for improving energy performance of buildings (family houses) it is clear that the support from the state is insufficient. How then should be a private person interested in the construction of the more energy efficient house, if it is financially very demanding?

3. ENERGY EFFICIENT BUILDINGS

The Slovak Republic by the adoption of EU directives on energy efficiency in buildings and promoting of the use of renewable energy committed themselves to observe the principles of “20-20-20”, which are the best achievable through application of the principles of new systems. Obligations towards the EU lead us to enhance the construction of the energy efficient houses.

The Energy Efficiency Action Plan for the years 2011-2013 shows that due to dependency on support from the Found of Energy Efficiency, which was not applied, the actions to the construction of buildings with improved thermal and technical indicators (construction of new systems, low-energy houses, passive houses, etc.) have not been implemented in practice [1].

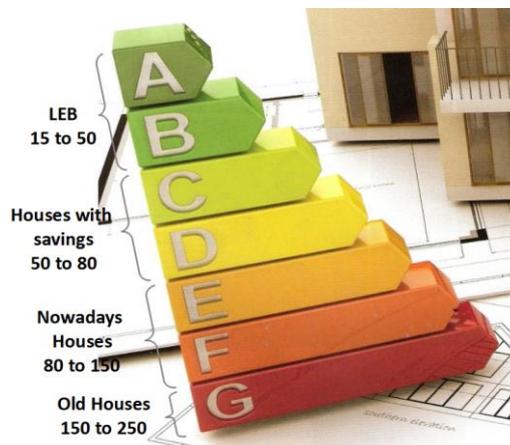


Fig. 2. Rating of houses by the specific heat consumption in kW·hour⁻¹

There is a large selection of house projects on the Slovak real estate market. Several design companies offered a variety of catalog projects. The first advantage of this selection, which can attract most of the potential investors, is the cost of the project (approximately 700 to 1,500 euro) significantly lower than the cost of

a customized project, i.e. EHB building project. The second advantage is immediate availability. What are the offers in designing energy efficient buildings? Figure 2 shows the rating of houses according to the specific heat consumption.

There are several design and building companies offering projects of buildings with low energy consumption together with their realization. Today there are very few companies, which brought under its catalog an offer of EPB buildings, whether low-energy, passive, or houses with lower energy consumption (energy class A).

Most of the information is very general, without specific data for the proposed construction. There is missing overview on calculated energy consumption while maintaining the technological design solutions to construction, on additional costs associated with implementation of the EPB, on reports of total required investment, on return on investments when calculating energy consumption and estimate development of energy prices, on options and prices for issuing a certificate of energy efficiency and the like.

For an investor who has only marginal or general information about the construction of a EPB possibility it is difficult to decide to choose this project and he would rather choose from more transparent variants of house projects, mostly belonging to the energy class B or C.

House project selection is obviously associated with considerable costs for project, construction materials and with the construction itself. High initial investment already during the selection of the project is a disadvantage of lower energy house project implementation.

If there existed a financial incentive in the project preparation level, e.g. by bonuses when energy efficient house is chosen, it would certainly expand this area, whether on their own energy efficient house projects, as well as realizing the construction of energy efficient buildings [9].

The bonuses could rely on type of building, consumption of energy, used materials (construction and environmental assessment), the widest use of renewable sources, regions (north, south) and the like.

3.1. House design catalogs - low energy standard

Below there is listed an overview of some companies offering catalog design of houses in low-energy standard (tables 3-7). The review includes type of EPBD (energy efficient buildings), calculation of the price for the project itself and an overview of house prices for producing energy certificate (if calculated) [10-17].

Table 3. **Ideálne bývanie s .r. o. - Design and construction company**

type EEB	Surcharge to the project	Energy certificate
Low energy buildings, only for selected types of houses	415 Euro	166 Euro

They offer possibility of low energy design projects in a Class A energy efficiency ($0 \div 50 \text{ kW/m}^2$) for selected projects. Individual constructions (walls, roof, floors, windows, etc.) are designed for this option with parameters that exceed the recommended values of thermal technical standards and after the modification of heat pumps and in combination with solar panels, the total energy consumption is lower than 50 kW/m^2 . There is extended delivery date for those kind of projects [8].

They offer several variants of the energy-efficient house projects: active houses, low-energy houses and passive houses (table 4).

Active house is a new product of the company. It actively reacts to the house needs through intelligent traffic management system that checks and automatically regulates heating, cooling, fresh air exchange, lighting, CCTV and security system, raising and lowering blinds as needed by the daylight and by insulation.

Table 4. **Euroline Slovakia s. r. o. - Design company**

type EEB	Surcharge to the project	Energy certificate
Active house, Low energy building, Passive house	600 to 850 Euro	200 Euro

While a low-energy house is selected, the project increases the cost of the house by 10 to 20% compared to the standard version. The cost of heating may drop by 40 to 60%.

The modification of the house to the passive standard requires increased financial demands by roughly 25 to 35% compared to the price of the house in the basic standard and by about 15 to 20% compared to the low energy house standard. Heating costs will drop by 80 to 95% [9].

Table 5. **Wranders, s. r. o. - Design Company**

type EEB	Surcharge to the project	Energy certificate
Low energy building	1530 to 1580 Euro	In offer, will be specified

They offer a low-energy type houses „TAU” low to mid-sized category (table 5). It is designed with the system of excellent insulation properties and heat recovery ventilation. Specific heat demand for these types of houses ranges from 24.9 to 48.4 kW/m^2 per year [10].

Table 6. **PROmiprojekt, s. r. o. - Design Company**

type EEB	Surcharge to the project	Energy certificate
Low energy building, Passive house	1050 to 1300 Euro for LEB 2600 Euro for PH	In offer, will be specified

They offer several variants of the projects of energy-efficient houses, low-energy houses and passive houses (table 4). The design is solved by improved insulation elements (roof, floor and wall insulation) and by plastic windows. There is installed underfloor central heating with condensing boiler, alt. heat pump, hot water condensing boilers, alt. with support of solar panels; ventilation is controlled with the heat recovery unit [11].

Table 7. **W8D - architectural studio**

type EEB	Surcharge to the project	Energy certificate
Low energy building	6840 Euro	In offer, will be specified

They are specialized in individual projects of modern energy-efficient houses for building permits, which are especially widespread in the working drawings in construction and static parts (table 7). There is calculated conversion of energy balance and set the parameters to the optimal consumption already with house design. The conversion is carried out by using the PHPP software (Passive House Planning Package), developed in scientific institute Passivhaus Institut Darmstadt, Germany. The calculation includes all the relevant factors, climate areas, house size, house insulation and windows size, position and thermal profile. Houses are designed brick and wood mounted. The project documentation is prepared on the basis of individual client requirements and land profile (size, shape, elevation of the land territory and on the other regulations) [12].

3.2. Other contractors for energy efficient buildings

Nízkoenergetické stavby, s. r. o. - Contractors, constructions

The company is a flexible, highly specialized construction company operating in the market since 2004. They offer to their clients an affordable living with the usage of all available forms of support. New Technology enables clients living in a very short time. Sophisticated home building system guarantees savings up to 65% on heating costs. The construction duration depends on the size of a house and it varies from 3 to 5 months. The company offers low-energy houses in different size categories. As addition to typical house projects they can construct a low-energy house from any project requested.

Table 8. **W8D - architectural studio**

	Before reconstruction to LEB	After reconstruction
Energy efficiency	150 kW/hour	30 kW/hour
Year energy spendings	2000 Euro	900 Euro

They are providing in their houses improved thermal insulation materials, design of low energy consumption, precision of construction with minimal dimensional tolerances, dry methods of construction without exclusion of moisture and climate regulatory action on wooden based, higher utility (residential) area reached by lower wall thickness with keeping all the static and thermal performance, eco-construction, where the main material is wood, and where by the keeping of all the technological processes, the life is comparable to a brick building [13] (table 8). There is shown in Table 8 a comparison of the savings before and after reconstruction to LEB standard and the Figure 3 shows a model of LEB house that is free for available client visits.



Fig. 3. Model of LEB house provided by Nízkoenergetické stavby s.r.o [13]

Usporne domceky - design and construction company

The company is engaged in design and construction of buildings with low energy consumption, low-energy houses and passive houses. They are constructing all the buildings as energy-efficient by using appropriate materials and work processes. Design and realization takes into account several parameters from the choice of suitable land and the orientation of the cardinal points of the house, through optimal thermal insulation of the house with supervision for quality control, through the appropriate selection of windows that precisely match the needs of the building and through eliminating of thermal bridges to the use of solar energy. Table 9 shows the comparison of the cost of operating a house with total floor area of 150 m², where the savings in conversion to energy prices in 2010 are calculated, provided that the price of energy will not increase in 30 years [14].

Table 9. Comparisons of spending for different types of houses [14]

	Typical house	LEB house	PH
Heating (kWh)	18000	5250	2250
spendings (Euro)	64	19	17
Electricity (kWh)	3500	3500	3500
spendings (Euro)	55	55	26
Monthly spendings TOTAL (Euro)	119	74	43
Yearly spendings (Euro)	1431	886	514
YEARLY SAVINGS (Euro)		545	917
20 YEAR SAVINGS (Euro)		10900	27510

CONCLUSION

Even though the buildings with nearly zero energy consume 80% less energy for heating and cooling compared with the conventional ways of obtaining energy for new buildings and 90% less energy than existing buildings, their construction in our country is not yet very extensive. The main reasons are high investment costs at the beginning of the construction, although with a guaranteed financial return. Another factor is lack public of trust, or rather ignorance of the future homeowners about the low-energy consumption buildings. Even when the Slovak Republic committed itself to keep the EU Energy directive, hardly any grants were awarded by the government.

The EU set up a Intelligent Energy - Europe (IEE) fund, which has been earmarked for 2007-2013, about 730 million of available funds. The program supports specific projects, initiatives and best practices through annual calls for proposals. Among the funded projects it may include training of new construction techniques that can lead up to 50 or more percent energy savings compared to traditional buildings, improvement in the efficiency of support systems for electricity from renewable energy sources and the like. The fund contains three different types of activities: projects of innovative ideas in the field of sustainable energy in practice, support for projects to meet the requirements of the European Commission and other financial establishment for releasing the funds for investment in sustainable energy at local level.

This is one way how to get the necessary insight and financial support for development for the construction of low energy buildings, through the design and construction companies that could expand its range of catalog houses with low energy potential. It needs to be supported by the state, which would significantly promote the project design preparation through a variety of bonuses for those who are interested in construction of low-energy buildings. These bonuses could be dependent on the type of selected house, the energy consumption, used materials (construction and

environmental assessment), the widest use of renewable energy, the regions (north, south) and the like. This would certainly spread low-energy building area, whether on offers of EHB projects, as well as realizing the construction of energy efficient buildings.

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PROJEKTY DOMÓW MIESZKALNYCH W ASPEKCIE EFEKTYWNOŚCI ENERGETYCZNEJ

Pokażny potencjał w zakresie oszczędności energii tkwi w sektorze mieszkaniowym, gdyż prawie 40% końcowego zużycia energii jest przeznaczane na tego typu budynki. Mimo że budynki prawie zeroenergetyczne zużywają około 80% mniej energii do ogrzewania i chłodzenia w porównaniu z tradycyjnymi nowo wznoszonymi i 90% mniej niż w przypadku istniejących ich budowa nie jest jeszcze dość rozpowszechniona. Głównym powodem są wysokie koszty inwestycyjne, brak zaufania do nowych rozwiązań oraz brak informacji o korzyściach płynących z posiadania budynku o niskim zużyciu energii. Jednym ze sposobów przełamania niechęci do wy-

boru tego rodzaju budynku może być premia finansowa oferowana w trakcie wyboru projektu domu.

Słowa kluczowe: budynki mieszkalne, efektywność energetyczna, premia finansowa