CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in the Czech Republic

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AUTHORS

Vojtěch Svoboda, *Ministry of Industry and Trade*

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1. Introduction

The Czech Republic's building market presents great potential for energy savings that can be largely achieved through implementing the EPBD, a responsibility of the Ministry of Industry and Trade. The EPBD has been transposed through the *Energy Management Act* No. 406/2000 Coll[1], with the last amendment coming into force in 2015. The *Energy Management Act* sets the obligation to increase the energy performance of buildings and the obligations related to EPCs; it also sets rules, conditions and educational standards for EPC issuers and heating and AC systems inspectors. The most recent amendments to the act relate to the obligation to show energy performance indicators in advertisements for the sale or rental of buildings via estate agencies, as well as to specify exemptions regarding where to process the EPC and the number of EPCs to be controlled each year. A new amendment to the act is currently under preparation. Improving the buildings' energy performance and increasing energy savings are high priorities in the Czech Republic. This report presents an overview of the progress and current status of the EPBD implementation in the Czech Republic.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

Regarding new building constructions, the builder is obliged to fulfil the legislative requirements for building energy performance. When applying for a building permit for making changes to the construction before its completion, which impact the building's energy performance, the builder must prove through the EPC that the building's energy performance meets cost-optimal levels. The assessment of the technical, economic and environmental feasibility of the local energy supply system of energy from RES, combined heat and power generation, thermal energy supply systems and heat must also be covered. Decree 78/2013 sets seven energy performance indicators:

1. total primary energy per year;
2. non-renewable primary energy per year;
3. total delivered energy per year;
4. partial delivered energy for technical building systems;
5. average U-value;
6. U-value on each construction on the system boundary;
7. energy efficiency of the technical building systems.

In order for the new building to be built, the builder must document that it meets the minimum values for non-renewable primary energy per year, total delivered energy per year and the average U-value. The total delivered energy indicator must reach level C, which is set as a minimum requirement for the building to be constructed. This is valid for all types of buildings (residential, non-residential, public, etc.). Decree 78/2013 also sets the minimum parameters for technical building systems.

2.I.i. Progress and current status of new buildings

See section above.

2.I.ii. Format of national transposition and implementation of existing regulations

The main act covering buildings' energy performance is, as already defined, the *Energy Management Act*. The energy performance is further covered by several decrees that specify technical issues:

- Decree 78/2013 Coll.[2] on building energy performance defines the methodology for calculation, energy performance indicators, parameters of the reference building, primary energy factors and appearance of the EPC;
- Decree 193/2013 Coll.[3] on AC systems inspections defines the methodology and frequency of AC systems inspections;

- Decree 194/2013 Coll.[4] on heating systems and hot water distribution defines the methodology for heating systems dimensioning and definition of efficiency, as well as the methodology and frequency of heating systems inspections.

The energy performance calculation must be based on standards including:

- ČSN EN 73 0540[5] on thermal protection of buildings, which specifies technical requirements for the design and verification of buildings including indoor environmental characteristics during their use (Table 1).

- Technical normalisation information, as TNI 73 0331[6], which contains typical energy efficiency parameter values and intervals of technical building equipment efficiency, typical profiles of building uses (operational hours, ventilation, lighting and hot water preparation), computated climate data, etc.

Description of the building component	Construction type	Required U-values	Recommended U-values
Flat and pitched roof pitch up to 45° included Floor above external space Ceiling below the unheated attic and the roof without thermal insulation Floor and wall with heating	light	0.24	0.16
	heavy		
External wall Steep roof with the roof pitch exceeding 45°	light	0.3	0.2
	heavy		
Floor and wall in contact with the soil* Ceiling and internal wall from a heated to an unheated space		0.6	0.4
Ceiling and internal wall from a heated to a partially unheated space		0.75	0.5
Windows and other 'opening fillers' in the envelope of the heated space, including the respective frame		1.8	1.2
Door, gates and other fillers from partially heated spacess to unheated spaces of heated building		3.5	2.3

Table 1. U-values set in the standard ČSN 73 0540.

2.I.iii. Action plan for progression to NZEB for new buildings

The *Energy Management Act 406/2000* Coll. defines as NZEB a building with very low energy performance whose energy consumption is to a very significant extent covered by RES. The exact proportion of energy that should come from RES is not defined. There are several conditions that must be fulfilled by the builder/designer for the building to be categorised as NZEB. Energy indicators to be met are the same as for new buildings. However, in the case of NZEB, the Czech legislation demands a gradual decreasing of the non-renewable primary energy for the reference building. The assessed building must meet this stricter requirement either by increasing the share of RES or by improving the building envelope. The NZEB must then meet the non-renewable value requirement, reduced by 25% for family houses, 20% for apartment

buildings, and 10% for other buildings. The legislation consists of a two-step requirements approach: the cost-optimal level requirements, which came into force on 1 April 2013, and the gradual tightening of requirements towards NZEB depending on the size and type of the building, which will be coming into force between 1 January 2016 and 1 January 2020.

Figure 1. Example of a NZEB; Koti Hyacint project (passive standard) located in Prague.

Methodology	Floor area	Demand for heating	Total delivered energy	Primary energy consumption
	m^2	kWh/m^2year	kWh/m^2year	kWh/m^2year
PHPP* methodology	1,963	15	-	68
TNI 73 0330	2,321	9	-	68
78/2013 Coll.	2,511	12	37	48

* Passive House Planning Package

Table 2. Energy Values according to different methodologies for the Koti Hyacint project

2.I.iv. Requirements for systems and / or building components for new buildings

Any new building must comply with the energy performance requirements of the *Energy Management Act*, which includes minimum energy efficiency requirements of technical building systems. These minimum values are defined in Annex 1 of Decree 78/2013 on building energy performance applied to the reference building.

Parameter	Symbol	Unit	Reference value
Heating			
Heat generation efficiency factor	$\eta_{H,gen,R}$	%	80
Heat distribution efficiency factor	$\eta_{H,dis,R}$	%	85
Emission efficiency factor	$\eta_{H,em,R}$	%	80
Cooling			
Energy efficiency ratio	$EER_{C,gen,R}$	W/W	2.7
Energy efficiency ratio of other cooling sources	$EER_{C,gen,R}$	W/W	0.5
Efficiency distribution factor for cooling	$\eta_{C,dis,R}$	%	85
Emission efficiency factor for cooling	$\eta_{C,em,R}$	%	85
Delivered energy for family and apartment houses (or zones with this operation)	$Q_{fuel,C}$	kWh	0

Table 3. Example of requirements for new or changed building systems.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

Existing buildings have to meet strict energy performance requirements in case of major or other renovations. In this case, the builder, owner or association of unit owners must fulfil the requirements given by the implemented legislation, Decree 78/2013 Coll., that sets the minimum parameters and energy performance indicators. The EPC must demonstrate that the cost-optimal levels are met for the changed building envelope and/or building technical systems, and that the assessment of the alternative energy delivery system as well as recommendations for decreasing the energy performance have been provided. The EPC must be part of the building permit application.

Number of building floors	Total number of family houses	Single-family houses	Semi-detached houses	Detached houses
Total	1,554,794	1,163,655	133,877	257,262
1	584,075	456,246	38,885	88,764
2	861,774	630,737	86,757	144,280
3	45,995	24,753	4,783	16,459
n.a.	62,950	51,739	3,452	7,759

Table 4. Number of family houses in the Czech Republic.

2.II.ii. Plans to improve the existing building stock

Implementing the Directive 2012/27/EU on energy efficiency, the "*Renovation Strategy of Buildings*" study[7] concerns renovations of the whole building stock in the Czech Republic. This study calculated the possible savings potential of all building renovations in the Czech Republic, including renovation costs, renovation models, and different scenarios of gradual renovations. The study calculated the savings potential for all buildings, especially for residential buildings, and including service and agricultural buildings. Other buildings were differentiated according to their age, size and thermal insulation properties of the building envelopes. The percentage of buildings renovated was taken into account, being 25% for single-family houses and 40% for apartment buildings. The study calculated the energy savings for heating, hot water preparation and lighting, and also took energy savings from shallow to deep renovations (to reach the passive standard) into account.

In 2001, the final energy consumption for households was 252 PJ. The total possible savings in buildings was 92 PJ (36.5%) in the case of moderately deep renovations, and 155 PJ (61.5%) in the case of deep renovations.

The study included five possible scenarios on how to achieve energy savings:

- business as usual;
- quick but shallow renovations;
- slow but deep renovations;
- quick and deep renovations;
- hypothetical renovations (3% of renovated buildings each year).

The study also estimated the investment cost for renovations of the building stock on the level of meeting recommended values for walls, roofs and floor insulation. The costs not only covered the price of the used material and work but also costs for the design work, costs on scaffolding, waste disposal, etc.

The total investment necessary for the building envelopes of family houses was estimated at 654 billion Czech crowns (24.5 billion €) to meet the recommended values, and 777 billion Czech crowns (29.2 billion €) to reach the passive standard. In the case of apartment buildings, the total investment for envelope insulation was estimated at 261 billion Czech crowns (9.8 billion €) to meet the recommended values, and 304 billion Czech crowns (11.4 billion €) to reach the passive standard. Considering also renovation of other building types, the study showed that 1.5 trillion Czech crowns (56.4 billion €) is needed to reach the recommended values, and 2.1 trillion Czech crowns (78.9 billion €) is needed to reach the passive standard.

2.II.iii. Regulation of system performance, distinct from whole building performance

The *Energy Management Act* sets an obligation in the case of improvements other than major renovations of either an existing building or a completed one, during which the requirement to improve the energy performance must be achieved for the altered structural elements of the building envelope or technical building systems. If improvements are performed within ten (10) years from issuing the EPC of the building,

the building owner or association of unit owners are obliged to comply with the energy performance requirements for buildings set in Decree 78/2013 Coll., and the construction must meet the energy performance requirements for either the altered structural elements of the building envelope or the altered technical building systems, also set in Decree 78/2013 Coll. This must be proved by copies of documents relating to an altered structural element of the building envelope or an altered technical system, required to be kept for five (5) years.

2.II.iv. Encouragement of intelligent metering

Smart metering in the field of heat and electricity in the Czech Republic is on a voluntary basis. Currently, 61% of electric meters in the Czech Republic are smart meters with continuous metering. There are currently no incentives supporting the installation of smart meters.

2.II.v. Financial instruments and incentives for existing buildings

The main financial incentives for building renovations in the Czech Republic are direct subsidies from operational and national programmes. There are three main operational programmes that provide financing for building renovations, targeting a wide range of potential applicants from the public and private sectors: *Operational Programme Environment*, *Integrated Regional Operational Programme*, and *Operational Programme Enterprise and Innovation for Competitiveness*. The national programme *New Green Savings*, funded from the profits of the sale of emissions allowances, is focused on improving the energy efficiency of residential buildings, the construction of new energy-efficient buildings, the replacement of heating systems and the use of RES.

The Czech Republic is launching a pilot financial instrument in energy efficiency – *Programme ENERG*[8] – a soft-loan programme for financing energy efficiency measures for small- and medium-sized enterprises. The programme aims to facilitate SMEs in the capital city of Prague in securing financing for their projects through soft loans aimed at reducing energy intensity in their activities, in order to achieve savings in their final energy consumption. The purpose of the programme is to fill the gap as regards financing enterprises, which cannot apply in the operational programmes in the capital city due to high GDP per capita The programme is funded from the profits of the sale of emissions allowances for 2014.

2.II.vi. Information campaigns / complementary policies

The Czech Republic runs energy consulting and information centres. Energy consulting is provided as a free service to the public, which serves to support the implementation of energy savings and RES. It is designed for citizens, public administrations, businesses and entrepreneurs. The information centres are represented in all regions of the country and provide advice from qualified energy consultants. Financial support for these centres comes from the Ministry of Industry and Trade programme *EFEKT*[9] – a state programme that promotes energy savings and the use of RES.

As already mentioned, the Ministry of Industry and Trade coordinates the programme *EFEKT*. It is aimed at realising energy savings, increasing energy efficiency and reducing energy consumption. Minor investment and non-investment projects are promoted throughout a five-year period; these assist with energy consulting, implementing energy management, preparing energy efficiency projects, hosting events and

providing books and pamphlets, all of which are free to the public. The *EFEKT* programme also supports the EPC system, for example, by providing essential books as learning materials for applicants who wish to obtain a licence to issue EPCs and inspect heating and AC systems. The programme also supports energy auditors.

2.III. Energy performance certificate requirements

The obligation to obtain an EPC is set in the *Energy Management Act* for all buildings that are covered by this Act before construction (in the process of getting the building permit), major renovations, sale and rental, as well as when a builder submits a request for building changes before building completion. The *Energy Management Act* covers all residential, commercial and public buildings and defines the following exemptions as regards the issuance of the EPC:

- buildings with a total floor area of less than 50 m^2;
- buildings that are considered to be historic buildings or are located in a conservation area;
- buildings used as places of worship and for religious activities;
- residential buildings which are used or intended to be used for a limited time annually and with an expected energy consumption of less than 25% of what would be the result of all-year use;
- industrial sites, workshops and non-residential agricultural buildings with energy consumption of less than 700 GJ;
- intelligence service buildings;
- buildings important for state defence;
- buildings built before 1947 to be sold or rented and which have not undergone major renovations since, and the seller/lessor and the buyer/tenant agree on not issuing the EPC.

The EPCs can only be issued by *energy specialists* having a licence from the Ministry of Industry and Trade. The Ministry of Industry and Trade maintains a database of all approved *energy specialists* on its website. Further to the *energy specialists*, the database also includes boiler and AC inspectors. The *energy specialist* is obliged to register all issued EPCs in *ENEX*, the electronic database maintained by the Ministry. It is the obligation of the building owner to obtain the EPC. In case the EPC is processed by an expert from a different Member State, the building owner is obliged to inform and present the licence of the expert to the Ministry.

2.III.i. Progress and current status on sale or rental of buildings and EPCs

The building owner covered by the *Energy Management Act* must show and hand over the EPC or its verified copy when selling or renting the building, either as a whole or in part. The handover must happen at the latest when signing the contract; this applies for all building types. An EPC issued for an apartment building serves as an EPC for each apartment unit within the building. In case of sale or rental of an apartment unit, the *Apartment Owners Association* must provide the EPC to the apartment unit owner.

If the building owner does not fulfil these obligations, a penalty can be imposed by the *State Energy Inspection*.

The price of the EPC can typically range between 120 € and 150 € for an apartment or for a single-family house, and may go up to 2,000 € – 3,000 € for hospitals or large apartment buildings.

2.III.ii. Quality Assurance of EPCs

The *State Energy Inspection* is annually required to check at least one in twenty EPCs issued in the previous calendar year. In 2016, the *State Energy Inspection* performed 279 controls of *energy specialists* from a total of 1,429 *energy specialists* (20% of *energy specialists* controlled). These controls covered 1,305 EPCs to verify whether they were processed objectively, truthfully and completely, as the *Energy Management Act* requires. The controls identified several law violations, and penalties were imposed on the 178 relevant *energy specialists*. So far, penalties applied for wrongly processed EPCs total more than 13,000 €.

In addition, 213 controls checked the obligations of constructors and building owners regarding major renovations, and of building/unit owners, owner associations, and third parties regarding the proper display of EPCs in the event of a rental or sale. The resulting penalties imposed were 30,700 € in total.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

The Czech Republic runs a database called the *Central Register of Administrative Buildings*[10]. This register keeps records of 5,000 buildings that are properties of the state. The *Energy Management Act* §7a; sets the obligation for public authorities and owners of buildings occupied by public authorities to have the EPC issued by 1 July 2013 for buildings with a total floor area of over 500 m^2, and by 1 July 2015 for buildings with a total floor area of over 250 m^2. The EPC has the same format as that for non-public buildings and must be displayed in a prominent place where it is clearly visible to the public. The EPC must be recalculated as soon as it expires (within 10 years), or in case of major building renovations.

2.III.iv. Implementation of mandatory advertising requirement – status

When a building or an apartment is offered for sale or rent, the energy performance indicator from the EPC should be included in the advertisements in commercial media. The obligation to present the energy performance indicator in advertisements started on 1 January 2013. When the sale or rental is advertised by a third party (e.g., an estate agency), the owner must provide the graphical part of the EPC to the third party that displays the energy performance indicator in the advertisement. If the building owner does not provide the EPC, the third party displays class G to fulfil the obligation; however, the building owner can nevertheless be fined if they did not provide the graphical part of the EPC to the third party.

2.IV. Inspection requirements – heating systems, air conditioning

2.IV.i. Report on equivalence of model A and B for Heating Systems

The Czech Republic implemented an obligation for mandatory inspections of heating systems over 20 kW and hot water distribution systems in line with Articles 1-3 of the EPBD. This provision was implemented into Article 6a of the *Energy Management Act*. This article defines inspections of heating systems in buildings with business purposes. Inspections relating to family houses are defined by the *Air Protection Act*[11], or 458/2000 Coll.[12], the *Energy Act* and Decree 85/1978 Coll.[13] on inspections, revisions and tests of gaseous heat sources.

The Czech Republic also coordinates energy consultancy and information centres which give advice for heat sources that are not covered by the EPBD, as well as for AC systems, energy efficiency and RES, as mentioned in Section II vi.

2.IV.ii. Progress and current status on heating systems

According to the *Energy Management Act*, all heating systems (with a boiler running on natural gas, liquid or solid fuels with a rated output power of above 20 kW) must be subject to regular efficiency inspections in compliance with Decree 194/2013 on the inspections of boilers and hot water supply (formerly Decree 276/2007). This decree sets the scope, manner and frequency of the inspections of heating systems as well as the form and content of the inspection reports, including:

1. documentation assessment;
2. visual inspection and a check of the operability of the accessible heating system;
3. evaluation of maintenance of the heating system;
4. evaluation of the dimensioning of the heating system in comparison with the heating requirements of the building;
5. evaluation of the efficiency of the heating system;
6. recommendations for financially feasible improvements of the heating system and thermal energy distribution.

The inspection report must be uploaded to the national database *ENEX* and can be subject to control.

2.IV.iii. Progress and current status on AC systems

Similarly to heating systems, the *Energy Management Act* requires AC systems with a rated cooling output above 12 kW to undergo regular efficiency inspections in compliance with Decree 193/2013 on the inspection of AC systems (formerly Decree 277/2007), resulting in a written report on the AC systems inspections. The decree also sets out the inspection methodology. The inspection of the AC systems consists mainly of:

1. documentation assessment;

2. visual inspection and a check of the operability of the accessible AC units;
3. evaluation of maintenance of the AC system;
4. evaluation of the dimensioning of the AC system in comparison with the cooling requirements of the building;
5. evaluation of the efficiency of the AC system;
6. recommendations for financially feasible improvements of the AC system.

The inspection report must be uploaded to the national database *ENEX* and can be subject to control.

2.IV.iv. Enforcement and impact assessment of inspections

Enforcement and penalties

Both the inspection and the inspection report can be issued only by *energy specialists* licensed to perform heating systems and thermal energy distribution or AC systems inspections. The report must be objective, complete and correct. If the inspection report is improperly processed, a penalty of up to 185,000 € can be imposed from the *State Energy Inspection*.

In 2016, 196 controls checked whether the building owner fulfilled the obligation for heating or AC system inspection. Penalties imposed for not fulfilling this obligation amounted up to 17,700 €.

Quality control of inspection reports

The *State Energy Inspection* checked 64 heating and AC systems inspection reports. It was discovered that 10 out of the 27 energy specialists violated the law. The administrative process to impose the relevant fines is still ongoing.

3. A success story in EPBD implementation

In 2016, the Czech Republic launched an information campaign to raise public awareness for the EPC on a national level. A broad range of texts were prepared, highlighting the importance of the EPC and explaining its parts, including who can issue an EPC and where complaints can be filed in case of improper processing. Energy savings calculations were done to show what role the EPC can play when considering a rental or house bargain. Finally, it also included requests for public advertisement.

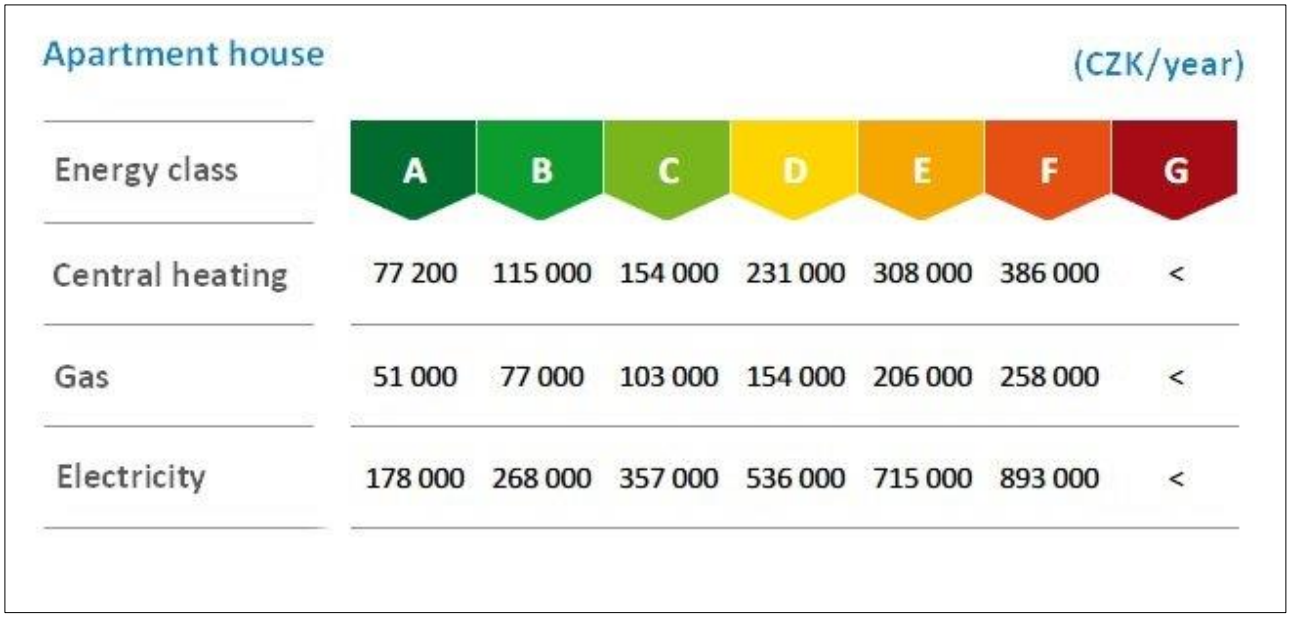
A relevant web page[14] was created to contain all the necessary information in an 'easy-to-understand' format. The campaign was based on two model houses commonly used by the public – a family house and an apartment house – in order to present different costs using different sources of energy and different energy classifications. The family house model costs were calculated for heating and hot water preparation using natural gas, heat pumps and electricity.

Family house with gas boiler (Czech crowns/year)

ENERGY CLASS	A	B	C	D	E	F	G
HEATING, HOT WATER	15 600	23 400	31 200	46 800	62 400	78 000	<
LIGHTING	3 600	5 400	7 200	10 800	14 400	18 000	<
TOTAL COSTS	**19 200**	**28 800**	**38 400**	**57 600**	**76 800**	**96 000**	<

Figure 2. Example of costs for different energy classes in case of a family house with gas boiler.

The energy sources used in the apartment model include gas, electricity and a central heating system. The costs are referenced for a building unit with a total floor area of 65 m^2.

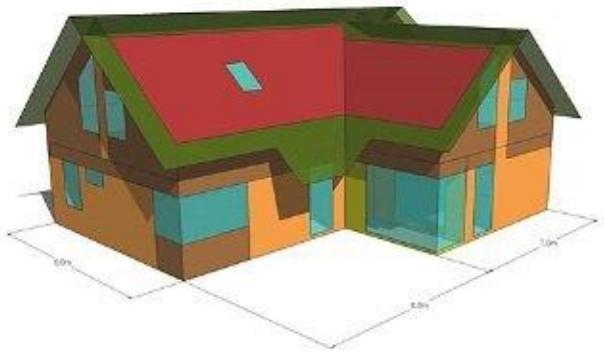


Apartment house (CZK/year)

Energy class	A	B	C	D	E	F	G
Central heating	77 200	115 000	154 000	231 000	308 000	386 000	<
Gas	51 000	77 000	103 000	154 000	206 000	258 000	<
Electricity	178 000	268 000	357 000	536 000	715 000	893 000	<

Figure 3. Example of costs for different energy classes in case of an apartment house with different energy sources.

As another example, a single-family house with different energy classes (B, C and G) was used to display savings under different conditions based on the EPC. The total floor area was 233 m^2, and the home design was L-shaped with wooden windows with double-glazing and wooden doors with partial glazing. Different conditions were chosen: a simple construction without any insulation, a construction with insulated walls and roof, a construction to reach level C, and the same example to reach level B.



Original state	Variant 1	Variant 2
uninsulated building with original double glazing (energy class G)	Facade, roof and construction insulation on level C	Facade, roof and construction insulation on level B

How much can be saved on heating costs

Annual saving	Variant 1 B	Variant 2 C
Electricity (MWh)	53	63
Gas (MWh)	68	78
Electricity (CZK incl. VAT)	**123 992**	**147 387**
Gas (CZK incl. VAT)	**92 484**	**106 087**

Figure 4. Difference in family house costs for heating in B or C energy class

The web page also contains an FAQ section on EPCs as well as the possibility to ask questions using the web interface. In order to reach the wider public, a TV commercial was prepared and broadcasted on the main TV channels within the Czech Republic during prime time. Promotional banners were also prepared and displayed on different web servers, with newspapers referring to the web page. The campaign lasted approximately six months. Both the TV and newspaper advertisements are no longer in circulation and the web page is also no longer in operation and cannot be accessed by the public.

4. Conclusions, future plans

In the Czech Republic, much attention is devoted to the energy performance of buildings, and the country is continuously transitioning towards NZEB in construction standards. Many seminars, webinars and lectures are currently taking place in order to assist architects, builders and designers with this transition.

In 2017, the Czech Republic was preparing to launch a project called "*Energy Savings Wisely*"[15]. This project is one of the key tools for increasing energy savings in buildings. It is focused on quality preparation and the development of energy saving measures without the use of investment subsidies, and it complements other subsidy programmes supported by European Union structural funds. The programme aims to increase the quality of energy saving projects and promote the implementation of energy saving projects in housing and the public and private sector, leading to a broadly efficient use of energy.

The core of the programme involves an energy assessment of the work done by *energy specialists* via a feasibility study which examines the appropriateness of buildings. The specialists offer a combination of complex energy efficiency measures, including specifications of investment costs and the energy saving potential of each measure.

The attention will be on:

- the complexity of proposed measures and the form of the upcoming project;
- the effectiveness of invested funds;
- the long-term and sustainable benefits that can be achieved by decreasing future operating costs related to energy consumption, at least for the specific measure's lifetime (with a minimum of 15 years, and in case of building insulation even longer);
- the reduction of the negative impacts on the environment.

The basis for the preparation of the energy saving project is the documentation of all potential measures. The building owner should then have the opportunity to compare which measures are feasible, how much investment is needed, how much of a reduction in operating costs can be acheived, and what length of payback period can be expected, to decide accordingly which measure(s) to pursue.

The goal of the programme is to promote the standardisation of quality during the preparation and implementation of energy efficiency measures in a natural way – in other words, without relying on subsidies – so that the primary focus is mainly on achieving real energy savings and less on the development of and reliance on subsidy schemes.

Endnotes

1. https://portal.gov.cz/app/zakony
2. https://portal.gov.cz/app/zakony
3. Ibid
4. Ibid
5. https://csnonline.unmz.cz/
6. Ibid
7. The Strategy is a part of the National Action Plan according to energy efficiency directive 2012/27/EU and can be found at https://www.mpo.cz/cz/energetika/energeticka-ucinnost/strategicke-dokumenty/narodni-akcni-plan-energeticke-ucinnosti-cr--150542
8. www.cmzrb.cz/produkty-a-sluzby/zvyhodneny-uver-v-programu-energ?lang=1
9. www.mpo-efekt.cz/cz
10. http://crab.uzsvm.cz
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12. Ibid
13. Ibid
14. www.vitekolikusetrite.cz
15. www.usporysrozumem.cz

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