Draft

NATIONAL PLAN FOR INCREASING THE NUMBER OF NEARLY ZERO-ENERGY BUILDINGS

Introduction

Drafting of the "National plan for increasing the number of nearly zero-energy buildings" (hereinafter "national plan") is a mandatory task pursuant to Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (hereinafter "Directive"), which was transposed by Act No 300/2012 amending Act No 555/2005 on the energy performance of buildings and amendments to some acts, as amended, and amending Act No 50/1976 on land planning and the building code, as amended (hereinafter "Act No 555/2005").

The necessary technical data and procedures are provided in the implementing regulation for Act No 555/2005 on the energy performance of buildings and amendments to some acts, as amended (hereinafter "Order").

Achieving nearly zero-energy demands in new buildings according to the Directive represents an extraordinarily ambitious target of increasing the energy performance of new buildings in a very short time period. Simultaneously, it is a target fundamentally impacting on public and private life in society. It will require effective planning of investment, objective requirements to secure adequate financial resources, resolution of the necessary forms of financial support, but also, in particular, quickly creation of the legal and technical conditions and appropriate time for design and implementation preparations. This must all be covered by the national plan in accordance with the Directive.

1. Current situation and premises for compiling the national plan and setting of the requirements for individual construction energy levels

Currently residential and non-residential buildings in Slovakia are mostly built at an energy-saving level of construction. Low-energy buildings are known and buildings are designed and constructed as passive buildings. Examples of the construction or design of nearly zero-energy buildings (hereinafter "NZEB") with a design different to passive buildings are not known.

1.1 Current situation and premises

Minimum energy performance requirements for buildings (hereinafter "EPB") are set by the Order. The setting of those minimum requirements is based on the upper limit of the energy classes determined for the relevant category of building and this requirement is also respected by the energy level of construction introduced by standard "STN 73 0540-2: 2012 Thermal protection of buildings. Heat engineering features of building structures and buildings. Part 2: Functional requirements." (hereinafter "STN"). Standardised requirements for the heat engineering features and heat demand for heating pursuant to STN correspond to the minimum requirements for EPB, which is the upper limit for energy class B for heat demand for heating.

The next construction energy level in the STN is always half the value of the preceding energy class, which depends on the upper limit of energy class A. The Order introduces energy class A0 for the NZEB energy level, while classification of buildings follows primary energy.

1.2 Requirements

Requirements for heat demand for heating for individual construction energy levels pursuant to the STN are expressed for the new buildings in Annex 1, Table 1 (energy criterion) and Table 2 (assumption of meeting the minimum EPB requirement).

Annex 1, Table 1 gives the current minimum EPB requirements and the values required from 1.1.2013, referred to as "standardised", and from 2015 and 2020, referred to as "recommended". The construction energy level values and the obligatory character of their achievement by the set deadlines are determined by the Order.

Fulfilment of the construction energy level requirements for individual building constructions and the relevant building categories are only the first precondition for achievement of nearly zero primary energy demand. Nearly zero-energy demands for a building need to be secured to a large extent by renewable sources in the building or its proximity. The Directive thus reinforces the obligation to use renewable energy sources (hereinafter "RES") when constructing new buildings. This is another demanding task which Slovakia does not have great experience with.

Quality thermal insulation of the building envelope is the basis, but not the guarantee of an adequate technical design. The architectural and technical design of the building must be drafted without complexity of shape with a targeted orientation of the glazed windows of the building (with effective use of heat gains), with the exclusion of thermal bridges (with reduction of heat losses), controlled ventilation and heat recovery. Significant energy savings in the future mean higher investment costs at the start of construction. Many new tasks in a very short period of time await designers, building owners and building offices with the construction of NZEB.

2. Requirements in European and national legislation for compiling the national plan

The obligation to prepare a national plan arises for the Member State from the Directive, specifically Article 9, according to which

a) after 31.12.2020, all new buildings are nearly zero-energy buildings, and
b) after 31.12.2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings.

In accordance with Act No 555/2012 the national plan shall include measures and procedures necessary for increasing the number of NZEB, divided into individual building categories.

The achievement of planned targets is elaborated into stages with specification of the intermediate targets for 2015. These targets need not be applied to existing buildings where analysis of costs and benefits during the economic life cycle of the building proves a time returnability of more than 15 years.

2.1 The term and method of calculating nearly zero-energy buildings

Act No 555/2012 provides a definition of NZEB, according to which they are buildings with very high energy performance. The almost zero or very small quantity of energy required in order to use these buildings must be secured with effective thermal protection and a high proportion of energy from RES in the buildings or their proximity.

To achieve the NZEB parameters it is necessary to proceed from the acceptance and determination of three interrelated criteria:

a) Reduction of specific heat demand for heating to a minimum. Such a criterion requires a quality design of the building's envelope construction and assumes the use of solar and internal gains.
b) Reduction of primary energy consumption for heating, cooling, ventilation, domestic hot water and lighting. The criterion already requires the interconnection of construction and technology. It has an impact on the reduction of the expected consumption of fuels and other forms of energy and better describes the environmental impact of using the building. The expected reduction in primary energy demands of about 50 % has an impact on reduction of CO_2 and pollutant emissions.
c) Significant coverage of the overall primary energy demands with renewable energy sources. Supply of energy from RES found in the building or its proximity should provide at least a 50 % reduction of primary energy.

Conformity with these procedures is also expressed by the schematic depiction of the calculating procedure provided in Annex 2 pursuant to the "Guidelines accompanying Commission Delegated Regulation (EU) No 244/2012 of 16 January 2012 supplementing Directive 2010/31/EU of the European Parliament and of the Council on the energy performance of buildings by establishing a comparative methodology framework for calculating cost-optimal levels of minimum energy performance requirements for buildings and building elements".

2.2 Current initial data base

The setting of time limits gives us a time frame for planning the achievement of individual construction energy levels. The control and comparison of development also requires a data base on residential and non-residential buildings, which will allow both quantification and a qualitative comparison of the development of construction in the given time frame. Effective measures can be taken on the basis of these data in the event of a deviation or lag. Thus, one of the important databases for evaluating the process is the database of energy certificates (hereinafter "EC").

Central records of energy certificates were introduced from January 2010. All energy certificates issued by professionally eligible subjects are sent and recorded electronically through the INFOREG information system. The system allows inter alia perusal of the list of certified buildings and search by selected criteria (e.g. building category, year and purpose of issuing the certificate or address).

Partial data on non-residential buildings:

Table 1

Numbers of new buildings	2010	2011	2012*	Total
Office buildings	116	139	95	350
School and educational facility buildings	15	13	8	36
Hospital buildings	12	16	14	42
Hotel and restaurant buildings	40	72	38	150

Source: INFOREG Information System

Note: * situation at 31.10.2012

The EC proves the quality and energy level of the completed building compared to the design documentation. Data are available from ca. 30 000 EC. The results provide data from completed new and renovated residential and non-residential buildings and data for buildings sold or leased. In addition to the specific use of EC for building owners, their use is also expected for the compilation and evaluation of energy saving measures in buildings.

The wider use of the results and the possibility of comparison with other EU Member States require the integration of this data base with statistical data and other findings. The provision of such statistical data in Slovakia in future is essential. Comparison with other data bases should also create an information basis for the control mechanism.

Data on started, partially built and completed apartment blocks, more precisely on issued building permits and certificates of practical completion and started office and other non-residential buildings as a whole is provided by a statistical statement (STAV 3-04). However, it does not include data on completed non-residential buildings. Available data can only be considered as approximate, since data in measurement units is lacking (e.g. m^2 of overall floor space, m^3 of walled space etc.). Data are only provided for dwellings in the apartment blocks and single-family houses, which does not allow the comparison between Slovakia and other countries.

Selected data on development in housing in the Slovak Republic from 2007 to 2011

Table 2

Number of dwellings in buildings for 2007 to 2011	2007	2008	2009	2010	2011
Number of completed dwellings in total	**16 473**	**17 184**	**18 834**	**17 076**	**14 608**
Including dwellings in overstories, conversions and annexes	673	541	841	561	314
Number of completed dwellings in family houses	7 897	8 502	9 022	9 136	8 763
Number of completed dwellings in apartment blocks	8 576	8 682	9 812	7 940	5 845
Number of started dwellings in total	**18 116**	**28 321**	**20 325**	**16 211**	**12 740**

Source: Statistical Office of the Slovak Republic

2.3 Existing financial stimulants

Existing forms of financial aid for residential and non-residential buildings were not specifically targeted only at EPB. With residential buildings the form of aid for renovation of a residential building through the State Housing Development Fund has been focused up to now on a whole range of building renovations and only the aid for insulation of residential buildings concerned extensive building renovations. Building societies and commercial banks provided resources mostly for the renovation of residential buildings, but the energy saving criterion did not arise as a specific condition for providing the loan.

With non-residential buildings forms of aid were focused on EPB in such projects as SLOVSEFF II and the pilot project "Energy efficiency in public buildings" financed through the European Bank for Reconstruction and Development or financial aid through the EkoFond. We can mention support of over 110 projects for non-residential buildings, but not with targeted measures to achieve significant energy savings in buildings and conditions, and projects were not systematically focused on achieving the minimum EPB requirements in effect.

Towns and municipalities have several funding options in the area of energy efficiency and EPB. The most important include the structural funds, the European Energy Efficiency Fund,

initiatives under the Intelligent Energy – Europe Programme – ELENA and MLEI (Mobilising Local Energy Investment), contracts on providing energy services and private banks.

Within the structural funds projects of energy efficiency and RES can be funded from the Cohesion Fund and European Regional Development Fund.

In the 2007 – 2013 period 900 projects concerned with improving the thermal performance of buildings were accepted under the Regional Operational Programme. Projects of a similar nature were already financed under the Operational Programme Health.

According to the updated EPB conception financial stimuli for the future must be differentiated for renewal of the building fund and for new NZEB. Financial stimuli will need to be differentiated pursuant to the level of energy savings achieved with a focus on achieving NZEB parameters in new construction and the possibility of achieving more significant energy savings when renewing the building fund. An important aspect for the financing of new construction is to link to the economic instruments of the State and financial support produces from public and private financial institutions already created in order to achieve the linkage of private and public sources.

3. Measures and procedures necessary for increasing the number of nearly zero-energy buildings

The definition of nearly zero-energy buildings, which considers national, regional and local conditions up to the specification of a primary energy use indicator, is governed in general by Act No 555/2012. In the Order and associated Slovak technical standards which the Order refers to the definition is clarified. Buildings are classified according to purpose into categories within the meaning of Act No 555/2005 on the energy performance of buildings and amendments to some acts, as amended, and their segmentation is given in Annex 3.

According to the Order the total energy demand is the sum of energy demand values for every energy consumption point in the building and every energy medium in the interior of the building associated with its standardised use. Supplied energy is determined according to the individual energy media which supply the technical equipment through the system boundary of the building to meet energy demands in the building for heating, hot water, ventilation, cooling and lighting, including the efficiency of sources, distribution, transfer and regulation. Supplied energy does not include energy from renewable energy sources in the building or its proximity. Energy from RES in the building or its proximity means only energy from equipment located:

- in indoor spaces with modified environments marked out by the boundaries of the building,
- at the boundaries of the building if they are firmly fixed to the building,
- in unheated spaces of the building outside the boundaries of the building,
- outside the boundaries of the building on the land used with the building if the energy from this equipment is used in the building.

Heat energy required for heating, cooling and hot water from RES is deducted from heat energy demands in the building, and electricity from RES in the building or its proximity are deducted from electricity demands. Carbon dioxide emissions are determined from the energy supplied according to individual energy media using the recalculation factors under the regulation.

The global indicator of minimum EPB is primary energy, which is determined from the quantity of energy supplied to the technical system of the building through the system boundary of

the building according to the individual consumption points in the building and energy media adjusted by the primary energy conversion factor.

Buildings are classified according to the energy demand indicator value for the energy consumption point and total energy demand value into energy classes A to G in each building category, and according to the global indicator (primary energy) into energy classes A0 to G in each building category.

Annex 3 to the Order specifies the scale of energy classes for individual building categories for all energy consumption points and summarily the scale of energy classes for total energy demand and the global indicator – primary energy.

Supply of energy from RES found in the building or its proximity should provide at least a 50 % reduction of primary energy by 2020. This is a requirement stipulated in Act No 555/2012 (Section 4b (2)).

3.1 Intermediate targets for improving the energy performance of new buildings by 2015

With the existing lack of experience with energy saving construction levels in Slovakia progressive steps are required to achieve the final objective by the set deadlines and at the required construction energy level.

Designers, owners, developers and public authorities must be familiar with stricter energy criteria. There must be time at least for drafting design documentation, issue of building permits and the option of completing the building, whereby its completion may be at a date with stricter requirements for the construction energy level. A realistic estimate of time for completing these procedures was minimised to three years, whereby if these deadlines are known in advance and binding, it will be possible in terms of the design documentation of the buildings to know the construction energy level the new building should be designed and approved for.

We must proceed from the premise that new buildings owned by public authorities built after 31.12.2018 and other buildings built after 31.12.2000 must achieve nearly zero-energy demands. Furthermore, the first tightening of the requirements to achieve a low-energy construction level of new and renovated buildings will be at latest 1.1.2013.

The Order lays down the minimum EPB requirements for individual construction energy levels as an intermediate target in 2015 and the target of achieving NZEB construction in 2018 or 2020. The deadlines and energy levels are stipulated as follows:

- The minimum energy performance requirement for the global indicator for new buildings built after 31.12.2015 is the upper limit of energy class A1. An extensively renovated building must meet this requirement if it is technical, functionally and economically feasible.
- For new buildings occupied and owned by public authorities built after 31.12.2018 and for all other new buildings built after 31.12.2000 the minimum energy performance requirement for the global indicator is the upper limit of energy class A0. An extensively renovated building must meet the nearly zero-energy requirement if it is technical, functionally and economically feasible.

It is also clear from the Order that the upper limit of energy class B for all indicators dictates the low-energy construction level and the upper limit of energy class A for individual indicators and simultaneously the upper limit of energy class A1 for the global indicator dictate the ultra-low-energy construction level. The upper limit of energy class A0 for the global indicator dictates the energy level of nearly zero-energy buildings.

Intermediate targets for achievement of individual construction energy levels are set in three time phases as follows:

a) the low-energy level of construction for new and renovated buildings from 1.1.2013, given by the upper limit of energy class B, for individual building categories,
b) the ultra-low-energy level of construction for all new buildings from 1.1.2016, given by the upper limit of energy class A, for renovated buildings conditional on meeting the required cost-optimal level,
c) the energy level of nearly zero-energy buildings for new buildings occupied and owned by public authorities built after 1.1.2019 and all other new buildings built after 1.1.2021. This is given in the Order by the upper limit of energy class A0 for the global indicator. Renovated buildings are required to meet this energy level if it is technical, functionally and economically feasible.

2.2 Creation of conditions for meeting the deadlines for individual construction energy levels in project preparation

From the stated deadlines for tightening requirements for achieving individual construction energy levels it is clear that the design documentation of new and renovated buildings submitted for the building permit must be at latest:

a) from 1.1.2015 elaborated in the ultra-low-energy level of construction for new buildings,
b) after 1.12.2018 elaborated at the energy levels of nearly zero-energy buildings for new buildings for public authorities,
c) after 1.12.2020 elaborated at the energy levels of nearly zero-energy buildings for all new buildings. From 1.1.2013 renovated buildings must be planned at a low-energy construction level. For categories of buildings that, according to the set cost-optimal requirements, allow renovation of a building at the ultra-low-energy construction level, design documentation must be prepared for this energy level from 1.1.2015.

3.3 Premises and instruments to increase EPB and to prepare for NZEB construction

One of the basic premises for creating conditions for fulfilling the tasks associated with preparation of NZEB construction is to raise general awareness on the necessity of such construction and also to formulate the theoretical preconditions. Informing both the professional and general public requires cooperation with educational institutions, professional organisations, interest groups and the media.

3.3.1 Premises for increasing the education level

The design of NZEB must be based on the fact that building's conception is changed from a pure energy consumer to one based on used of RES. The building's shape, its orientation, quality thermal insulation of structural, in particular, external elements, glazed windows and adapted technical equipment are all part of the conception of new NZEB. The designer must have detailed knowledge of them and include them in designs in 2016 or 2017 at latest.

A designer must, however, be familiar with solutions for designing low-energy constructions already in 2013 and for designing ultra-low-energy new buildings in 2015. The required demands on the designer should only support the efforts of the SKA (Slovak Chamber of

Architects) and SKSI (Slovak Chamber of Construction Engineers) towards systematic additional training of designers.

A basic premise in this area for meetings targets in 2018 or 2020 is the inclusion of the necessary information in the curricula of vocational colleges. Universities have a dominant position in this case as independent legal subjects.

3.3.2 Monitoring and database of buildings owned by public authorities

To understand the energy consumption of buildings occupied by central public and other authorities requires monitoring of those buildings with the intention of preparing options for their effective renovation. Achieving an annual 3% ratio of renovation of the total floor space of these buildings would allow renovation of buildings with the greatest energy consumption. In order to specify the ratio of renovated buildings it is necessary to identify them along with information on the size of total floor spaces.

To acquire the necessary technical information that will be used for comparison of the results achieved in Slovakia with other Member States, including the energy certificates, in technical analyses, it is necessary to expand statistical data to cover all started and completed residential and non-residential buildings (building permits and certificates of occupancy) so that EPB can be assessed for all building categories.

3.3.3 Efficient use of RES in buildings

RES are within the competence of the Slovak Ministry of Economy. Increasing the share of RES in the generation of electricity and heat with the objective of creating adequate additional sources required to cover domestic demand is one of the basic priorities defined in the Energy Policy of the Slovak Republic. The growth in prices of fossil non-renewable fuels in recent years will force this energy alternative into the economic and political limelight. RES which are currently technologically feasible to use for electricity, heat generation and transport fuels are biomass, including biofuels and biogas, solar, hydroelectric, wind and geothermal energy.

The document with the forecast of the estimated excess production of energy from renewable sources gives the estimated excess production of energy from RES in Slovakia compared to the indicative trajectory which could be transferred to other Member States, as well as the estimated potential for joint projects, until 2020. A slight exceedance of 14 % of the RES share in total energy consumption (76 PJ) is expected and a possible expected transfer of a RES 6 PJ to other Member States.

Construction of buildings to meet NZEB criteria will require use of RES. In the coming period it will be necessary to prepare an analysis of the effective use of RES for each energy consumption point and with emphasis on the building category.

Involvement of public administration in increasing energy efficiency and use of RES is supported by the Covenant of Mayors. This is a European drive incorporating towns and regions that have voluntarily undertaken to increase energy efficiency and use of RES within their territories. Signatories to the Covenant of Mayors have agreed to an initiative to meet the European

"3x20" targets by 2020. Currently 4 300 European towns are incorporated in the Covenant of Mayors, representing 170 million inhabitants. In Slovakia 9 towns and municipalities and one self-governing region have signed the Covenant of Mayors.

3.3.4 Promoting the increase in EPB and changeover to NZEB construction

The objective of financial aid will be, above all, to adapt existing financial instruments to increase investment into EPB and to seek new forms in view of the potential within the national budget. This process must and will be continual and must react to development in the area of construction. It will be oriented to use of private-public partnerships, promotion of ecological technologies and energy efficient systems, revision of construction processes and use of more energy efficient construction products. The purpose of existing and proposed measures of a financial nature will be above all support for research and development into:

- progressive construction products and construction systems suitable for the building envelope and glazed windows,
- building technical systems, including high-efficiency alternative energy systems focused on the use of renewable energy sources in the building and its proximity,
- intelligent metering systems,
- automation, control and monitoring systems that aim to save energy.

3.4 Potential savings

Fulfilment of the progressive steps to achieve the target in 2020 represents a reduction of the energy demands of buildings. Therefore, it is necessary to get an idea of the potential energy savings. The basic data are enumerated in Annex 4. It covers the potential energy savings in the construction of new buildings in the given time period taking account of the tightening up of criteria for construction. The expected period of calculated savings is up to 2021, i.e. including the phase of construction of nearly zero-energy buildings. Other premises used in the calculation are based on statistical findings, which assume an annual construction of 15 000 dwellings in single-family houses and apartment blocks and 110 office buildings. In the calculation values were used for energy demands for individual building categories, which are determined as the energy demands for the ultra-low-energy construction level (see Annex 1 Table 2).

Based on the given premises and calculations an energy saving of about 1.5 PJ can be achieved, which represents a CO_2 emission reduction of 87 000 tons.

3.5 Conditions of the differentiated approach for existing buildings

In specific and justified cases a decision can be made not to apply the measures and procedures of the national plan to existing buildings, where the difference of costs and benefits of a building's operation during its economic life cycle when taking account of the cost-optimal energy performance requirements for buildings is negative. Principles will be specified on the basis of the results of the research and development task "Technical aspects of cost-optimal measures ensuring the energy performance of buildings" issued by the Technický a skúšobný ústav stavený, n. o. *(Technical and Testing Institute of Building).*

Introduction of a construction low-energy level from 1.1.2013 should conform to the cost-optimal levels of minimum EPB requirements for renovated buildings.

4. Conclusions

The energy performance is a current, though not new theme. Research and development tasks were elaborated in the past to support this area resulting in conceptual and legislative instruments. The trend in this area is clearly toward reduction of energy consumption. The creation of the conditions for meeting the targets for the construction of nearly zero-energy buildings required the drafting of new legislation, updating of the conception and tightening of the requirements laid down in technical standards.

Gradual tightening of requirements for the heat engineering features of building structures in W/(m^{2}xK)

[Key to chart]
■ External envelope
■ Roof cladding
■ Vent construction

1) Achieve individual construction energy levels:
   a) low-energy level of construction for new and renovated buildings from 1.1.2013,
   b) ultra-low-energy level of construction for all new buildings from 1.12.2015, for renovated buildings conditional on meeting the cost-optimal levels of the minimum requirements for the energy performance of buildings,
   c) the energy level of nearly zero-energy buildings occupied and owned by public authorities after 1.12.2018 and all new buildings after 1.2.2020.

2) Analyse the options for the effective use of energy from renewable sources in buildings.

3) Analyse and prepare motivational tools for the preparation and construction of nearly zero-energy buildings taking account of the cost-optimal levels of the minimum energy performance requirements for buildings.

4) Create support programmes for the energy performance of buildings.

5) Cooperate with professional chambers to increase the professionalism of designers.

6) Participate in the international exchange of information and know-how in the area of building energy performance.

7) Promote the introduction of a model solution to new construction or reconstruction of buildings owned by public authorities.

8) Secure an information campaign focused on tasks associated with nearly zero-energy buildings, which needs to be directed at all those involved in the process of constructing low-energy and ultra-low-energy level new and renovated buildings, and at the general public.

9) Involve public administration in the information campaign and preparation for the implementation of construction of nearly zero-energy buildings.

10) Make interim evaluations of the fulfilment of the national plan targets.

Annex 1

Meeting the energy criterion for individual construction energy levels

Table 1

Type of construction	Heat consumption for heating depending on the building shape factor kWh/(m^2xa)	Heat transfer coefficient W/ (m^2xK)		
		External envelope	Roof cladding	Vent construction
Energy-saving buildings minimum requirements **current situation**	≤ 100	0.46	0.30	1.5
Low-energy buildings standardised requirements **required from 1.1.2013**	≤ 100	0.32	0.22	1.5
Ultra-low-energy buildings recommended requirements **required from in 31.12.2015**	≤ 50	0.22	0.10	0.9
Nearly zero-energy buildings recommended requirements **required from 31.12.2018/20**	≤ 25	0.15	0.10	0.6

Standardised and recommended values of heat demand for achieving EPB in kWh/(m^2xa)

Table 2

Category of building	Low-energy buildings	Ultra-low-energy buildings	Nearly zero-energy buildings
Single-family houses	81.4	40.7	20.4
Apartment blocks	50.0	25.0	12.5
Office buildings	53.5	26.8	13.4
School and educational facility buildings	53.2	26.6	13.3
Hospital and medical facility buildings	66.3	33.2	16.6
Hotel and restaurant buildings	67.4	33.7	16.9
Sports halls and buildings for sport	63.0	31.5	15.8

Source: STN 73 0540-2: 2012 Thermal protection of buildings. Heat engineering features of building structures and buildings. Part 2: Functional requirements.

Annex 2

Schematic depiction of the calculating procedure for EPB after primary energy consumption

[simplified]

Heat demand	Energy need	Delivered energy	Primary energy
	Thermal energy from RES consumed in situ		
	System losses		Losses during transformation
Heat demand for: heating, cooling, hot water	Energy need from fuel for: heating, hot water	Delivered energy from fuel	(Pure) primary energy
	Electricity demand for: cooling, lighting, ventilation, connected systems	Delivered electricity	
	System losses	Electricity from RES consumed in situ	Primary energy associated with energy supplied on the market

The calculation of energy performance from net heat demands to primary energy demands requires the following procedures and steps:

1. The calculation of **net heat energy demands** in a building to meet the user's requirements. The heat demand in winter is calculated as energy losses through the building envelope and ventilation minus internal gains (from appliances, lighting and occupation) and "natural" energy gains (passive solar heating, passive cooling, natural ventilation etc.)
2. Deduction of **thermal energy from renewable energy sources** generated and consumed in situ (e.g. thermal solar collectors) from point 1.
3. The calculation of **energy demands** for each final use (heating, cooling, hot water, lighting and ventilation) and for each energy medium (electricity, fuel) taking account of the characteristics (seasonal effectiveness) of the systems for generation, distribution, transfer of heat/cold to the interior and regulation.
4. Deduction of **electricity from renewable energy sources** generated and consumed in situ (e.g. photovoltaic panels) from electricity demand.
5. The calculation of **energy supplied** for each energy medium as the sum of energy demands (not covered by renewable energy sources).
6. Calculation of **primary energy** associated with supplied energy using national conversion factors.
7. Calculation of primary energy associated with **energy supplied on the market** (e.g. generated from renewable energy sources or co-generators in situ)
8. The calculation of **primary energy** as the difference between the two preceding calculated quantities: (calculation of primary energy from row 6 – calculation of primary energy from row 7).

Annex 3

A. Scale of energy classes for energy demand for heating in kWh/(m^2xa)

Consumption point	Category of building	Building energy performance classes						
		A	B	C	V	E	F	G
Heating	Single-family houses	≤ 42	43-86	87-129	130-172	173-215	216-258	> 258
	Apartment blocks	≤ 27	28-53	54-80	81-106	107-133	134-159	> 159
	Office buildings	≤ 28	29-56	57-84	85-112	113-140	141-168	> 168
	School and educational facility buildings	≤ 28	29-56	57-84	85-112	113-140	141-168	> 168
	Hospital buildings	≤ 35	36-70	71-105	106-140	141-175	176-210	> 210
	Hotel and restaurant buildings	≤ 36	37-71	72-107	108-142	143-178	179-213	> 213
	Sports halls and other buildings for sport	≤ 33	34-66	67-99	100-132	133-165	166-198	> 198
	Wholesale and retail trade services buildings	≤ 33	34-65	66-98	99-130	131-163	164-195	> 195

B. Scale of energy classes for energy demand for preparing hot water in kWh/(m^2xa)

Hot water preparation	Single-family houses	≤ 12	13-24	25-36	37-48	49-60	61-72	> 72
	Apartment blocks	≤ 13	14-26	27-39	40-52	53-65	66-78	> 78
	Office buildings	≤ 4	5-8	9-12	13-16	17-20	21-24	> 24
	School and educational facility buildings	≤ 6	7-12	13-18	19-24	25-30	31-36	> 36
	Hospital buildings	≤ 26	27-52	53-78	79-104	105-130	131-156	> 156
	Hotel and restaurant buildings	≤ 32	33-64	65-96	97-128	129-160	161-192	> 192
	Sports halls and other buildings for sport	≤ 6	7-12	13-18	19-24	25-30	31-36	> 36
	Wholesale and retail trade services buildings	≤ 5	6-9	10-14	15-18	19-23	24-27	> 27

C. Scale of energy classes for energy demand for ventilation and cooling in kWh/(m^2xa)

Forced ventilation and cooling	Single-family houses	Not evaluated						
	Apartment blocks	Not evaluated						
	Office buildings	≤ 16	17-31	32-45	46-59	60-75	76-90	> 90
	School and educational facility buildings	Not determined						
	Hospital buildings – cold wings	≤ 27	28-53	54-77	78-101	102-126	127-152	> 152
	Hotel and restaurant buildings	≤ 14	15-28	29-42	43-56	57-70	71-84	> 84
	Sports halls and other buildings for sport	Not determined						
	Wholesale and retail trade services buildings	≤ 34	35-66	67-99	100-132	133-165	166-198	> 198

D. Scale of energy classes for energy demand for lighting in kWh/(m^{2}xa)

Lighting	Single-family houses	Not evaluated						
	Apartment blocks	Not evaluated						
	Office buildings	≤ 10	11-20	21-25	26-30	31-38	39-45	> 45
	School and educational facility buildings	≤ 8	9-16	17-22	23-27	28-34	35-41	> 41
	Hospital buildings	≤ 13	14-26	27-33	34-40	41-50	51-60	> 60
	Hotel and restaurant buildings	≤ 12	13-24	25-31	32-37	38-46	47-56	> 56
	Sports halls and other buildings for sport	≤ 9	10-17	18-23	24-28	29-35	36-42	> 42
	Wholesale and retail trade services buildings	≤ 11	12-21	22-27	28-33	34-41	42-50	> 50

E. Scale of energy classes for total building energy demand in kWh/(m^{2}xa)

Total building energy demand	Single-family houses	≤ 54	55-110	111-165	166-220	221-275	276-330	> 330
	Apartment blocks	≤ 40	41-79	80-119	120-158	159-198	199-237	> 237
	Office buildings	≤ 58	59-115	116-166	167-218	219-272	273-327	> 327
	School and educational facility buildings	≤ 42	43-84	85-124	125-163	164-204	205-245	> 245
	Hospital buildings	≤ 101	102-201	202-293	294-385	386-481	482-578	> 578
	Hotel and restaurant buildings	≤ 94	95-187	188-275	276-363	364-454	455-545	> 545
	Sports halls and other buildings for sport	≤ 48	49-95	96-140	141-184	185-230	231-276	> 276
	Wholesale and retail trade services buildings	≤ 81	82-161	162-237	238-313	314-391	392-469	> 469

F. Scale of energy classes for global indicator – primary energy in kWh/(m^{2}xa)

	Category of building	**Building energy performance classes**							
		A0	**A1**	**B**	**C**	**V**	**E**	**F**	**G**
Global indicator – primary energy	Single-family houses	≤ 54	55-108	109-216	217-324	325-432	433-540	541-648	> 648
	Apartment blocks	≤ 32	33-63	64-126	127-189	190-252	253-315	316-378	> 378
	Office buildings	≤ 60	61-120	121-240	241-360	361-480	481-600	601-720	> 720
	School and educational facility buildings	≤ 34	35-68	69-136	137-204	205-272	273-340	341-408	> 408
	Hospital buildings	≤ 96	97-192	193-384	385-576	577-769	770-961	962-1153	> 1153
	Hotel and restaurant buildings	≤ 82	83-16	165-328	329-492	493-656	657-820	821-984	> 984
	Sports halls and other buildings for sport	≤ 38	39-76	77-152	153-258	259-304	305-380	381-456	> 456
	Wholesale and retail trade services buildings	≤ 85	86-170	171-340	341-510	511-680	681-850	851-1020	> 1020

Source: For example, Slovak Ministry of Transport, Construction and Regional Development Order implementing Act No 555/2005 on the energy performance of buildings and amendments to some acts, as amended.

Annex 4

Potential total energy savings with new buildings for 2016 to 2021

Table

Measure	Years					
	2016	**2017**	**2018**	**2019**	**2020**	**2021**
1) Estimated potential:						
a) number of dwellings	7000	7000	7000	7000	7000	7000
b) annual TJ savings	50.4.TJ	50.4.TJ	50.4.TJ	50.4.TJ	50.4.TJ	75.6.TJ
c) annual increase in heat savings in TJ		100.8.TJ	151.2.TJ	201.6.TJ	252.TJ	327.6.TJ
2) Estimated potential:						
a) number of single-family houses	8000	8000	8000	8000	8000	8000
b) annual TJ savings	175.82.TJ	175.82.TJ	175.82.TJ	175.82.TJ	175.82.TJ	266.11.TJ
c) annual increase in heat savings in TJ		351.64.TJ	527.46.TJ	703.28.TJ	879.1.TJ	1145.21.TJ
3) Estimated potential:						
a) number of office buildings	110	110	110	110	110	110
b) annual TJ savings	3.83.TJ	3.83.TJ	3.83.TJ	3.83.TJ	3.83.TJ	5.73.TJ
c) annual increase in heat savings in TJ		7.66.TJ	11.49.TJ	15.32.TJ	19.15.TJ	24.88.TJ

Note:

1) Heating energy savings per year after 2015 represent 40.7 kWh/m^2 for a single-family house, 25 kWh/m^2 for an apartment unit and 26.8 kWh/m^2 for an office building.
2) Heating energy savings per year from 31.12.2020 to 31.12.2021 compared to 2013 represent 61.1 kWh/m^2 for a single-family house, 37.5 kWh/m^2 for an apartment unit and 40.1 kWh/m^2 for an office building. (The contribution to energy savings is based on Table 2, Annex 1 of the National Plan)
3) Under the specified conditions the potential of possible energy savings for 2016 to 2021 in new buildings by achievement of nearly zero-energy demand represents a total of 1 497.7 TJ or 1.5 PJ, which in turn represents an approximate CO_2 emission reduction of 87 000 tons.