Update of the Residential and Non-residential Building Stock Renovation Strategy, Slovak Republic

Bratislava, 24 April 2017

Contents

Introduction

The requirement to draw up a strategy for the renovation of residential and non-residential buildings in Slovakia stems from Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, transposed into Slovak legislation by Act No 321/2014 on energy efficiency and amending certain laws. Article 4 of that Directive directs Member States of the European Union to establish a long-term strategy for mobilising investment in the renovation of the national stock of residential and non-residential buildings, both privately and publicly owned,[1] and to update it every three years.

The Update of the Residential and Non-residential Building Stock Renovation Strategy, Slovak Republic, includes an overview of the national stock of residential and non-residential buildings, the identification of cost-effective approaches to renovations relevant to the building type and climatic zone, policies and measures to stimulate cost-effective major (deep) renovations of buildings, including staged (deep) renovations. It contains a forward-looking evidence-based estimate of expected energy savings and other benefits of renovations of residential and non-residential buildings to guide the investment decisions of individuals, the construction industry and financial institutions in Slovakia. In addition to the above, it updates guidance on education related to relevant professions for the construction of energy-efficient buildings according to the increasing minimum requirements for the construction thereof.

The obligation deriving from Article 5 of Directive 2012/27/EU, that each Member State shall ensure that, as from 1 January 2014, 3 % of the total floor area of heated and/or cooled buildings owned and occupied by central bodies of state administration is renovated each year, is implemented according to an annually produced plan for the renovation of relevant buildings. These buildings should be renovated so that they meet at least the minimum energy performance requirements set by the relevant Member State further to Article 4 of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast).

The update respects the requirements arising from Article 4 of Directive 2012/27/EU, taking into account the related conditions set out in the 'Assistance Documents for EU Member States in developing long-term strategies for mobilising investment in building energy renovation (CA EED, CA EPBD and CA RES)' and the observations presented in the 'Synthesis Report on the Assessment of Member States' Building Renovation Strategies'.

1. Background and current approach to the renovation of buildings in Slovakia, market characteristics

1.1 Current approach to the renovation of buildings

A systemic approach to building renovation was adopted in Slovakia in the late 1990s, when it was found that features common to ***buildings older than 30 years*** built in Slovakia, for the most part, between 1960 and 1992 in collective forms of construction were the

[1] According to Directive 2012/27/EU: residential *and commercial buildings, both public and private.*

insufficient thermal protection of the structures and the high degree of wear found in the buildings' technical equipment, which needed to be urgently replaced with components of a quality and properties that would create the required safety and well-being in these buildings for their further viable life. Another common negative feature comprised the static and technical shortcomings of building structures, influenced by the initial technical design, the method of implementation, and, in particular, the lack of maintenance and repair.

All of these residential and non-residential buildings, erected according to design documents with substantial levels of repetitiousness, were constructed up to 1992, i.e. they have been in use for over 20 years. This period of occupancy is borne out by the fact that a large proportion of these structures and technical facilities are approaching the end of their viable life. The need for renovation is also corroborated by changes in legislation and, in particular, technical regulations relating to the essential requirements of static, fire and user safety, hygiene, health and the environment, as well as acoustic protection, energy savings and thermal protection.

Associated with the renovation strategy are concepts defining the scope of renovation, draft cost-effective measures, and, consequently, the estimated costs and expected energy savings. These concepts are defined in Annex 1.

The Ministry of Construction and Public Works of the Slovak Republic[2] prepared and submitted a Building Renovation Concept with an Emphasis on Housing Stock Renovation, which was approved under Government Resolution of the Slovak Republic No 1088 of 8 December 1999. The scope of residential and non-residential buildings is shown in Table 1.

Table 1

Total building stock	Up to 1950	1951 to 1960	1961 to 1970	1971 to 1980	1981 to 1990	1991 to 2000	Total
	built-up volume of buildings (m^3 millions)						
Non-residential buildings	20.95	14.29	22.86	53.33	63.81	34.01	209.25
Residential buildings	44.11	29.52	47.00	88.82	87.51	32.76	329.72
Buildings, halls for manufacturing and services	55.96	41.45	64.28	117.00	143.83	58.11	480.63
Total	121.02	85.26	134.14	259.15	295.15	124.88	1 019.60

Source: Building Stock Renovation Concept with an Emphasis on Housing Stock, Ministry of Construction and Public Works/VVÚPS-NOVA (Surface Structure Research and Development Institute), 1999; amendments for the years 1998-2000 by ÚEOS-Komercia, a.s., Bratislava

According to the Building Stock Renovation Concept, the initial procedural action was to fix systemic defects in multi-apartment buildings built according to specific types, structural systems and building systems ('structural systems'). The number of systemic

[2] For the Ministry of Construction and the Construction Industry, the Ministry of Construction and Public Works, the Ministry of Construction and Regional Development, the Ministry of Transport, Construction and Regional Development, the Ministry of Transport and Construction (the 'Ministry').

defects was extended from the originally proposed 6 to 11 in 2002, rising to 12 systemic defects in 2006. The second procedural step was to employ renovation as a means of addressing static, hygienic and user flaws in multi-apartment buildings more than 30 years old. The third procedural step was to renovate multi-apartment buildings built in the last 30 years. Government Regulation No 587/2001 amending Government Regulation No 137/2000 on housing programmes, which implemented the Act on the State Housing Development Fund, revised the criterion used to support the renovation of multi-apartment buildings, bringing the age down from 30 years to 20 years. This also potentially altered the number of apartments in multi-apartment buildings built *en masse* that were eligible under the renovation scheme. Besides the age of a multi-apartment building, scheme eligibility was also contingent on a 20 % reduction in the heat consumed on space heating compared to the original situation.

Financial support for the thermal insulation of buildings was linked to conditions deriving from Resolution of the Government of the Slovak Republic No 493/1991, on the basis of which, in October 1991, the Ministry drew up a Directive on Procedures and Specifications for the Additional Insulation and Removal of Faults in Multi-apartment Buildings.

Since 1996, loans have been available from the State Housing Development Fund for the insulation of residential buildings. The numbers of renovated residential buildings (apartments) supported by the housing development scheme and the State Housing Development Fund are presented in Annex 2.

The terms and conditions applicable to the State Housing Development Fund's loans for residential building renovation are currently governed by Act No 150/2013 on the State Housing Development Fund (Section 6(1)(c) of the Act). Under that Act, loans are granted for the renovation of residential buildings entailing the modernisation or reconstruction of the common parts of a multi-apartment building and the common facilities thereof, the removal of a systemic defect in a multi-apartment building, or structural alterations to a multi-apartment building or a separately used part thereof or to a single-family building involving the thermal insulation of the external skin and/or roof cladding and the replacement of the original external doors and windows of a multi-apartment or single-family building ('residential building insulation'). Similarly, insulation loans are granted for the renovation of social service facilities.

Terms and conditions were drawn up as early as 2000 to promote the elimination of systemic defects in multi-apartment buildings by means of external skin insulation. In the period from 2000 to 2016, subsidies totalling approximately EUR 106 462 000 were granted for 147 397 apartments.

Terms and conditions applicable to subsidies for the elimination of systemic defects in multi-apartment buildings are currently governed by Act No 443/2010 on housing development subsidies and on social housing, as amended.

The launch of action to eliminate systemic defects in the housing stock was a very urgent matter. Financial resources were also gradually released for loans (via the State Housing Development Fund) intended for the renovation of residential buildings. No systemic action for the renovation of non-residential buildings had been drawn up by 2014. Structural and private resources were used to cover the partial renovation of selected categories of non-residential buildings.

A common approach to improving the energy performance of buildings in the European Union, and in particular to significantly reducing CO_2 emissions through buildings, was laid down in Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings and Directive 2010/31/EU, which were transposed into Slovakia's legal and technical regulations. The method for the implementation thereof was addressed initially in the Building Energy Performance Concept up to 2010 with an Outlook up to 2020 (approved under Resolution of the Government of the Slovak Republic No 384/2008) and, subsequently, in the Updated Building Energy Performance Concept up to 2010 with an Outlook up to 2020, approved under Resolution of the Government of the Slovak Republic No 336/2012. The proposed building renovation strategy should serve as an umbrella for many of the new roles stemming from these concepts, currently encompassing the years 2015 to 2020. The results of the scientific and technical service 'Technical and economic aspects of cost-optimal measures to safeguard the energy performance of buildings' will also be used. Those results reflect conditions and procedures under 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, which complements Directive 2010/31/EU.

1.2 Background to the renovation of buildings

1.2.1 Renovation of residential buildings

Since 1992, Slovakia has targeted the renovation of housing stock which is more than 20 years old, in particular by installing thermal insulation and removing static deficiencies. The construction of prefabricated multi-apartment buildings came to an end in 1993. All of these residential buildings should gradually be renovated. This policy is based on the underlying observation that building stock younger than 20 years old undergoes periodic maintenance and upkeep, whereas building stock older than that requires renovation.

The Statistical Office of the Slovak Republic and other institutions have yet to carry out statistical evaluations of individual building works (e.g. the thermal insulation of external walls). Nor does Slovakia engage in the statistical year-on-year monitoring of completed buildings that are being renovated to determine whether they are residential or non-residential buildings. The Statistical Office first addressed building renovation (insulation) in detail in the 2011 Population and Housing Census. Here, it extended the tracking of building data to include the items 'Thermal insulation' (the insulation of external walls and the replacement of windows) and 'Scope of reconstruction'.

It should be borne in mind that the precision of the data collected is skewed by the way the question has been worded and by the way owners subjectively and individually assess the scope of the renovation or insulation of their building. Data from the 2011 Census (Annex 3) show that 27 % of single-family buildings and 41.04 % of multi-apartment buildings had been renovated (at least partially) as at 21 May 2011. These figures were distorted somewhat by the number of unoccupied apartments and buildings, i.e. 15 % of single-family buildings and 5.75 % of multi-apartment buildings.

The scope of building renovation (insulation) forms a basis for us to compare the results for Slovakia as a whole and also to address regional differences (Table 4, Annex 3). The extent of single-family building renovation is highest in the Bratislava Region (41.86 %) and Žilina Region (33.08 %), and lowest in the Banská Bystrica Region (19.55 %) and Nitra Region (22.97 %). The situation is much the same for multi-apartment buildings, with as many as 53.13 % renovated in the Žilina Region, followed by 50.25 % in the Bratislava Region, while the Košice Region (31.21 %) and the Nitra Region (32.04 %) languish at the other end of the scale. The expert estimate of building renovation, drawn up by the Building Insulation Civic Association (*Občianske združenie pre zatepľovanie budov*) by reference to the progressively updated mechanism detailing thermal insulation installed in the external skin of buildings from 1992 to 2012, can be compared with data from the 2011 Census. The Building Insulation Association's original figures can then be adjusted accordingly (paragraphs 2 and 3 of Annex 3).

Once the Building Insulation Association's figures had been adjusted, it was also possible to calculate the scope of renovation (insulation) for the period from 2011 until the end of 2016. This showed that, taking Slovakia as a whole, more than 58 % of multi-apartment buildings and 37.5 % of single-family buildings had been renovated. We assume that the stated number of renovated single-family buildings and multi-apartment buildings includes some buildings where only partial renovation has been carried out.

Table 2 Apartments in multi-apartment and single-family buildings renovated up to 31 December 2016

Description	Apartments in multi-apartment buildings	Apartments in single-family buildings	Total
2011 Census	931 605	1 008 795	1 940 400
Renovation as at 2011 Census	382 319	272 415	654 734
Renovation as at 31 December 2016	543 406	378 271	921 677
Proportion of renovation as at 31 December 2016 (%)	58.33	37.5	47.5

Source: Data from the 2011 Census (Statistical Office), prepared by the Building Insulation Association

1.2.2 Renovation of non-residential buildings

The extent to which non-residential buildings have been renovated has not yet been statistically monitored in Slovakia. This is due in part to the fact that national support schemes to promote the renovation of non-residential buildings have not yet been prepared.

Under the Operational Programme Basic Infrastructure 2004-2006, 178 buildings were renovated, of which 86 were school buildings, 28 were healthcare buildings, 26 were social service facilities and 38 were cultural buildings. This programme did not specifically focus on building renovation or energy savings.

In 2012, 610 projects under Measure 1.1, Priority Axis 1 Education Infrastructure, of the 2007-2013 Regional Operational Programme were duly completed (506 primary schools, 56 nursery schools and 48 secondary schools); 21 projects were completed under Priority Axis 2 Social Service, Social Protection and Social Care Infrastructure; six projects were completed and 45 were in progress under Measure 3.1, Priority Axis 3 Reinforcement of the Cultural Potential of the Regions and Tourism Infrastructure; and 77 projects were duly completed under Measure 4.2, Non-commercial Rescue Services, Priority Axis 4 Estate Regeneration.

Financial resources disbursed by the Bohunice V1 International Decommissioning Support Fund were used to implement the pilot project ‘Energy Efficiency in Public Buildings’, under which 57 buildings were renovated (18 nursery and primary schools, 35 municipal authorities and community buildings and four healthcare centres) in the Trnava and Nitra Self-governing Regions. Between 2008 and 2012, the EkoFond supported improvements in the energy performance of 61 school and school-facility buildings and 21 public-service buildings. Between 2005 and 2012, approximately 2 387 500 m² of external skin was insulated in the renovation of non-residential buildings.

Energy performance certificate issued since 2008 offer some indication of the scale of renovation. Since 2010, the central register has contained records of energy performance certificates classified by building category and the energy class achieved. According to the number of energy performance certificates issued, between 2010 and 2016 a total of 3 911 buildings were renovated, of which 1 105 were office buildings (28.25 %), 1 069 were the buildings of schools and school facilities (27.33 %), 599 were commercial-service buildings (15.32 %), 391 were the buildings of hotels and other accommodation facilities (10 %), 121 were hospital buildings (3.1 %), 95 were sports halls and the buildings intended for sport (2.42 %) and 531 were other mixed-purpose buildings (13.58 %). More detailed results on the number of buildings renovated under energy performance certificates are presented in Annex 4.

2. Underlying background to the public and private building stock renovation strategy (for residential and non-residential buildings)

2.1 Overview of building stock, broken down by category

Buildings (heated and cooled) have an impact on long-term energy consumption. Buildings account for approximately 40 % of energy consumption. Given the long renovation cycle for existing buildings, new, and existing buildings that are subject to major renovation, should therefore meet minimum energy performance requirements adapted to the local climate.

The results of the statistical processing of the 2001 Census and the 2011 Census, along with the Building Testing and Research Institute (TSÚS) database of residential and non-residential buildings (for the years 1994 to 2003), are the underlying sources for the preparation of the housing stock overview. Data characterising buildings and the heat they consume on space heating can only be accessed from the above database and account for a large proportion of the buildings mentioned in the 2011 Census. These data form a basis when determining the renovation strategy. The construction of buildings built after 2002 should comply with new requirements derived from the revised set of STN 73 0540 heat standards and parts, revised in 2012, of STN 73 0540-2 Thermal performance of structures and buildings. Thermal protection of buildings. Part 2: Functional Requirements, and STN

73 0540-3 Thermal performance of structures and buildings. Thermal protection of buildings. Part 3: Properties of the environment and construction products, for structures and buildings. Built-in structures and technical systems have an estimated service life of at least 20 years (for more details, see Annex 5).

2.1.1 Residential buildings

Residential buildings are divided into multi-apartment buildings and single-family buildings. Their design and technical solutions are different. As a matter of principle, they differ in size, number of storeys and number of apartments.

The properties of structures and their share in the overall area of the building envelope are different, resulting in different heat and energy requirements for space heating in these buildings, measured per unit of floor area. The number of existing buildings and their age should be used as factors when determining the potential to reduce energy needs. Construction in individual years of the second half of the 20th century was influenced by the availability of various building materials and structures, and by the controlled construction process using standardised and prefabricated designs.

Table 3 Aggregate data on buildings and apartments according to the 2011 Census

Description	Single-family buildings	Multi-apartment buildings	Total
Number of buildings	969 360	64 846	1 034 206
Total number of apartments	1 008 795	931 605	1 940 400
Number of apartments occupied	856 147	877 993	1 734 140

Source: 2011 Census, Statistical Office

Besides multi-apartment and single-family buildings, apartments can also be found in other buildings (religious institutions, social-service buildings, retirement homes, etc.), of which there are 13 020, equating to a 3.41 % share. These buildings accommodate 54 497 apartments.

Most of this housing stock was built between 1960 and 1983 and is therefore more than 30 years old. Construction work carried out up to 1983 (inclusive) incorporated very poor thermal performance due to the requirements applicable at the time and the technological capacities of construction.

2.1.1.1 Multi-apartment buildings

Multi-apartment buildings can be characterised by the period in which they were constructed. Between 1947 and 1992, mass housing construction saw the erection of multi-apartment buildings of various set types, construction systems and structural systems (existing buildings), with a particular inclination for prefabricated concrete technology (large-panel system buildings). After 1992, atypical buildings started to be designed on an individual basis (new buildings). More precise data on the construction of apartments in multi-apartment buildings up to 1992 could be drawn from the 2001 and 2011 Censuses.

Figure 1 – Number of apartments in multi-apartment buildings (source: Science and Technology Service – cost-optimal proposals of minimum requirements for the energy performance of buildings, Building Testing and Research Institute)

In view of the thermal performance of the external skin and the construction technology, multi-apartment buildings can be broken down into five groups which, in the various periods, were influenced by requirements regarding the properties of building structures. These differ by the thermal properties of envelope structures, their share in the surface area of the building envelope, and energy requirements or actual energy consumption.

Table 4 Number of buildings, apartments, sections and specific area by group (type, construction system and structural system)

Type of structural system, construction system	Number of buildings	Number of apartments	Number of sections	Total floor area (m^2)
Brick and pre-assembled masonry panels	6 761	133 814	14 447	10 733 966
Single-layer large-panel system, built between 1955 and 1983	7 983	374 503	20 284	29 807 256
Multi-layer large-panel system, built between 1971 and 1983	2 131	96 298	5 878	8 234 737
Large-panel system, built between 1983 and 1998	3 646	183 402	9 415	16 159 811
Atypical buildings built from 1992	65	996	117	58 776
Other, unspecified	1 137	11 621	2 355	427 121
Total	21 723	800 634	52 496	65 421 666

Source: Slovak Report for the Commission (EU). Reference Buildings. Determination of Cost-optimal Levels of Minimum Energy Performance Requirements, 2013

Multi-apartment buildings built up to 2001 can be found in only 567 Slovak municipalities (i.e. in the form of buildings with more than three apartments). Multi-apartment buildings constructed *en masse* took the form of terraced houses, slab blocks, point blocks and tower blocks in any of 61 different types, construction systems and structural systems. 43.2 % of apartments are located in multi-apartment buildings with up to four floors, and only 15 % of apartments are located in multi-apartment buildings with more than eight floors. In particular, this results in different renovation costs.

Most multi-apartment buildings are located in an area with a winter design temperature of -11 °C (308 212 apartments), -13 °C (163 195 apartments) and -15 °C (186 437 apartments). Only 23 multi-apartment buildings are located in sites with a temperature of -19 °C (274 apartments). All of the coldest areas where multi-apartment buildings have been constructed are located in the Prešov and Žilina Higher Territorial Units. Of the 21 723 multi-apartment buildings, only 1 147 are located at an altitude more than 600 m above sea level and only 175 are at an altitude of more than 800 m above sea level.

The most recent comprehensive surveys show that the average annual heat consumption for space heating between 1994 and 2003 in multi-apartment buildings was 131.7 kWh/(m^2.a) for buildings made from brick and pre-assembled masonry panels, 110.3 kWh/(m^2.a) for buildings made using single-layer large-panel systems (built between 1955 and 1983), 119.0 kWh/(m^2.a) for buildings made using multi-layer large-panel systems, and 101.9 kWh/(m^2.a) for buildings made using large-panel systems constructed after 1983. The results obtained for buildings constructed after 1983 and up to 1992 were used, following a statistic evaluation thereof, to determine the upper limit of energy class B in the energy performance of buildings in 2006. The actual energy consumed on space heating is influenced by climatic conditions, which can vary significantly in Slovakia. More detailed information on multi-apartment buildings is presented in Annex 6.

Apertures (building structures with the worst thermal performance) over the building envelope account for a large share of energy consumption. They range approximately from 13 % to 25 % of the overall area of the building envelope and from 19 % to 32 % of the area of the external skin. Apertures in the original construction are a major point of heat loss in a building.

2.1.1.2 Single-family buildings

Single-family buildings are variable in their shape, shape factor values and share of individual structures in the thermal envelope. Detailed statistics and databases with data on single-family buildings are not available. Only the number of single-family buildings built in each period, as reported in the 2001 and 2011 Censuses and published by the Statistical Office, is available.

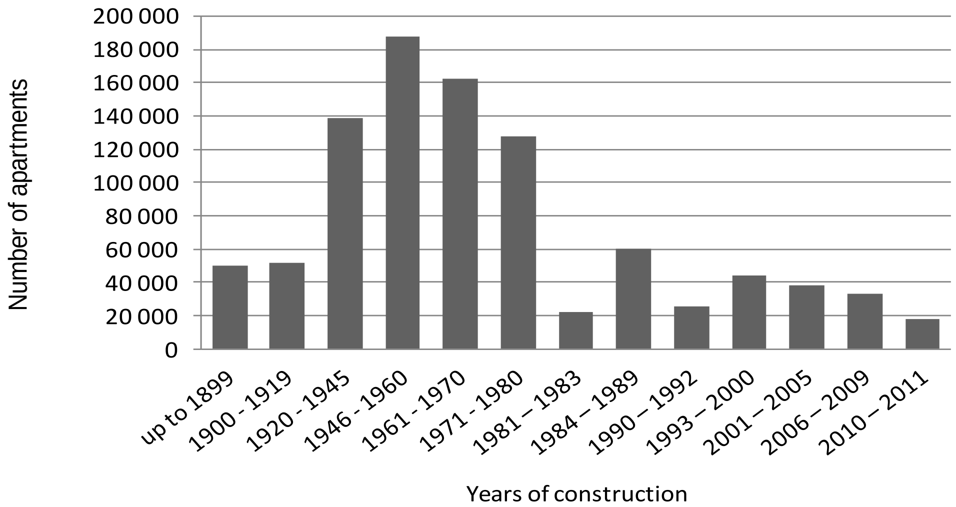


Figure 2 – Numbers of apartments in single-family buildings according to statistical data, Statistical Office

To determine more detailed typical geometric characteristics of single-family buildings, the set of representative single-family buildings used to determine the scale for the energy certification of buildings in the handling of research and development tasks, as commissioned by the Ministry, could be used as a basis. The habitable areas of single-family buildings are known from the statistics. The ratio between the habitable area and the total floor area varies and depends on the layout of the single-family building. The ratio of the habitable area to the total floor area was set at 75 %.

Table 5 Average size of the habitable area and total floor area of single-family buildings

Single-family buildings Location of apartment, by storey	Average number of habitable rooms per apartment	Average habitable area per apartment (m^2)	Average adjusted total floor area per apartment (m^2)
Ground floor	3.32	60.6	80.8
Ground floor and first floor	4.83	87.4	116.5
First floor	3.53	65.1	86.8
Second floor	4.08	75.2	100.3

Source: Slovak Report for the Commission. Reference Buildings. Determination of Cost-optimal Levels of Minimum Energy Performance Requirements

Owing to their large envelope area compared to their built-up volume (shape factor), single-family buildings require more heat for space heating than multi-apartment buildings. The minimum shape factor for single-family buildings is 0.6 1/m; the maximum is 1.11 1/m. The total floor area per apartment in single-family buildings is approximately 1.5 to 2 times the area per apartment in multi-apartment buildings.

No detailed data on the energy consumption of existing single-family buildings are available. Based on the evaluations available, average annual energy consumption on space heating of 165 kWh/(m^2.a) can be assumed. However, it is not usual for all rooms to be heated at once and therefore the actual energy consumption is lower.

The minimum share of the aperture area is 4.1 %; the maximum is 12.8 %. A large proportion of this is taken up by roof structures, especially in single-family buildings with sloping roofs.

2.1.2 Non-residential buildings

2.1.2.1 Buildings owned by central and local government bodies

Of the total number of non-residential buildings, between 1994 and 2003, 15 435 buildings were identified as being owned by central and local government bodies. Broken down by built-up volume, 50.9 % of these non-residential buildings were schools, 13.2 % were healthcare facilities, 12.5 % were office buildings and 10.3 % were accommodation facilities.

Non-residential buildings owned by central and local government authorities account for a 54.8 % share of the built-up volume of non-residential buildings identified to date (Table 7, Annex 6).

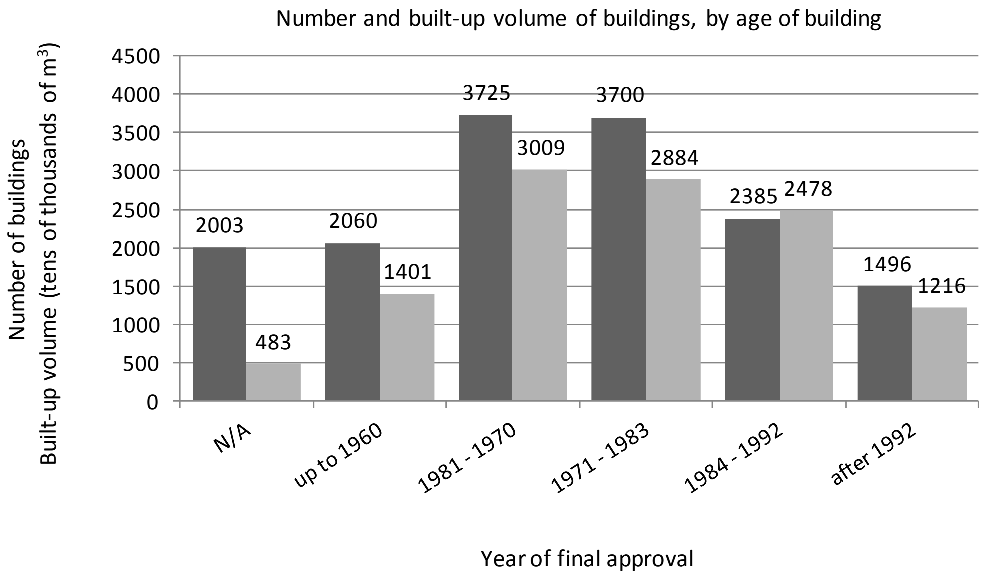


Figure 3 – Built-up volume of non-residential buildings owned by central and local government bodies and number thereof, by age (source: Slovak Report for the Commission (EU). Reference Buildings. Determination of Cost-optimal Levels of Minimum Energy Performance Requirements, 2013)

Information on the average energy consumption on space heating is available only for the period from 1994 to 2003. The average consumption at all non-residential buildings owned by central and local government bodies is 55.2 kWh/(m³.a); for primary schools it is only 49.1 kWh/(m³.a). The lower annual heat consumption of primary schools compared with the average for all buildings is due to the lower average temperature of the indoor air in schools, compared, for example, with office buildings or healthcare buildings, and the relatively large number of holidays in the winter. The highest heat consumption is recorded by the buildings of healthcare facilities, i.e. 68.3 kWh/(m³.a), and the lowest, at 42.7 kWh/(m³.a), is recorded by the buildings of cultural facilities, which are often not heated all year round, and the entire built-up volume is not heated. Sports facilities report low heat consumption at 44.3 kWh/(m³.a). These facilities generally comprise the gyms of primary and secondary schools, which are heated to a lower temperature. Average energy consumption on space heating has changed in recent years following the replacement of windows and the installation of insulation. However, in more than a third of buildings arrangements are not in place to reduce space heating at night and weekends. Besides space heating, most non-residential buildings also use a lot of energy on lighting and hot water. Figures on actual consumption in these areas of energy use are not available.

2.1.2.2 Buildings of central bodies of state administration

According to Article 5 of Directive 2012/27/EU, each Member State shall ensure that, as from 1 January 2014, 3 % of the total floor area of heated and/or cooled buildings owned and occupied by central bodies of state administration is renovated each year to meet at least the minimum energy performance requirements that it has set in the application of Article 4 of Directive 2010/31/EU.

Directive 2012/27/EU (Article 5(6)) also allows for an alternative approach to be taken in the fulfilment of the obligation under Article 5(1). This means that a Member State may take cost-effective measures, including deep renovations and measures for a change in the behaviour of building occupants, to achieve, by 2020, energy savings in relevant buildings at least equivalent to the volume of savings required in Article 5(1) of Directive 2012/27/EU; Member States are to report on this to the European Commission on an annual basis.

Table 6 Number of buildings, total floor area and built-up volume of buildings of central bodies of state administration

Data	Number of buildings	Total floor area (m^2)	Built-up volume (m^3)
Sum of all buildings	3 806	4 773 344	21 678 102
Sum of all buildings, by owner – area not specified	189	0	9 408
Buildings more than 500 m²	**1 893**	**4 370 709**	**19 571 523**
Buildings more than 500 m², from 1947 to 1993 (inclusive)	1 364	3 175 872	14 026 720
Buildings more than 500 m² – year not specified	62	112 392	536 336
Buildings more than 500 m² – up to 1947	135	365 202	1 860 893
Buildings more than 250 m² (including those more than 500 m²)	**2 631**	**4 641 021**	**21 070 474**
Buildings more than 250 m², from 1947 to 1993 (inclusive)	1 938	3 386 048	15 178 299
Buildings more than 250 m² – year not specified	1938	3 386 048	15 178 299
Buildings more than 250 m² – up to 1947	192	385 754	1 000 936

Source: Ministry of Transport, Construction and Regional Development – Report notifying an alternative approach in accordance with Article 5 of Directive 2012/27/EU

A list of relevant (eligible) buildings of central bodies of state administration, in accordance with Article 5 of Directive 2012/27/EU, is published on the Ministry’s website at http://www.telecom.gov.sk/index/index.php?ids=170474.

The notification report informs the European Commission of alternative measures planned in the pursuit of the energy savings target up to 2020 in accordance with Article 5(6). The report includes a draft preliminary target in accordance with Article 5(1), a target expressed as energy savings for the purposes of applying the alternative approach, and a list of the alternative measures.

The determining factor in the preparation of the list of buildings for the implementation of the obligation to deep-renovate buildings of central bodies of state administration is a total floor area of more than 500 m². From 9 July 2015, this area was reduced to 250 m². The annual target in accordance with Article 5 of Directive 2012/27/EU is 3 % of the total floor area of the buildings listed.

2.2 Cost-effective approach to building renovation according to the building category and climatic zone

The proposed cost-effective measures for improvements in the energy performance of buildings are linked to deep renovations. During deep renovations, attention needs to be paid – in addition to building stock structures and their major renovation (improvements in the thermal protection of structures) – to the major renovation of buildings' technical systems, i.e. the space heating system and hot water system for residential and non-residential buildings, as well as the ventilation, cooling and lighting of non-residential buildings.

The publication of the 'Draft methodology and input data for the determination of the cost-effectiveness of the construction and renovation of buildings in terms of energy performance' provides guidance. This document focuses on determining input data on construction products and technical systems in order to define measures affecting the energy performance of buildings at various levels of energy performance requirements. It is available on the Ministry's website at http://www.telecom.gov.sk/index/index.php?ids=82867 .

Improvements in the energy performance of buildings are also dependent on the energy efficiency of heat and cold production. Slovakia has a well-developed district heating system that covers more than 30 % of overall heat consumption (approximately 16 100 multi-apartment buildings). Most heat sources and heat distribution systems were built prior to 1990. The boilers used in district heating systems vary considerably in terms of their age, technical parameters and fuel type. Most of the boilers in operation are less than 15 years old. Installed capacity is dominated by boilers more than 20 years old. District heating systems tend to use warm water and hot water distribution systems. The bulk of heat distribution pipes were installed 20-30 years ago, which is reflected in their technical condition. As the expected service life of these sources and distribution systems is between 25 and 30 years, the major renovation of technical equipment also encompasses heat and hot water production and distribution.

Deep renovation may be carried out as partial measures, in the form of gradual steps, or separately as the major renovation of a building (structures) and the major renovation of technical systems. Deep renovation may also encompass all measures at once.
Draft measures are differentiated by:

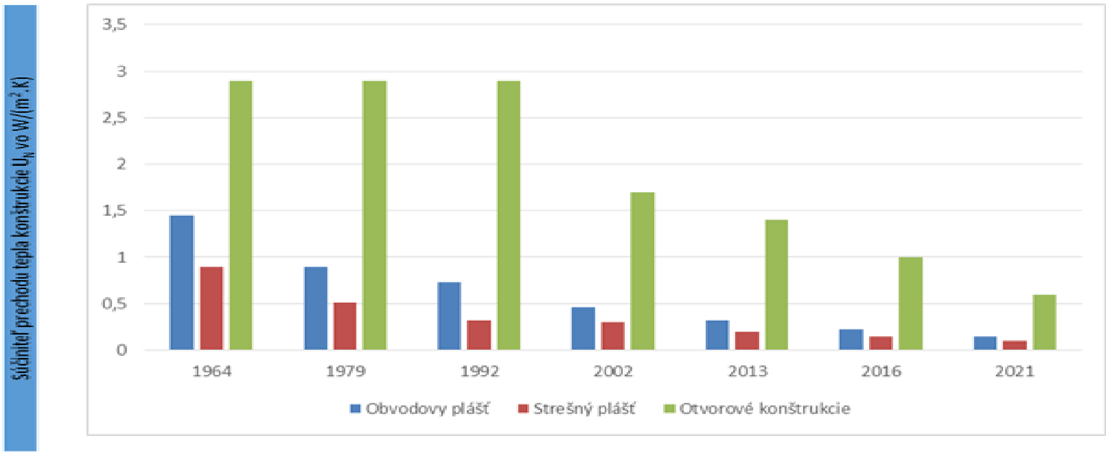
(a) the targets set to ensure the energy performance of buildings, as laid down by Act No 555/2005 on the energy performance of buildings, as amended by Act No 300/2012 and Implementing Decree No 364/2012;
(b) the building category (residential and non-residential buildings);
(c) the construction period (up to 1983, inclusive, up to 2002, after 2002);
(d) the original condition of structures (apertures, external skin, roof cladding and internal partitions between heated and non-heated rooms);
(e) the original condition of technical systems in the building (space heating, hot water, ventilation, cooling, lighting);
(f) the age and technical condition of sources of heat, hot water, cold and distribution systems in and outside of the building;
(g) the extent to which renewable sources of heat, hot water and electricity have been introduced.

The proposed cost-effective measures and improvements in the energy performance of buildings are detailed in Annex 5.

Procedures for the evaluation of cost-effectiveness are laid down in the standard STN EN 15 459 Energy performance of buildings. Economic evaluation procedure for energy systems in buildings (06 0004). These procedures were also applied when determining the cost-optimal levels of the minimum requirements for the energy performance of buildings in accordance with Commission Regulation (EU) No 244/2012. When calculating the net present value during the expected economic cycle, it is necessary to determine the initial investment costs of implementing the measures and to set the calculation period and the life of the individual measures (components), the replacement costs, the costs of maintenance and economic activities, disposal costs, and the cost of heat, electricity and other energy carriers.

To maintain the cost-optimal level of minimum requirements for the energy performance of buildings, greater stringency was introduced from 1 January 2016. The results of the calculation of the cost-optimal levels were reported to the Commission in May 2013 and are published at http://ec.europa.eu/energy/efficiency/buildings/doc/sk_cost-optimal_2013.

The following graph shows how the structural heat transfer coefficient, by level of construction, has become more stringent.



Heat transfer coefficient for structures U_N in W/(m^2.K)
External skin Roof envelope External windows and doors
Source: 25 Years of Insulation in Slovakia; 15 years of Activity by the Building Insulation Association, TSÚS, n.o., August 2016

2.3 Procedures and measures to promote cost-effective deep renovations

The Ministry has prepared a National Plan to Increase the Number of Nearly Zero-energy Buildings (the 'National Plan'), designed to ensure that new construction after 2020 is of the required standard. The National Plan has been published on the Ministry's website at http://www.telecom.gov.sk/index/index.php?ids=83491.

Interim targets to achieve the individual energy levels of construction have been laid down in Implementing Decree No 364/2012 implementing Act No 555/2005 on the energy performance of buildings and amending certain laws, as amended, encompassing three stages as follows:

(a) the low-energy level of construction for new and renovated buildings from 1 January 2013, equal to the upper limit of energy class B for the individual building categories;
(b) the ultra-low-energy level of construction for all new buildings from 1 January 2016, equal to the upper limit of energy class A1, and for renovated buildings, assuming compliance with cost-effectiveness conditions;
(c) the energy level of nearly zero-energy buildings for new buildings owned and managed by public entities from 1 January 2019, and all new buildings from 1 January 2021, equal to the upper limit of energy class A0 for the overall indicator (primary energy). This energy level is also required, where technically, functionally and economically feasible, for renovated buildings.

The heat required for space heating has a significant influence on space heating energy requirements and hence on the overall energy needs of a building. The heat required for space heating depends on the efficiency and quality of a building's thermal protection. Standard STN 73 0540-2 Thermal protection of buildings. Thermal performance of structures and buildings. Part 2: Functional requirements (70 30540), defines requirements for energy-efficient buildings (the maximum permitted values guaranteeing compliance with hygiene criteria), low-energy buildings (standardised requirements from 1 January 2013), ultra-low-energy buildings (recommended values, applicable as standardised from 1 January 2016) and nearly zero-energy buildings (target recommended values, applicable as standardised from 1 January 2021). Thermal protection is essential to safeguard the necessary level of construction in terms of energy requirements.

New buildings must comply with standardised requirements for the thermal performance of structures and buildings. Buildings undergoing major renovation must also comply with standardised requirements. Where this is not functionally, technically or economically feasible, all structures subject to major renovation must at least meet the minimum requirements for energy-efficient buildings.

If a nearly zero level of energy requirements is to be achieved for all new and renovated buildings, renewable energy sources must be used efficiently.

The cost-optimal levels of minimum requirements for the energy performance of buildings were laid down in the Commission's comparative methodology framework established by Commission Regulation (EU) No 244/2012 and the Guidelines accompanying Commission Regulation (EU) No 244/2012, supplemented with national parameters. The objective pursued in the handling of the scientific and technical service was to prove, by means of calculations and comparisons, whether the current requirements for the minimum energy performance of buildings and building elements in Member States lag far behind than the cost-optimal requirements. The results of a comparison show the merits of tightening requirements after 2015 to 50 % of the 2013 level of requirements (Annex 7).

2.4 Expectations and scope of renovation of residential and non-residential (public and private) buildings to guide the investment decisions of individual investors, the construction industry and financial institutions

2.4.1 Scope of residential building renovation expected

Assuming financial resources are secured at the same level as in previous years (approximately EUR 100 million per year), materials and staffing are in place to continue building renovation at the same pace as in recent years.

The need to ensure more stringent energy levels of construction will also increase demands on the quality of work related to the energy performance of buildings. Based on experience to date and on adequate forms used to promote the renovation of residential buildings, projections indicate that such renovation should continue at an annual tempo of 29 000 apartments in multi-apartment buildings and 22 000 apartments in single-family buildings. The renovation of such a number of apartments should have covered, in 2020, 70.8 % of multi-apartment buildings and 45.5 % of single-family buildings.

At this rate of renovation, multi-apartment buildings in Slovakia should be renovated in 2029, and single-family buildings in 2043. If we were to limit our forecasts solely to the renovation of occupied single-family buildings, their renovation could be completed in 2036.

Table 7 Scope of residential building renovation expected after 2016

Description	Apartments in multi-	Apartments in

	apartment buildings	single-family buildings
2011 Census	931 605	1 008 795
Renovation as at 31 December 2016	543 406	378 271
Proportion of renovation as at 31 December 2016 (%)	**58.33**	**37.5**
Scope of renovation in 2017-2020	116 000	88 000
Scope of renovation as at 31 December 2020	659 406	458 946
Proportion of renovation as at 31 December 2020 (%)	**70.8**	**45.5**
Balance for 2021-2030	272 199	549 869
Number of years of renovation after 2020	9.4	25.0
Renovation of occupied apartments in single-family buildings after 2020		18.05

Source: Data from the 2011 Census (Statistical Office), prepared by the Building Insulation Association and TSÚS

The tightening of requirements for the energy performance of buildings will require the re-renovation of buildings already renovated in the past. If the energy performance of buildings is to be improved, it is necessary to ensure the effective heat protection of structures, with a positive impact on reductions in the need for heat to provide space heating. The need for heat to provide space heating is affected in particular by the structural heat transfer coefficient U in $W/(m^2.K)$. External skin insulation after 1992 entailed thermal insulation in ETICS, primarily on the basis of 40-60 mm expanded polystyrene (EPS). The thermal insulating function will be improved by increasing the thickness of the thermal insulation, i.e. by doubling the ETICS. The required thickness of the thermal insulating layer in the added ETICS must provide a level of thermal resistance equivalent to the difference between the calculated value of the heat transfer coefficient of the original structure, including the existing insulation, and the standardised (required) value.

All thermal insulation composite systems (ETICS) based on expanded polystyrene and mineral wool can be proposed and installed provided that they have been issued with documents associated with a European or national technical assessment (or, up to 1 July 2013, certification) complying with the requirements of STN 73 2901 Installation of external thermal insulation composite systems (ETICS) (73 2901).

2.4.2 Scope of non-residential building renovation expected

As the total floor area of the buildings of central bodies of state administration is 445 791 m² and every year 3 % needs to be renovated, 13 374 m² (Annex 2 to the Notification Report) should be renovated, and the saving should be 52.17 GWh/year.

2.5 Evidence-based estimate of expected energy savings and other benefits

The potential for overall energy savings in residential and non-residential buildings up to 2020 was first determined in the updated Building Energy Performance Concept up to 2010 with an Outlook up to 2020, approved under Resolution of the Government of the Slovak Republic No 336 of 6 July 2012. The potential for energy savings anticipated an increase in the non-residential buildings renovated up to a level of a 3 % share of the total floor area of such buildings per year. The fact that the scope of energy savings would be positively influenced by the future renovation of non-residential buildings at a low-energy and ultra-low-energy level was taken into account. The energy-saving potential in the period from 2011 until 2020, if the proposed measures were implemented for residential and non-residential buildings, should have resulted in total energy savings of 15 222.8 TJ.

The conditions for determining the energy-saving potential were changed. The energy-saving potential determined for the years from 2014 to 2016, with an outlook until 2030, is based on measures proposed by the Ministry in the preparation of the third Energy Efficiency Action Plan for 2014-2016 with an Outlook until 2020 (the ‘action plan’). The energy-saving potential from the renovation of residential and non-residential buildings up to 2030, established in this manner, is presented in Annex 8. The projected energy savings are 6 928.6 GWh.

3. Mobilisation of investment in public and private building stock renovation (for residential and non-residential buildings)

3.1 Existing forms of building support

3.1.1 Existing forms of residential building renovation support

State housing policy concepts adopted after 1990 regulated an unequivocal task in housing quality: to improve the technical condition of the existing housing stock and, using appropriate renovation instruments, to contribute to the extended service life thereof and to enhancements in the energy performance of buildings. These state housing policy concepts paved the way for the Building Renovation Concept with an Emphasis on Housing Stock Renovation, which was adopted as early as 1999 and has remained in force since. This concept systemically addressed housing stock renovation to safeguard the housing policy concept’s residential and non-residential building renovation targets.

In order to expand and enhance housing stock, in its housing policy the state currently employs a system of economic instruments in the form of direct and indirect support.

(a) **Direct state support** for tasks associated with building renovation is provided in the following form:

- direct subsidies under a housing development scheme, granted by the Ministry to eliminate systemic defects in multi-apartment buildings;
- direct subsidies in the form of an allowance for the insulation of a single-family building, granted to natural persons – owners of single-family buildings from 2016;
- soft loans granted to natural persons and legal persons via the State Housing Development Fund, subject to compliance with statutory conditions.

(b) **Indirect state support** is available:

- under the Housing Stock Renovation State Support Scheme, in the form of bank guarantees for loans (the ‘bank guarantee scheme’), which was approved by the Slovak Government to revive housing construction and foster conditions conducive to the renovation of housing stock;

- as mortgage financing, where state support is provided in the form of a state contribution to mortgages or a state contribution to mortgages for young people (this is only available for natural persons);
- under a system of state-subsidised building society savings, where state support takes the form of a state premium added to the building society savings of natural persons and associations of the owners of apartments and non-residential premises.

The results of state support for the renovation of housing stock can be summed up as follows:

(a) In the period from 2000 to 2016, subsidies totalling approximately EUR 101 462 000 were granted to eliminate systemic defects in multi-apartment buildings with 141 397 apartments.

(b) In 2016, the single-family building insulation allowance was granted, after insulation had been installed, for 14 single-family buildings in the amount of EUR 56 204.63; allowances aggregating to EUR 526 500 were reserved for 81 single-family buildings ahead of such insulation.

(c) State Housing Development Fund resources provided EUR 803 516 000 in support for the renovation of residential buildings in 1996-2016, encompassing 183 276 apartments and 2 093 single-family buildings.

These are just the figures for renovation because, since 2014, in keeping with Act No 150/2013 on the State Housing Development Fund renovation has encompassed multiple support sub-purposes, including insulation, and the fund does not monitor these sub-purposes separately.

(d) Between 2000 and 2013, bank guarantees were granted for loans totalling EUR 43 019 000, intended for 26 852 apartments. Since 2013, no bank guarantees have been provided for loans financing the renovation of housing stock.

(e) In the building society savings system, building societies grant approximately 80 % of financial resources for the renovation of housing stock; expressed financially, this translates into approximately EUR 280 million per year. Minor measures for the modernisation and reconstruction of multi-apartment and single-family buildings account for approximately 56 %.

Information on direct support for the renovation of residential buildings, as presented in Annex 2, highlights the fact that building owners are aware of the need to eliminate systemic defects prior to the renovation of the building itself or as an initial step in the renovation process, as evidenced by the share of apartments in which systemic defects have been removed (141 397 apartments).

One particular area where support for residential building renovation and residential building insulation has so far proved to be of little effect is single-family buildings, the number of which receiving support accounts for under 2 % of all apartments renovated. The form of support and the conditions thereof for the renovation of insulated buildings, intended to increase interest in the use of such support among single-family building owners, have failed to make these new types of support – introduced in 2009 – more popular. Of the single-family buildings insulated up to 2015, estimated to be more than 338 000, only 0.6 % have been renovated with the use of financial support from the state.

The forms of state support intended for single-family buildings were revised. It should be borne in mind that the area of envelopes and apertures (the external skin and roof, as well as windows), on a per-apartment basis, is at least four to six times larger per apartment; while this requires a larger proportion of support, it results in greater energy-saving benefits per apartment and, as such, the proportion of CO_2 emission reductions per apartment is higher.

3.1.2 Existing forms of non-residential building renovation support

The support for residential building construction has not been mirrored by national support schemes for the financial support of non-residential buildings in Slovakia.

Information published in the Building Energy Performance Concept up to 2010 with an Outlook up to 2020, approved under Government Resolution No 384 in 2008, indicates that a major step forward in the renovation of non-residential buildings was taken by the implementation of the Operational Programme Basic Infrastructure, especially Priority 3 thereof (Local infrastructure for 2004-2006). The financial resources released, amounting to SKK 1 872 258 937 (EUR 62 147 611), contributed to the renovation of 178 buildings, of which 86 were school buildings, 28 were healthcare buildings, 26 were social service buildings and 38 were cultural buildings. The required monitoring of information did not focus on measures geared towards energy savings and, hence, the reporting of benefits delivered by improvements in the energy performance of buildings.

Under a grant agreement signed in 2008 between the Ministry of Economy of the Slovak Republic, the European Bank for Renovation and Development and the Slovak Innovation and Energy Agency, other programmes were used to implement the pilot project 'Energy Efficiency in Public Buildings', under which 57 buildings were renovated (18 nursery and primary schools, 35 municipal authorities and cultural buildings and four healthcare centres) in the Trnava and Nitra Self-governing Regions. The Bohunice V1 International Decommissioning Support Fund provided financial resources.

Financing for the energy performance of buildings from the private sector was provided by EkoFond between 2008 and 2012; this primarily took the form of financial support for municipalities as the founders of schools and school facilities or social, healthcare and cultural facilities. As such, EkoFond contributed to improvements in the energy performance of buildings at 61 schools and school facilities and 21 community buildings by providing support of EUR 3 996 968. In addition, a programme call in 2008 supported energy measures implemented at another 34 single-family and eight multi-apartment buildings at a cost of EUR 597 457.

At an estimate, the energy performance of more than 300 non-residential buildings was supported. This remains a very low proportion, with no focus on achieving major energy savings in buildings. Neither the established conditions nor projects were rigorously centred on achieving applicable minimum requirements for the energy performance of buildings, and therefore the buildings renovated so far fall short of the criterion of major renovation.

The project Energy Audits, for more than 250 buildings owned or managed by organisations throughout Slovakia funded fully or partly from the public purse, aims to analyse the potential for savings and propose specific measures to reduce energy consumption in public buildings.

Audit breakdown by building type:

- 161 office buildings;
- 79 school and school-facility buildings;
- 37 primary schools;
- 16 nursery schools;
- 26 secondary schools;
- 10 social-care buildings.

Each building type was assessed to determine whether the use of energy services with guaranteed savings was also feasible. In practice, such projects are implemented if a return can be made on the investment, in the form of energy cost savings, within about 10 years.

Municipalities, towns, higher territorial units and state institutions were able to use the processed audits in the preparation of projects to finance measures proposed under support mechanisms; they can also be used in the 2014-2020 programming period.

3.2 Requirements concerning the forms of residential and non-residential building support from 2014

The strategic objective pursued by energy policy in Slovakia is to achieve a competitive low-carbon energy industry delivering the safe, reliable and efficient supply of all forms of energy at affordable prices, with due consideration for consumer protection and sustainable development. The deep renovation of residential and non-residential buildings paves the way for low-carbon energy industry, but requires sufficient motivation among the owners of residential and non-residential buildings – with effective forms of financial support for the renovation of buildings – in order to meet stringent minimum requirements for the energy performance of buildings which also deliver the required economic returns.

3.2.1 Requirements concerning the forms of residential building support from 2014

The State Housing Policy Concept up to 2020, approved under Government Resolution No 13 of 7 January 2015, as the baseline document for housing up to 2020, lays down the state's comprehensive objectives for housing policy, defines the instruments to achieve them, and formulates the responsibilities of citizens, the state, municipalities, higher territorial units and the private sector in the provision of housing.

Through its instruments (the State Housing Development Fund), the state has long supported the financing of priorities reflected in state housing policy in relation to the expansion and enhancement of the housing stock. This support is mainly being channelled into assistance for the procurement of rental apartments and into the renovation of residential buildings.

There was also a seismic shift in the forms of state support intended for single-family buildings. Act No 277/2015 amending Act No 443/2010 on subsidies for the development of housing and on social housing, as amended by Act No 134/2013 and amending Act No 555/2005 on the energy performance of buildings and amending certain laws, as amended, which established subsidies to support improvements in the energy performance of single-family buildings, was adopted in 2015. It has become clear, since the Act took effect, that the amount of subsidisation needs to be increased, so an amendment is now being prepared that is intended to push up this amount.

In the renovation of buildings, it is necessary to take into account the need to exploit the full cost-effective potential of energy savings for a particular building, while bearing in mind the long cycle of renovation, and, therefore, to engage in comprehensively major renovation at the time such renovation is essential. Such major, or deep, renovation should also factor in the efficient use of renewable energy sources.

For financing purposes, more use needs to be made of sources from the European Union's Structural Funds in the form of repayable financial assistance via the JESSICA financial instrument because the implementation of measures focusing on improved energy efficiency contributes directly to the pursuit of one of the main Europa 2020 objectives. There are plans to use resources from the Integrated Regional Operational Programme 2014-2020 (within the scope of Priority Axis 4 Improvement in the quality of life in regions, with an emphasis on the environment, Investment Priority 4.1: Support of energy efficiency, smart energy management and the use of energy from renewable sources in public infrastructure, including public buildings, and in the housing sector) for the renovation of residential buildings, with an overall allocation of EUR 111.4 million (sourced from the EU), of which EUR 101.4 million is earmarked for less-developed regions and EUR 10 million for a more developed region.

In particular, to improve the living conditions of marginalised Roma communities in the housing sector, it is possible to support their housing with financial resources from the Operational Programme Human Resources, Priority Axis 6 Technical infrastructure in municipalities where marginalised Roma communities are present, especially Investment Priority 6.1. Provision of support for the physical, economic and social regeneration of neglected urban and rural communities, Specific Objective 6.1.1 Growth in the number of Roma households with access to improved housing conditions.

Another major source, apart from the central government budget, will be resources from the sale of CO_2 emissions, where the renovation of buildings is one of the most significant sources of CO_2 reductions and, therefore, proof of effective use in the investment of these resources. The completed renovation of each residential building (multi-apartment or single-family building), by means of the energy performance certificate delivered upon final approval, can serve as proof not only of savings in overall energy, but also of the scope of CO_2 emission reductions.

Since July 2014, SlovSEFF III has distributed more than EUR 12.80 million to 29 projects. An annual reduction in greenhouse gas (CO_2) emissions by 5.698 tonnes and an annual energy saving of 32 025.93 MWh are expected. The carbon reduction compensation (CRC), which is accepted as recognition of a future potential reduction in emissions, is EUR 704 847. Extending this instrument will result in more projects being funded.

The EBRD has approved a EUR 60 million increase for the sustainable energy project financing instrument SlovSEFF III. This means that a total of EUR 100 million is available in the form of financial resources. The EBRD is deepening its support with a new loan extended to Slovenská sporiteľňa, a.s. (SLSP) and VÚB Banka, a.s. (VÚB). In addition, another bank – OTP Banka Slovensko, a.s. – will provide the EBRD with a credit line of EUR 10 million. This credit line will allow the bank to provide financial resources to businesses and housing cooperatives so that they can make sustainable investments in the energy sector in Slovakia. The development of energy efficiency and renewable energy supplies demonstrates the positive effects of rational energy use and a reduction in greenhouse gas emissions. It will also help to reduce the high energy and carbon intensity in the region.

We expect the system of economic instruments currently in use, in the form of direct and indirect support as presented in Section 3.1.1, to be continued in national support for the renovation of residential buildings after 2014. The gradual tightening of conditions required to achieve more demanding energy levels of construction will be reflected in revised requirements for the granting of the corresponding financial support.

At present, the estimated absorption capacity for improvements in the thermal performance of housing structures and the modernisation of building technical systems is expected to comprise between EUR 250 million and EUR 350 million from public resources (the Ministry, the State Housing Development Fund) for the 2014-2020 period, which is insufficient. Approximately EUR 110 million needs to be earmarked from public resources every year to cope with the projected rate of renovation of multi-apartment buildings in Slovakia not only up to 2020, but beyond – up to 2030. Therefore, only around two thirds of the financial resources required to renovate 29 000 apartments in multi-apartment buildings every year will be covered. It follows that the gap in funding will have to be secured from other sources, e.g. by drawing on financial resources from European funds, building societies, commercial banks and other avenues open to the owners of apartments.

Annex 2 shows that the overall scope of support, if a subsidy covering 30 % of eligible costs per renovated apartment in a single-family building were to be applied (capped at EUR 6 000), would be reduced to a third for single-family buildings compared to the need for credit facilities. Currently, an amendment to the law aimed at increasing the cap, probably from 1 January 2018, is being proposed. This creates conditions for realistic future energy savings and reduced emissions as a result of renovated single-family buildings; this is one of the greatest energy-saving potentials in Slovakia in the future. Many related deficiencies in single-family buildings would also be addressed by appropriate incentives to renovate such buildings:

1. single-family buildings built prior to 1992 were generally self-help, unskilled projects with numerous errors in design and construction;
2. today, the renovation of single-family buildings is often not carried out on the basis of a building permit, the necessary design documentation is not drawn up, and energy performance certificate are not submitted (in the reporting period from 2010 to 2013, energy performance certificates were issued for only about a tenth of the single-family buildings renovated);
3. the thermal protection of single-family buildings is not addressed sufficiently, crucial details are not covered by design documentation and, hence, in construction, thermal bridges are created; heat is leaked and hygiene deficiencies arise;
4. many single-family buildings are only partially insulated, and energy performance certificate for the years from 2000 to 2013 prove that many such buildings, even today, are only renovated in energy classes D, E or F;
5. there is scrimping on materials, unsuitable construction products are frequently used, and the components of external thermal insulation composite systems (ETICS) are

replaced with others.

3.2.2 Requirements concerning the forms of non-residential building support from 2014

In the long run, the European Union's Structural Funds are a fundamental source of financing for the development of Slovak businesses' competitiveness and the attainment of a competitive low-carbon energy industry; this also applies to the renovation of non-residential buildings. There are plans to make use of the Structural Funds, in particular via the Operational Programme 'Quality of Environment' and the Integrated Regional Operational Programme 2014-2020. Under the Environmental Fund, in order to make use of proceeds from the sale of emission allocations, the specification of subsidy-related support activities for 2014 was extended to include improvements in the energy efficiency of existing public buildings, including insulation. This support encompasses the buildings of primary and secondary schools, nursery schools/preschool facilities, community centres and municipal authorities in the competence of municipalities, local government bodies, and their facilities.

In Member States of the European Union, the renovation of public buildings and, in particular in this respect, the renovation of the buildings of central bodies of state administration, should serve as an example for non-residential buildings. There are plans to achieve the energy savings target set for the purposes of the alternative approach under Article 5 of Directive 2012/27/EU by means of the following measures:

(a) increased energy efficiency in public sector buildings;

(b) energy auditing for public sector buildings or energy management;

(c) measures designed to change the behaviour of the occupants of buildings of central bodies of state administration – the provision of advisory services, information and training activities aimed at public sector buildings and the provision of energy management.

The measures are detailed in the Report notifying an alternative approach in accordance with Article 5 of Directive 2012/27/EU on energy efficiency with the use of relevant resources of the European Union's Structural Funds.

Based on the structuring of the financial plan for the Operational Programme 'Quality of Environment', approved under Resolution of the Government of the Slovak Republic No 175 of 16 April 2014, and further to the Commission Implementing Decision of 11 June 2015 correcting Implementing Decision C(2014)8047 approving certain elements of the operational programme 'Quality of Environment' for support from the European Regional Development Fund and the Cohesion Fund under the Investment for growth and jobs goal in Slovakia, European Union resources amounting to EUR 937 558 268 and national co-financing of EUR 674 913 781 (a total of EUR 1 612 472 049) are being considered for less-developed Slovak regions under Priority Axis 4, Thematic Objective 4 Energy-efficient low-carbon economy in all sectors. The national co-financing for the more developed regions of Slovakia is EUR 1 328 212 (a total of EUR 2 656 424).

It follows from the above document that spending of approximately EUR 938 million is projected for measures focusing on increased energy efficiency in Slovakia in the 2014-2020 programming period. Under the Operational Programme 'Quality of Environment', financial resources earmarked for the renovation of public buildings outside the Bratislava Region amounting to between EUR 350 million and EUR 499 million may be spent on proposed energy efficiency measures at central bodies of state administration as part of the mandatory renovation of those bodies' buildings. Following the exhaustion of financial resources for the renovation of the buildings of central bodies of state administration outside the Bratislava Region, at present there is no supporting financial mechanism to facilitate the financing of the annual renovation required in the Bratislava Region.

Under the performance framework of Priority Axis 4 of the Operational Programme 'Quality of Environment', output indicators include the 2018 milestone objective to renovate 187 200 m^2 of the floor area of public buildings beyond the level set by minimum requirements, and the ultimate objective to renovate 1 248 000 m^2 of floor area by 2023.

Besides opportunities to make use of European Union resources, it is also essential to learn about the offers of European banking institutions in good time. One is the MUNSEFF (Municipal Energy Efficiency Finance Facility) project.

MUNSEFF is a credit line to support the development of energy efficiency and renewable energy sources among towns and municipalities in Slovakia. This support is provided by the European Bank for Renovation and Development. The programme is implemented in Slovakia by Slovenská sporiteľňa, a.s. and Všeobecná úverová banka, a.s.

The MUNSEFF programme enables applicants to receive a grant covering part of the loan principal; the amount of the grant depends in part on the scope of the project or the amount of energy saved. Under the MUNSEFF programme, multi-apartment buildings with renovation projects aimed at increasing energy efficiency may apply for soft loans, grants or the free assistance of a design consultant.

The minimum loan per project is EUR 20 000; the maximum loan is EUR 850 000. Upon the successful completion of project implementation, a multi-apartment building may obtain a grant covering between 10 % and 15 % of the overall loan. One of the requirements is the attainment of energy savings of more than 30 % compared to the situation prior to project implementation. Eligible applicants are municipalities, companies majority-owned by municipalities, and private companies providing public services, e.g. theatre or swimming pool operators. Resources may be granted for projects targeting the energy efficiency of municipality-owned buildings (e.g. offices, health care, education, culture, sport and relaxation, catering services, etc.). The eligible groups of measures are:

1. renovation of the space heating system, replacement of boilers, installation of heat exchanger stations, modernisation of mechanical equipment (heaters, pumps, heat recovery);
2. replacement of windows and doors (transparent building apertures) with more energy-efficient versions;
3. thermal insulation of buildings (exterior walls, roof and ceiling of the service floor);
4. renovation of lighting;
5. installation of solar thermal panels.

4. Tasks for the construction industry, the business community, employment and improved qualifications arising from the strategy

Residential and non-residential building renovation stakeholders are central bodies of state administration, local government bodies, private owners and investors (represented by facility managers), manufacturers of construction materials and the building technical systems, designers (architects and civil engineers, represented by professional organisations), contractors (represented by employer associations and expert associations), and research and development centres.

New tasks associated with the renovation strategy for investors and designers are incorporated into the strategy's conclusions.

The aim of BUILD UP Skills – Slovakia (BUSS) was to prepare the initial steps of a national strategy to improve training in construction with a specific focus on future construction site specialists so that Slovakia and Europe would be able to meet the challenges of a 'green economy', i.e. energy efficiency (reduced energy consumption), the use of renewable energy sources, and reductions in greenhouse gas emissions, and, consequently, to meet the 20/20/20 targets by 2020.

Employee skills, training and expertise are currently regarded as key attributes in the further development of the construction industry. In construction, as in many other sectors, increased productivity at all levels hinges on the skills of those in the industry.

In general, the manual skills of workers in the Slovak construction industry are thought to be very good, and the professional reputation enjoyed by Slovak workers has also spread abroad. The working morale of blue-collar professions, however, is much worse.

In the wake of transformation, the Slovak construction industry established the organisational structure commonly used in other countries. A natural hierarchy of small (up to 49 employees), medium-sized (up to 250 employees) and large (over 250 employees) enterprises was formed, the organisation of which mirrors the structure of contracting and demand. Self-employed persons, i.e. lone traders, in the construction industry form a distinct group in this respect. Each of these groups has found its natural place in the construction market.

Based on their experience of the existing quality of work, employees project that, on average, 31 % of their employees and 43 % of the employees of their subcontractors will require additional training in the pursuit of professions related to deep renovations of the existing stock of residential and non-residential buildings. In other words, with an average of 165 254 employees in the construction industry, almost 80 000 will need training.

Obstacles hindering progress towards the targets set up to the year 2020 have been identified in two areas. The first area comprises barriers related to primary education and training. The second area comprises barriers in today's construction market that also reflect current macroeconomic, sociological and demographic circumstances, because all of these help to form the construction environment.

It is estimated that at least 40 % of building construction workers will need to undergo training, take a course or otherwise improve their skills in the next few years.

A worker who has undergone training and embraced environmental changes can be regarded as a representative of a green profession. Green professions include the following expert areas of employment: bricklayers, plasterers, roofers and building structure assemblers – responsible for construction work related to the insulation of the external skin and roof cladding, and the installation and replacement of windows and doors, electricians – who install solar panels, plumbers – who install solar collectors for hot water, construction workers – who build energy-efficient buildings and wind power stations, and other workers involved in the sustainable development of the clean and renewable energy of the future, as well as specialists in verifying the functionality of energy-efficient building systems and facility managers of energy-efficient buildings. These are professions associated with the sector responsible for reducing energy consumption in buildings and for the use of renewable energy, and with energy efficiency.

In recognition of the importance of increasing green profession skills, on 1 April 2015 the new Act No 61/2015 on vocational education and training and amending certain laws took effect with a view to facilitating the smooth transition from education to the labour market and increasing the prospects of secondary vocational school leavers in the labour market. Starting in the 2015/2016 school year, the Vocational Education and Training Act enables pupils to be trained in a dual education system. This lets employers prepare pupils precisely and specifically for an occupation or a job according to their needs and requirements.

Dual education is a system of vocational education and training for an occupation that provides pupils with the knowledge, abilities and skills necessary for that occupation. It is characterised, in particular, by the close interlinking of comprehensive and vocational theoretical education at a secondary vocational school with practical training at a particular employer. In a dual education system, employers are not only able to enter the vocational training process, but are also fully responsible for the organisation, content and quality of practical training. To this end, they cover all the costs associated with the financing of practical training. In order to maintain a unified scope and content of practical training in individual fields of study, practical training will be held according to model curricula and model syllabuses that have been developed in cooperation with the relevant professional and trade organisations and are binding on employers active in the dual education system.

Dual education strengths

- A highly skilled workforce, a smooth transition from education to the labour market.
- The acquisition of skills and experience directly at the employer.
- The acquisition of work habits directly in the production process at the employer.
- Training using new technologies directly at the employer.
- The employer’s responsibility for the practical part of the vocational training.
- Employers have a say in the content of vocational training.
- Vocational training programmes and their content are up to date, and can be flexibly adjusted.
- Verification of the knowledge and skills of school-leavers by the employer upon the completion of studies.
- Pupils choose an occupation and the employer who is to provide practical training.
- Pupils are selected for dual education directly by the employer, and they are admitted to the school with the employer’s consent.
- Supervision of the dual education system by employer associations.
- The pupil’s financial and material security is provided by the employer.
- Close cooperation between the business, the school and the pupil.
- Practically targeted curricula for each field.
- The development of occupations linked to market needs.
- A high probability of getting an employment contract with the employer.

4.1 Projects to improve qualifications in the construction sector after 2014

4.1.1 StavEdu project

The StavEdu project is a nationwide project aimed at creating a system to deepen qualifications and further the training of construction craftsmen and workers in the energy performance of buildings and the use of renewable energy sources in buildings. It is aimed in particular at craftsmen and workers with a secondary vocational education in a technical field (certificate of apprenticeship) who are interested in acquiring professional knowledge and expertise in the energy performance of buildings and in the use of renewable energy sources in buildings.

The aim is to expand knowledge about the types, properties and use of building materials necessary to reduce the energy intensity of buildings, and required for technological procedures and principles. To learn about the work activities used in synergy with technological procedures, to be able to install thermal insulation systems on building façades, including surface treatment. To learn about innovated technological processes and new materials, to be able to use smart energy solutions, measurement methods, technologies, the properties and structure of materials, including technical regulations. (Source: the website at http://www.stavedu.sk)

4.1.2 ingREeS project

The ingREeS project, in its focus, priorities and planned activities, is a follow-up to the European Build Up Skills (BUS) Initiative. The ingREeS project expands the scope of the Roadmap, which was adopted in 2013 to develop the skills and knowledge of construction workers in Slovakia, to include construction experts from middle and senior management. This Roadmap set out key measures for the establishment of national qualification frameworks and the education and training system, as well as other measures to ensure the development of skills needed for energy efficiency in the construction industry, in order to meet the EU energy targets by 2020.

The main target group of the project and the upcoming training programmes is construction-sector experts at the middle and senior management levels in five professions that, according to the Roadmap, are crucial to achieve energy targets by 2020:

1. site manager;
2. site supervisor;
3. civil engineers and architects;
4. building sustainability consultant;
5. persons professionally competent for the energy performance certification of buildings.

The project’s second target group comprises experienced construction-sector professionals working in the field of energy efficiency and the usability of renewable sources, who have the potential to participate in the project as an external expert or trainer.

The project's third target group is made up of the relevant Slovak state, public and professional institutions and organisations, as well as construction-sector companies and employers, who will be invited to discuss incentive measures.

The ingREeS project introduces qualitative change to the system of lifelong learning in the construction sector, driving forward increased efficiency and participation in educational activities. This project unites professional organisations and associations bringing together the target groups with the vision of building a system of further education for construction professionals at medium and senior levels of management. Those who undergo this training will also have the skills and knowledge to meet European standards, expectations and requirements.

4.1.3 The BIM phenomenon in the construction industry

The building information model is a revolutionary way of communication in the preparation, construction and management of buildings (facility management). The systematic push for the use of building information model technology in professional practice by all those involved in the building process throughout the entire life cycle of a building will save on investment and operating costs.

5. Review of the strategy's implementation outputs

The Residential and Non-residential Building Stock Renovation Strategy, Slovak Republic, is not a static or final document, nor was it intended as such. Rather, it is a document that has the potential to be developed and encapsulate trends in this area. The authors originally conceived it as a basis to work on a more specific stage for the renovation of residential and non-residential buildings. The strategy for the renovation of residential and non-residential buildings was meant to result in a long-term plan. This aim was dropped because the long-term outlook for the renovation of residential and non-residential buildings is provided by the strategy *per se*, which is and will be updated every three years, as required of us by Section 9 of Act No 321/2014 on energy efficiency and amending certain laws. Section 10 of that Act lays down a further obligation that influenced our decision not to draw up a long-term plan. Specifically, the Ministry, in cooperation with central bodies of state administration and public bodies, is to draw up an annual plan for the renovation of relevant buildings in the following calendar year.

On this basis, since 2015 a 'Plan for the Renovation of Relevant Buildings' has been drawn up and submitted to a Government session in June each year. That document is dedicated to identifying buildings planned for renovation and the energy savings potential of buildings.

6. Barriers and obstacles

A key task in the implementation of the renovation strategy is to achieve, in the very short period between 2015 and 2020, the energy efficiency of buildings by gradually tightening the requirements of the three energy levels of construction. This requires the amendment of legal and technical regulations, new forms of support and sufficient awareness among all building renovation stakeholders.

Well-known barriers in construction also apply to building renovation. These include

- poor energy and legal awareness on the part of owners;
- mixed building ownership (e.g. a residential part and a non-residential part);
- public procurement and tendering procedure geared primarily towards the lowest price;
- the poor quality and low price of design work;
- the low price and quality of execution of energy performance certificates;
- insufficient awareness among construction stakeholders regarding new requirements, measures, construction products, etc.;
- the inadequate system for the training and acquisition of skills required for green professions;
- the lack of lifelong learning for selected professions (e.g. designers);
- the lack of deep renovation (including the renovation of the technical equipment of buildings);
- the lack of renovation of heat distribution systems, heat generators and sources used for the preparation of hot water.

Low prices affect the quality and completeness of design documentation and therefore have an adverse effect on the quality of the executed work. The low prices of energy certificates mean that they cannot be drawn up objectively and, consequently, they cannot present the true quality or information about the impact of the measures taken or draft measures recommended for application in the future. The initial critical tasks to dismantle these barriers are included in the strategy conclusions. Updating the strategy at three-year intervals will make it possible to assess not only the extent to which these tasks have been accomplished, but also to propose and approve other tasks leading to the elimination of these obstacles.

7. Conclusions

The strategy has formed a framework in which to express public priorities in energy efficiency and has provided the business community in the energy and construction industries with an indication of the state's long-term vision, thus contributing to the better planning of investments and other action by private businesses.

It should be noted that the conclusions, the implementation date of which is ongoing, have been fulfilled over the reporting period and it is assumed that their fulfilment will continue in the coming period.

To fulfil Conclusions 3 to 6, a legislative framework was drawn up, organisational conditions were created, methodical guidance and an informative environment were devised to meet the tightened conditions for the energy performance of buildings. The conclusions appear to have been fulfilled.

Conclusion 9 can be judged to have been fulfilled because 'Principles for the Design and Execution of ETICS Doubling' were drawn up (ISBN 978-80-8076-126-4). The use of research results paved the way for the application of new materials and procedures for the improvement of buildings renovated in the past to bring them up to the level of the more stringent requirements established for the energy performance of buildings.

Taking into account the facts presented in chapter 5 (Review of the strategy's implementation outputs), it would be fair to say that Conclusion 10 has not been formally fulfilled in accordance with the content of the title mentioned in the conclusion, but that its content has been fulfilled and will continue to be met in the coming period because it is a long-term task. The Plan for the Renovation of Relevant Buildings was drawn up in accordance with Act No 321/2014 on energy efficiency and amending certain laws.

Annexes

Annex 1
Terms and definitions associated with the renovation of residential and non-residential buildings

Annex 2
Numbers of renovated residential buildings (apartments) supported under the housing development scheme and the State Housing Development Fund

Annex 3
Underlying documentation from the 2011 Population and Housing Census on the scope of renovation of multi-apartment and single-family buildings

Annex 4
Numbers of energy performance certificates issued for buildings undergoing major renovation from 2010 to 2016

Annex 5
Cost-effective measures to improve the energy performance of buildings

Annex 6
Information on the stock of residential and non-residential buildings

Annex 7
Cost-optimal levels of minimum energy performance requirements for building

Annex 8
Summary of primary-energy-saving measures, their benefit and energy-saving potential in the period from 2015, with an outlook up to 2030

Annex 1

Terms and definitions associated with the renovation of residential and non-residential buildings

The long-term strategy uses terms related to the renovation of buildings that are incorporated into Slovak legal and technical regulations following the recasting of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast) and Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

Energy performance of a building: the amount of energy required to meet all energy needs associated with the normal use of a building, in particular the amount of energy required for space heating and hot water production, cooling and ventilation, and lighting (pursuant to Section 3(1) of the Act[3]).

The energy performance of a building is determined by calculation, or by a calculation using the energy consumption measured, and is expressed by numerical indicators of energy demand within the building and primary energy. Primary energy is energy from renewable and non-renewable sources which has not undergone any conversion or transformation process (pursuant to Section 3(2) of the Act[1]).

Building: a roofed structure with walls in which energy is used to adapt the interior environment; a building means a structure as a whole or a part thereof that has been designed or modified for separate use (pursuant to Section 2(3) of the Act.[4]).

Energy performance of a public building: the ratio of annual energy consumption measured in a public building to the total floor area of the public building (pursuant to Section 10(8) of the Act[2]).

Energy efficiency: a process that contributes to an increase in energy efficiency or to a reduction in the energy intensity of energy conversion, distribution or consumption, taking into account technical, economic or operational changes or changes in the behaviour of end-users and end-consumers (pursuant to Section 2(f) of the Act[2]).

Public building: a building owned or managed by a public entity (pursuant to Section 2(k) of the Act[2]).

Relevant building: a building under a special regulation, managed by a central body of state administration which, as at 1 January of the given calendar year, fails to comply with the minimum energy performance requirements for buildings pursuant to a special regulation, and which has a total floor area of more than 250 m² (pursuant to Section 10(2) of the Act[2]).

Renovated building: an existing building in which changes are made to the structures and

[3] Act No 555/2005 on the energy performance of buildings, as amended.
[4] Act No 321/2014 on energy efficiency and amending certain laws.

technical system so that, before the end of their lifetime, it will meet the essential requirements for structures and an extension to the lifetime of the structure or parts of the structure, usually without disrupting the use of the building, in which respect renovation, depending on the scope, may be full or partial (according to STN 73 0540-2 Thermal protection of buildings. Thermal performance of structures and buildings. Part 2: Functional requirements (73 0540), Article 2.5).

Major renovation: structural alterations to an existing building that affect more than 25 % of the surface of the building envelope, in particular involving insulation of the external skin and roof cladding and the replacement of the original apertures (pursuant to Section 2(7) of the Act[1]).

Major renovation can be carried out in one go or by means of successive (partial) structural alterations. Major renovation constitutes the partial renovation of a building. If a major renovation is carried out in progressive steps, each progressive step constitutes a partial renovation of a building.

Substantial refurbishment: renovation of the technical system for the space heating, hot water preparation, ventilation, cooling, and lighting of buildings and combinations thereof, the investment costs of which exceed 50 % of the investment costs of the acquisition of a new comparable building technical system (pursuant to Section 9(2)(b) of the Act[2]).

Deep renovation: the major renovation and substantial refurbishment of a building so that the building can be classified under the minimum energy class required by law,[1] taking into account the life cycle of each element of the building, and taking place in a one-off or progressive manner according to the design documentation (pursuant to Section 9(2)(a) of the Act[2]).

Comprehensive renovation: the condition of a building is secured by structural alterations. All structures and the technical system meet basic building requirements established by applicable legal and technical regulations (according to STN 73 0540-2 Thermal protection of buildings. Thermal performance of structures and buildings. Part 2: Functional requirements (73 0540), Article 2.5).

Comprehensive renovation can be carried out in one go or gradually as a partial renovation. Comprehensive renovation consists of major renovation, substantial refurbishment, and the renovation of structures and technical systems not significantly affecting the need for and consumption of energy in the building (the ensuring of static, user and fire safety, hygiene and acoustic protection, e.g. the renovation of open and enclosed balconies, the lightning rod, lifts, sewage system, waterproofing, floors, etc.).

Total floor area: the floor area of a storey, ascertained from the outside dimensions of the building, without taking into account local protruding structures, such as pillars, ledges, pilasters, local reductions in the thickness of the external skin, excluding the areas of open and enclosed balconies and terraces; if the room headway covers two or more storeys, e.g. a staircase or gallery, the total floor area is calculated as if the room were divided by a horizontal structure on the plane of each storey (according to STN 73 0540-2 Thermal

protection of buildings. Thermal performance of structures and buildings.
Part 2: Functional requirements (73 0540), Article 2.11).

Annex 2

Table 1 Numbers of renovated residential buildings (apartments) supported by the housing development scheme and the State Housing Development Fund

Form of support	Period	Number of apartments			Support provided (euro)
		Multi-apartment buildings	Single-family buildings	Total	
Removal of systemic defects in a multi-apartment building	2000 to 2013	141 860	0	141 860	101 715 800
Renovation of a residential building	2014 to 2016	89 258	2	89 260	416 369 072
Insulated residential building	2014 to 2016	-	-	-	191 804 194
Removal of systemic defects in a multi-apartment building	2014 to 2016	-	-	-	78 117 266
Total residential buildings		**231 118**	**2**	**231 120**	**518 084 872**

Table 2 Scope and analysis of the renovation of a multi-apartment building with State Housing Development Fund resources

Years	Renovation of a multi-apartment building			Insulation of a multi-apartment building		
	Support provided (euro)	Number of apartments	Average support per apartment	Support provided (euro)	Number of apartments	Average support per apartment
2006	22 874 959	4 636	4 934	0	0	0
2007	31 562 531	8 219	3 840	0	0	0
2008	24 909 945	6 474	3 848	0	0	0
2009	26 090 530	7 208	3 620	70 242 012	14 740	4 765
2010	32 232 110	9 199	3 504	0	0	0
2011	52 036 646	12 537	4 151	16 542 296	3 735	4 429
2012	68 828 561	16 690	4 124	20 863 521	4 892	4 265
2013	82 146 773	18 993	4 325	24 002 665	6 618	3 627
2014	112 942 112	25 280	4 468	56 111 888.65	-	-
2015	109 369 420	22 828	4 791	53 086 350.13	-	-
2016	194 034 450	41 150	4 715	82 605 955.05	-	-
Total	**757 028 037**	**156 708**	**46 320**			

Table 3 Scope and analysis of the renovation of a single-family building with State Housing Development Fund resources

Years	Renovation of a single-family building			Insulation of a single-family building		
	Support provided (euro)	Number of apartments	Average support per apartment	Support provided (euro)	Number of apartments	Average support per apartment
2006	143 597	8	17 950	0	0	0

2007	196 043	12	16 337	0	0	0
2008	22 937	1	22 937	0	0	0
2009	46 674	2	23 337	645 396	36	17 928
2010	0	0	0	0	0	0
2011	54 938	2	27 469	139 038	10	13 904
2012	0	0	0	76 476	4	19 119
2013	0	0	0	18 536	1	18 536
2014	0	0	0	-	-	-
2015	23 090	2	11 545	23 090	2	11 545
2016	0	0	0	-	-	-
Total	**487 279**	**27**	**119 575**			

Source: Ministry of Transport, Construction and Regional Development

Annex 3

1. Underlying documentation from the 2011 Population and Housing Census on the scope of renovation of multi-apartment and single-family buildings

The 2011 Census tracked a lot of new data, making it possible to compare data obtained previously from other surveys. Form C. BUILDING DATA tracked twelve items:

1. building type (*single-family building, multi-apartment building, accommodation facility without an apartment);*
2. occupancy;
3. form of ownership;
4. time of construction;
5. time of reconstruction;
6. number of storeys;
7. number of apartments in the building;
8. material of the load-bearing structure;
9. type of water connection;
10. type of sewer system;
11. thermal insulation;
12. gas connection.

The item ‘thermal insulation’ was important for comparison. Here, the explanatory notes to the census form stated that a building is insulated if it has an insulated external skin and, at the same time, the windows and doors have been modified to prevent heat loss. The thermal insulation used may also be **partial**. This was to be indicated if only some parts or walls of the building were insulated. The data were to be filled in by the home-owner, facility manager, occupant or census commissioner.

The ‘time of reconstruction’ item was intended to indicate when the most recent reconstruction of the building (horizontal or vertical extension, conversion) was completed. According to the form’s explanatory notes, the insulation of a building (contrary to building regulations) was also treated as a reconstruction. Regular maintenance work, including the repair of a façade, the repair and replacement of roofing, the repair and replacement of minor structures, such as partitions, the replacement of equipment, the replacement of windows, and similar modifications, is not considered to be a reconstruction. If the building had not been reconstructed (renovated), this also had to be indicated.

Table 1 Thermal insulation – single-family buildings

Slovakia, regions	Thermal insulation – single-family buildings				Total
	yes	partially	no	unidentified	
Slovakia	145 470	116 273	509 548	198 069	969 360
Bratislava Region	20 009	8 132	25 014	14 068	67 223
Trnava Region	21 197	15 122	62 713	20 907	119 939
Trenčín Region	15 656	12 759	57 882	26 205	112 502
Nitra Region	20 329	16 573	91 478	32 239	160 619
Žilina Region	25 698	18 491	61 233	28 170	133 592
Banská Bystrica Region	11 710	13 085	70 253	31 751	126 799
Prešov Region	17 337	17 032	72 881	22 222	129 472
Košice Region	13 534	15 079	68 094	22 507	119 214

Source: 2011 Census, Statistical Office

Table 2 Thermal insulation – multi-apartment buildings

Slovakia, regions	Thermal insulation – multi-apartment buildings				Total
	yes	partially	no	unidentified	
Slovakia	18 416	8 196	36 280	1 954	64 846
Bratislava Region	4 070	1 280	4 745	551	10 646
Trnava Region	1 619	586	3 949	189	6 343
Trenčín Region	1 912	1 043	5 263	222	8 440
Nitra Region	1 662	859	5 097	248	7 866
Žilina Region	2 763	1 102	3 238	171	7 274
Banská Bystrica Region	2 964	1 338	4 155	239	8 696
Prešov Region	1 804	1 111	4 500	159	7 574
Košice Region	1 622	877	5 333	175	8 007

Source: 2011 Census, Statistical Office

In order to use the information in Tables 1 and 2 to express major renovations of single-family and multi-apartment buildings as a percentage, along with a lot of other information, summary data on buildings and apartments as at 21 May 2011 needed to be monitored:

Table 3

Numbers of buildings and apartments	Single-family buildings	Multi-apartment buildings
buildings	969 360	64 846
total apartments	1 008 795	931 605
apartments occupied	856 147	877 993

Source: Data from the 2011 Census, prepared by the Building Insulation Association

The data obtained from Tables 1 and 2 are an indisputable benefit. These are the first statistical data documenting the extent of single-family building renovations in Slovakia. Both tables also provide data that make it possible to determine the extent of renovations in each region.

Table 4

Region	Renovations (%)	
	Single-family buildings	Multi-apartment buildings
Slovakia	**27.00**	**41.04**
Bratislava Region	41.86	50.25
Trnava Region	30.28	34.76
Trenčín Region	25.26	35.01
Nitra Region	22.97	32.04
Žilina Region	33.08	53.13
Banská Bystrica Region	19.55	49.47
Prešov Region	26.55	38.49
Košice Region	24.00	31.21

Source: Data from the 2011 Census (Statistical Office), prepared by the Building Insulation Association

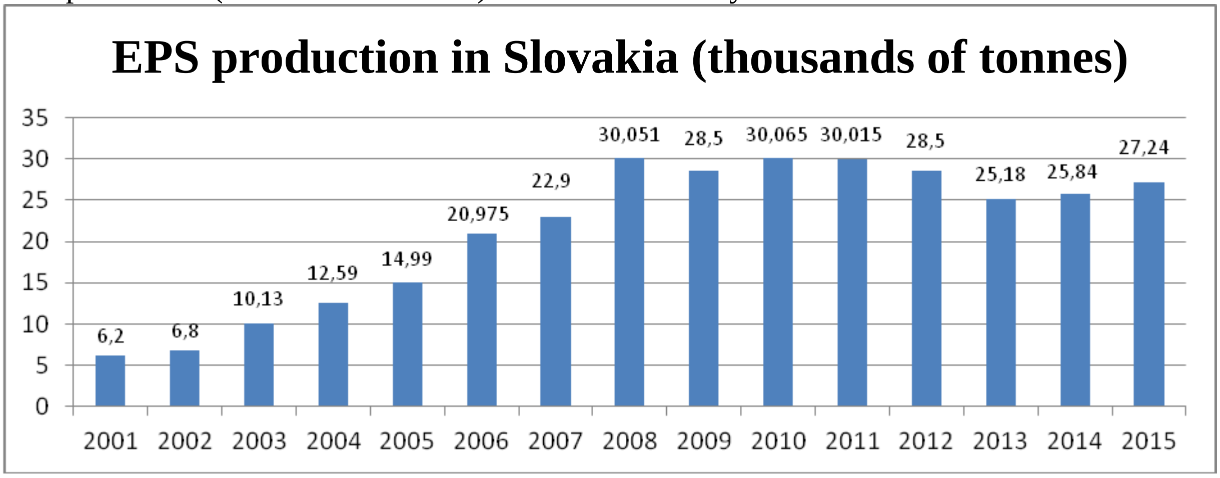
2. Expert estimate of the extent of thermal insulation in the years 1992 to 2012, and establishment of the procedure to determine this according to the Building Insulation Association

The extent of thermal insulation is determined on the basis of a construction product that copies the perimeter wall of the building during the insulation process, i.e. the expanded polystyrene (EPS) EPS/F 70, as an ETICS component. EPS accounts for 85 % to 90 % of the thermal insulation used in the thermal insulation composite system (ETICS).

This is a methodically determined expert estimate drawing on a range of variable data on the consumption of foam polystyrene, such as EPS consumption, expressed as total tonnes, the deduction of EPS exports, the deduction of EPS for fittings and packaging, the extent of EPS in the construction industry, and, on this basis, the extent of EPS for façades, the share of EPS waste, the bulk density of EPS, the average EPS thickness in ETICS, and a determination of the extent of EPS 70F in m^2 and the total extent of ETICS production.

The extent of total EPS production in the years 2001 to 2012 is represented by a graph taken from the EPS Association in Slovakia.

EPS production (thousands of tonnes) in Slovakia in the years 2001 to 2015



Source: Slovak EPS Association

When determining the check conversion from m^2 of EPS 70F to the number of apartments in multi-apartment and single-family buildings, as well as non-residential buildings, the basis was formed by the annual scope of EPS 70F from 2008 to 2011, which was almost identical in each year (approximately 30 000 tonnes of EPS and approximately 8 million m^2 of façades in Slovakia).

<u>The annual conversion rate is as follows:</u>

8 million m^2 of façades (30 000 tonnes of EPS) represented
- 22 000 single-family buildings;
- 35 000 apartments in multi-apartment buildings;
- 5 000 new insulated single-family buildings; and
- 94 non-residential buildings;

all of different sizes, respecting the extent of construction in the regions of Slovakia.

3. Further steps in determining the extent of renovations up to and after 2020

The Building Insulation Association's expert estimate of building renovation, by reference to the progressively updated installation of thermal insulation on building façades from 1992 to 2012, can be compared with data from the 2011 Census, and a suitable correction can be established for the original figures. Consequently, the extent of renovations of multi-apartment and single-family buildings from 2011 to 2013 could be added to data from the 2011 Census. It is currently possible to discuss the extent to which residential buildings have been renovated. In the future, it will also be possible to focus in detail on the renovation of non-residential buildings, expressed through ETICS for the years 2005 to 2012 as approximately 2 387 500 m^2 of exterior skin (this is not broken down into the individual categories of non-residential buildings).

Annex 4

Numbers of energy performance certificates issued for buildings undergoing major renovation from 2010 to 2016

Table 1 Numbers of energy performance certificates by building category and energy class in 2010

Building category	Energy class							Total
	A	B	C	D	E	F	G	
Single-family buildings	8	372	248	55	20	8	9	**720**
Multi-apartment buildings	0	356	350	29	4	1	0	**740**
Office buildings	1	58	62	21	6	6	3	**157**
Schools and school facilities	0	51	121	52	18	4	1	**247**
Hospitals	0	9	6	2	0	0	0	**17**
Hotels and restaurants	1	32	8	4	0	1	0	**46**
Sports halls and other buildings intended for sport	0	3	6	4	2	0	0	**15**
Wholesale and retail trade services buildings	0	26	13	5	5	0	1	**50**
Other mixed-purpose buildings	1	25	21	5	2	0	0	**54**
Total	**11**	**932**	**835**	**177**	**57**	**20**	**14**	**2 046**

Source: INFOREG

Table 2 Numbers of energy performance certificates by building category and energy class in 2011

Building category	Energy class							Total
	A	B	C	D	E	F	G	
Single-family buildings	8	540	295	77	24	6	9	**959**
Multi-apartment buildings	1	606	455	20	3	1	0	**1 086**
Office buildings	1	100	67	17	5	4	3	**197**
Schools and school facilities	1	48	142	55	15	8	5	**274**
Hospitals	0	13	5	0	0	0	0	**18**
Hotels and restaurants	1	33	6	3	2	0	0	**45**
Sports halls and other buildings intended for sport	1	9	7	7	3	1	0	**28**
Wholesale and retail trade	2	28	18	5	2	3	2	**60**

services buildings								
Other mixed-purpose buildings	1	40	27	8	2	0	1	**79**
Total	**16**	**1 417**	**1 022**	**192**	**56**	**23**	**20**	**2 746**

Source: INFOREG

Table 3 Numbers of energy performance certificates by building category and energy class in 2012

Building category	Energy class							Total
	A	B	C	D	E	F	G	
Single-family buildings	22	535	321	101	20	10	11	**1 020**
Multi-apartment buildings	1	843	429	20	4	0	0	**1 297**
Office buildings	1	93	58	14	2	1	0	**169**
Schools and school facilities	0	36	78	16	3	2	4	**139**
Hospitals	0	11	5	0	0	0	0	**16**
Hotels and restaurants	2	48	9	3	1	0	0	**63**
Sports halls and other buildings intended for sport	0	3	6	2	0	0	0	**11**
Wholesale and retail trade services buildings	3	42	18	4	1	2	0	**70**
Other mixed-purpose buildings	0	41	25	5	0	0	1	**72**
Total	**29**	**1 652**	**949**	**165**	**31**	**15**	**16**	**2 857**

Source: INFOREG

Table 4 Numbers of energy performance certificates by building category and energy class in 2013

Building category	Energy class							Total
	A	B	C	D	E	F	G	
Single-family buildings	27	638	391	108	32	12	17	**1 225**
Multi-apartment buildings	1	641	379	30	2	0	0	**1 053**
Office buildings	2	50	68	24	7	4	2	**157**
Schools and school facilities	1	26	43	17	2	4	2	**95**
Hospitals	1	12	6	3	1	0	0	**23**
Hotels and restaurants	1	25	15	1	1	0	0	**43**
Sports halls and other buildings intended for sport	1	3	3	3	0	0	1	**11**
Wholesale and retail trade services buildings	2	39	33	14	2	3	0	**93**
Other mixed-purpose buildings	4	39	36	8	1	0	0	**88**
Total	**40**	**1 473**	**974**	**208**	**48**	**23**	**22**	**2 788**

Source: INFOREG

Table 5 Numbers of energy performance certificates by building category and energy class in 2014

Building category	Energy class								Total
	A0	A1	B	C	D	E	F	G	
Single-family buildings	139	244	668	129	31	14	4	4	**1 233**
Multi-apartment buildings	77	41	791	158	22	9	1	1	**1 100**
Office buildings	2	4	75	38	12	3	1	1	**136**
Schools and school facilities	1	3	27	33	12	2			**78**
Hospitals			10	4	1				**15**
Hotels and restaurants	2	6	32	15	3	4	1		**63**
Sports halls and other buildings intended for sport			1	2	1			1	**5**
Wholesale and retail trade services buildings	1	9	52	32	9	3	2		**108**
Other mixed-purpose buildings	2	6	54	27	4	1	1		**95**
Total	**224**	**313**	**1 710**	**438**	**95**	**36**	**10**	**7**	**2 833**

Source: INFOREG

Table 6 Numbers of energy performance certificates by building category and energy class in 2015

Building category	Energy class								Total
	A0	A1	B	C	D	E	F	G	
Single-family buildings	150	284	693	123	40	10	6	3	**1 309**
Multi-apartment buildings	72	49	699	119	15	3	1	4	**962**
Office buildings	1	12	83	52	9	6		5	**168**
Schools and school facilities	1		50	66	22	9	6	6	**160**
Hospitals			13	5	1				**19**
Hotels and restaurants	2	9	42	14	5	2		1	**75**
Sports halls and other buildings intended for sport			1	8	1	1			**11**
Wholesale and retail trade services buildings		3	58	33	8	3	3	3	**111**
Other mixed-purpose buildings	1	4	46	14	1	2			**68**

Total	227	361	1 685	434	102	36	16	22	2 883

Source: INFOREG

Table 7 Numbers of energy performance certificates by building category and energy class in 2016

Building category	Energy class								Total
	A0	A1	B	C	D	E	F	G	
Single-family buildings	168	391	656	126	37	9	7	2	**1 396**
Multi-apartment buildings	80	69	820	121	19	8	4		**1 121**
Office buildings	4	8	67	37	2	1		2	**121**
Schools and school facilities	1	2	37	26	6	3	1		**76**
Hospitals	1	2	9	1					**13**
Hotels and restaurants	2	5	35	9	3	2			**56**
Sports halls and other buildings intended for sport		1	5	4	3	1			**14**
Wholesale and retail trade services buildings		7	52	32	12	2		2	**107**
Other mixed-purpose buildings	1	8	49	13	1	3			**75**
Total	**257**	**493**	**1 730**	**369**	**83**	**29**	**12**	**6**	**2 979**

Source: INFOREG

Annex 5

Cost-effective measures to improve the energy performance of buildings

Cost-effective measures to improve the energy performance of buildings are distinguished by building category. Their service life is taken into account for the specified calculation period. In keeping with conditions under 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, a calculation period of 30 years for residential buildings and public buildings and 20 years for other buildings will be factored in.

Table 1 Measures proposed for selected building categories

Building category	**Structure/ technical system**	**Proposed measure**	**Service life** (years)
Multi-apartment building	External skin	Change in thermal protection with insulation where the thickness of thermal insulation in the ETICS depends on the original condition and level of requirements for the energy performance of buildings, and respects fire safety requirements	25-30

	Roof envelope	Change in thermal protection where the thickness of thermal insulation depends on the original condition and level of requirements for the energy performance of buildings, production of new waterproofing layer	25
	Windows, doors	Replacement of external windows and doors	30
	Ceiling above an unheated space/ neighbouring an unheated space	Change in thermal protection with surface treatment	30
	Space heating	Installation or replacement of thermostatic valves	10
		Measurement of heat consumption	10
		Reduction in the temperature gradient of the heating system	
		Improvement in the thermal insulation of distribution systems	20
		Hydraulic regulation	10
		Heat recovery (recuperation) systems	20
		Replacement of pumps with pumps with frequency converters	15
		Replacement of radiators	30
		New or upgraded district heating	30
		Replacement of boilers with condensing boilers (if there is a separate boiler room)	20
		Replacement of boilers with condensing boilers using solar collectors for space heating and hot water preparation (if there is a separate boiler room)	20
	Hot water preparation	Replacement of taps with lever mixers	15
		Replacement of taps with thermostatic and automatic ones	15
		Thermal insulation of risers and horizontal pipes with max. heat loss of 10 W/m	20
		Hydronic balancing of the distribution system	10
		Replacement of pumps with pumps with frequency converters	15
		Reduction in the volume of storage tanks and increase in their thermal insulation/replacement of tanks	15
		Installation of solar collectors	15
		Photovoltaic solar panels	10
Single-family building	External skin	Change in thermal protection with insulation where the thickness of thermal insulation in the ETICS depends on the original condition and level of requirements for the energy performance of buildings	30
	Roof envelope	Change in thermal protection where the thickness of thermal insulation depends on the original condition and level of requirements for the energy performance of buildings, production of new waterproofing layer	25
	Windows, doors	Replacement of external windows and doors	30
	Ceiling above an unheated space/ neighbouring an unheated space	Change in thermal protection with surface treatment	30
	Space heating	Same measures as for a multi-apartment building apart from district heating	10-20
	Hot water preparation	Same measures as for a multi-apartment building	15
Office building	External skin,	Same measures as for a multi-apartment building	25

	roof envelope, internal partitions, external windows and doors		
	Space heating	Same measures as for a multi-apartment building, apart from district heating	10-20
		Installation of zone regulation	15
		Introduction of night and weekend temperature attenuation in heated rooms	5-10
	Hot water preparation	Same measures as for a multi-apartment building	15
		Alternatively, removal of central water heating and installation of local heating	20
	Lighting	Replacement of light sources with light fittings with electronic ballast and higher optical efficiency	5
		Change in the arrangement of lights	15
		Installation of motion sensors	10
		Installation of luminance sensors	10
		Optimisation of intervals for the replacement and cleaning of light fittings	3-5

Annex 6

Information on the stock of residential and non-residential buildings

1. Data on existing multi-apartment buildings

Data from the multi-apartment building database are reported as there are still no other complete data in Slovakia that are of such an informative scope that they could replace data from this database. By the end of 2004, there were 867 704 apartments in multi-apartment buildings in Slovakia. The multi-apartment building database contains 92.3 % of all apartments in multi-apartment buildings.

The multi-apartment building database includes data on the energy consumed on space heating for each of the years from 1994 to 2003 for the entire housing stock. The average annual energy consumption from 1994 to 2003 is reported in kWh/m² of total floor area.

In housing construction, 24 construction technologies were used, but when the differences between regional variants of solutions and the varying types, including MS 5 and MS 11, are considered, the figure is 39; when terrace houses, point houses and tower blocks are taken into account, 60 technologies were used (excluding T 20 and 22, VNB, B70/R and brick houses). As one multi-apartment building built as a whole in the P 1.24 complex in Bratislava and one section in Spišská Nová Ves, to which the same construction principles were applied as those to P 1.14-7.5RP multi-apartment buildings, had already been renovated (insulated), they were not taken into account when the number of technologies applied in housing construction was being considered. Inspections also found different solutions for multi-apartment buildings, e.g. T 06 B Žilina with protruding staircases and prefabricated enclosed balconies ending in an attic, the T 06B Nitra on plinths, etc.

Table 1 Distribution of housing construction by external skin technology

Group of multi-apartment	Time of construction	Types, design systems, structural systems

buildings		
1	up to 1955, 1956-1970	T 11-16, T 01 -03 PV-2
2	1956-1970	BA, G 57, LB (MB), MS 5, MS 11, T 06 B (KE, NA, BA, BB, ŽA), T 08 B, K 61, NMB (VMB), PD-62
3	1971-1983	ZT, ZTB, BA-BC, B-70, BA-NKS
4	1984-1992	P 1.14-6.5RP, P 1.14-7.5RP, PS-82 (TT, PP, ŽA, BB) U-65, P 1.15, BA NKS-S, P 1.24

Table 2 Basic geometric data on multi-apartment buildings

	Form factor	**Built-up volume**	**Total floor area**	**Building envelope area**	**Window area**	**Window area**	**External skin area**	**External skin area**	**Roof area**	**Roof area**
	1/m	m^3	m^2	m^2	m^2	%	m^2	%	m^2	%
Average	0.7968	762	251	579	47	8.1	217	38.7	162	27.2
Median	0.7536	696	228	508	41	7.7	216	37.4	141	27.5
Minimum	0.6149	260	87	279	15	4.1	94	17.8	69	18.2
Maximum	1.1115	1907	530	1500	125	12.8	449	57.7	574	38.3

A statistical analysis of the parameters from which the energy consumption is derived indicates that the year of final approval is the third most influential factor in terms of energy consumption. Bearing in mind how requirements regarding the thermal performance of envelopes have evolved, it is advisable to divide existing multi-apartment buildings into those built up to 1983 (inclusive) and those built after 1983, when a more stringent thermal technology standard entered into force and prompted a change in external skin technology.

Table 3 Average heat consumed on space heating by structural system group

Type, construction system, structural system group	**Heat consumed on space heating in the years in kWh/(m².a)**										**Average annual heat consumption in the years 1994 to 2003**
	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	
brick and pre-assembled masonry panels	132.6	139.9	151.5	143.2	130.7	126.1	116.7	128.1	125.2	123.3	**131.7**
single-layer panel	112.9	117.6	129.4	120.5	108.4	105.1	96.0	106.5	103.2	103.0	**110.3**
layered panel	123.1	128.8	137.1	128.9	117.0	114.9	104.9	114.4	110.7	110.0	**119.0**
panel	103.2	110.3	117.6	109.3	98.3	94.6	86.6	95.7	90.2	90.9	**99.7**
atypical buildings						120.0	118.4	92.8	83.5	94.7	**101.9**
other, unspecified	110.2	118.5	111.3	101.2	99.5	97.8	88.9	103.5	133.5	93.7	**105.8**
National average	**116.6**	**122.9**	**134.3**	**125.8**	**113.1**	**109.8**	**100.3**	**111.6**	**107.3**	**106.3**	**114.8**

Areas determined by the outside temperature are also characteristic of areas with different conditions during the winter period, affecting the energy consumed on space heating.

The number of buildings, apartments, sections, and the total floor area are shown for each outside air design temperature in the table below.

Table 4 Number of buildings, apartments, sections and specific area by outside air design temperature

Outside air design temperature (°C)	**Number of buildings**	**Number of apartments**	**Number of sections**	**Total floor area (m^2)**
-11	7 484	308 252	17 995	25 170 252
-12	1 059	36 210	2 842	2 925 353
-13	4 307	163 195	10 438	13 192 946
-14	516	21 805	1 833	1 823 699
-15	5 290	186 437	13 262	15 427 402
-16	2 409	71 320	4 937	5 804 761
-17	491	10 122	907	809 150
-18	144	3 019	252	244 078
-19	23	274	30	24 025
Slovakia – total	**21 723**	**800 634**	**52 496**	**65 421 666**

2. Data on existing single-family buildings

Single-family buildings may have a maximum of three apartments according to Act No 50/1976 on spatial planning and building rules (the Building Act), as amended. Residential buildings with a larger number of apartments are considered to be multi-apartment buildings. These data are published by the Statistical Office of the Slovak Republic according to the results of the 2001 Population and Housing Census.

Table 5 Permanently occupied single-family buildings with apartments, by time of construction and number of apartments

Permanently occupied single-family buildings and their technical facilities	**Buildings with number of all apartments**			
	1	**2**	**3**	**Total**
Up to 1899	18 849	747	211	19 807
1900-1919	26 707	831	208	27 746
1920-1945	85 367	2 726	384	88 478
1946-1960	161 136	4 590	292	166 018
1961-1970	159 149	7 042	278	166 469
1971-1980	127 451	8 699	354	136 504
1981-1985	54 101	2 253	113	56 467
1986-1990	47 837	1 353	43	49 233
1991-1995	33 118	1 045	42	34 205
1998-1999	22 643	953	78	23 674
2000 or later	7 315	311	17	7 643
Unidentified	15 441	802	68	16 311
Total permanently occupied buildings	**759 114**	**31 352**	**2 088**	**792 555**

The heat losses of single-family buildings affect the geometric properties of those buildings. The data are presented in the following table.

Table 6 Average geometric data on single-family buildings

Subcategory	**Form factor**	**Built-up volume**	**Total floor area**	**Envelope area**	**Window area**	**External skin area**	**Roof area**
	1/m	m^3	m^2	m^2	m^2	m^2	m^2
All single-family buildings	0.7536	696	228	508	41	216	141
Single-storey single-family buildings	0.9879	459	138	448	30	139	138
Single-family buildings with two or more storeys	0.7293	730	256	539	48	226	145

3. Data on existing non-residential buildings

At present there are only data from a database detailing non-residential buildings owned by central and local government authorities.

Table 7 State-owned non-residential non-manufacturing buildings broken down by purpose of use

Purpose of use	**Number of buildings**	**Share of total number (%)**	**Built-up volume of buildings m³**	**Share of total built-up volume (%)**
Schools	6 943	45.0	58 382 303	50.9
Commerce and services	156	1.0	680 090	0.6
Healthcare facilities	1 293	8.4	15 197 903	13.2
Cultural facilities	525	3.4	3 071 713	2.7
Office buildings	2 556	16.6	14 365 517	12.5
Accommodation	1 317	8.5	11 814 638	10.3
Sports	126	0.8	810 218	0.7
Railway stations and airports	7	0.0	92 991	0.1
Post offices	440	2.9	966 192	0.8
Other	2 072	13.4	9 322 087	8.1
Total	**15 435**	**100.0**	**114 703 652**	**100.00**
Of which primary schools	**2 513**	**16.3**	**26 549 348**	**23.1**

Table 8 Average heat consumed on space heating by purpose of use

Purpose of use	**Energy consumed on space heating in the years in kWh/(m^3.a)**										**Average consumption in the years 1994 to 2003**
	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	
Schools	51.2	51.8	53.7	52.7	51.4	50.9	46.8	51.1	49.5	50.7	51.0

Commerce and services	54.5	54.3	62.6	60.4	57.3	50.2	51.5	53.0	48.4	62.9	55.5
Healthcare facilities	59.7	59.5	79.0	75.9	71.2	71.9	68.1	70.6	65.1	61.7	68.3
Cultural facilities	47.3	45.8	46.3	46.6	45.4	43.7	37.7	41.1	33.3	39.6	42.7
Office buildings	56.7	59.3	61.6	60.1	58.2	57.8	53.0	56.7	54.7	57.8	57.6
Accommodation	57.4	59.7	62.2	60.6	59.4	60.0	57.9	62.0	57.4	58.7	59.5
Sports	48.8	46.8	49.1	47.8	44.0	46.3	42.5	42.9	37.5	37.0	44.3
Railway stations and airports									46.2		46.2
Post offices								62.9	63.2	65.4	63.9
Other	53.7	53.8	61.4	58.8	57.5	58.0	55.4	58.3	57.5	56.3	57.1
Average for all buildings	52.8	54.0	58.3	56.9	55.2	54.9	51.1	55.4	54.7	58.3	55.2
Primary schools	49.4	49.5	50.9	50.3	48.4	47.7	42.6	46.9	47.3	58.3	49.1

Non-residential non-manufacturing buildings are characterised by their division into individual construction periods, taking into account the differences in requirements, in particular those regarding the thermal performance of structures, as well as developments in the material composition and structural design, as follows:

- up to 1950, brick structures and primarily sloping roofs (wooden trusses);
- 1951 to 1970, development of prefabrication systems, application of concrete with lightweight fillers and lightweight concrete (porous concrete), almost exclusive use of flat roofs, installation of double-glazing;
- 1971 to 1983, application of layered cladding, installation of aluminium double-glazed windows, unless wooden, flat roof structures;
- post-1983, improvements in the thermal performance of structures in connection with requirements of the revised thermal performance standard by proving the design values; the calculation methods did not take into account the influence of the design used for the details, resulting in higher thermal losses, especially at contact areas on the external skin.

Table 9 Average heat consumed annually on space heating by time of construction

Year of final approval	**Heat consumed on space heating in the years in kWh/(m^3.a)**										**Average consumption for 1994-2003**
	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	
Not specified	66.0	65.1	69.6	69.0	70.4	74.5	65.0	73.6	59.6	73.3	68.6
Up to 1950	49.2	50.8	56.1	55.2	53.3	53.7	50.0	53.6	52.5	55.6	53.0
1951-1970	54.0	54.8	59.3	57.5	55.0	54.2	51.0	55.9	56.1	60.0	55.8
1971-1983	54.7	55.5	59.1	57.5	56.0	54.9	50.8	55.4	55.1	58.6	55.8
1984-1992	49.7	52.1	55.8	53.9	52.2	52.9	49.5	52.5	52.7	56.3	52.8
Post-1992	47.9	50.6	57.7	56.6	55.3	54.6	51.5	55.0	55.0	56.0	54.0
Average for all buildings	52.8	54.0	58.3	56.9	55.2	54.9	51.1	55.4	54.7	58.3	55.2

The heat consumed on space heating in individual years is influenced by the frequency of low outside air temperatures during the heating season, as well as by the total number of degree days.

Table 10 Average heat consumed annually on space heating by outside air design temperature

Outside air design temperature °C	Heat consumed on space heating in the years in kWh/(m^3.a)										Average consumption in 1994-2003
	1994	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	
From -11 to -13	52.1	53.8	57.8	56.4	54.9	55.0	51.3	55.3	53.8	56.7	**54.7**
From -14 to -16	52.7	53.4	57.8	56.3	54.5	53.5	49.4	54.0	54.1	58.6	**54.4**
-17 or less	63.3	63.1	69.5	67.9	65.6	67.7	63.3	69.4	72.4	75.7	**67.8**
Average	**52.8**	**54.0**	**58.3**	**56.9**	**55.2**	**54.9**	**51.1**	**55.4**	**54.7**	**58.3**	**55.2**

Annex 7

Cost-optimal levels of minimum energy performance requirements for buildings

Eleven reference buildings were proposed by means of selection according to defined features (building category, construction period, size, availability of underlying design documentation), using the database of residential and non-residential buildings, and based on statistical analysis methods. In addition to the set obligation to propose two reference buildings from the existing stock and one reference new building, representing the categories of multi-apartment buildings, single-family buildings and office buildings, one reference building was proposed that represented school buildings.

The packages of measures included measures complying with the applicable requirements set for the level of low-energy construction, the level of ultra-low-energy construction and nearly zero-energy buildings according to STN 73 0540-2 Thermal protection of buildings. Thermal performance of structures and buildings. Part 2: Functional requirements (73 0540). All packages, including the package with the optimal structural properties under consideration, were used to determine primary energy and life cycle costs, including the net present value. The effect of recuperation was also examined. Recuperation was excluded from the package because of its cost and technical complexity.

For each reference building, 5 to 12 packages/variants of measures are used. A separate package comprises a reference case characterised by the initial situation for existing buildings and a package characterised by requirements applicable to new buildings. Variant solutions were proposed for each level of thermal protection for structures (e.g. 12 variants for the thermal protection of the external skin, taking into consideration different thicknesses of thermal insulation, ranging from 40 mm to 240 mm with additional thermal protection by means of a thermal insulating composite system). The value of the heat transfer coefficient took into account the original quality of the external skin, roof envelope and internal partitions between heated and non-heated spaces. Products characterised by the heat transfer coefficient of the frame and the glazing (U_f, U_g, U_w in W/(m^2.K)), the solar energy throughput g (-) and the linear loss coefficient of the glazing spacer bar were selected for individual variants of the change in the thermal performance of the apertures. Heat generation variants (seven variants, e.g. district heating running on natural gas, wood chips, combined heat and power generation, a condensing boiler running on gas, a wood pellet boiler, an air - water heat pump, a ground - air heat pump) and variants for hot water production and cold production were considered. The variants were used in five of the packages under assessment, of which Package 3 was analysed using properties of structures with defined cost-optimal values. For the lighting, the cost optimality of the measures was analysed separately and compared with the energy requirement. The variant chosen was applied in all packages of proposed measures when determining the net value.

The results of the calculations indicate that the global costs are different from the macroeconomic and financial perspectives, but the optimal position is not changed by this fact. The national benchmark considered for Slovakia to compare the calculated cost-optimal levels with the current minimum energy performance requirements is a level from the financial perspective (a microeconomic level), and therefore includes VAT and disregards the costs of CO_2 emissions.

Table 1 Resultant cost-optimal values for the minimum requirements regarding the thermal performance of structures – the maximum heat transfer coefficient values for a structure (U)

Structure	Selection of cost optimum U [W/(m^2.K)]	Requirements after 2013 (standardised value) [W/(m^2.K)]	Requirements after 2015 (recommended value) [W/(m^2.K)]	Cost optimum – rounded [W/(m^2.K)]
External skin (O1)	0.209	0.32	0.22	0.21
Difference compared to requirement		-53 %	-5 %	
Roof (O2)	0.177	0.20	0.10	0.18
Difference compared to requirement		-13 %	44 %	
Interior partitions for top-down heat flow for a difference in temperature of up to 20 K (O3)	0.310	0.75	0.50	0.31
Difference compared to requirement		-142 %	-61 %	
Windows (O4)	0.836	1.40	1.00	0.90
g – solar radiation transmittance	0.620			0.62
Difference compared to requirement		-67 %	-20 %	

Table 2 Resultant cost-optimal values for the minimum energy performance requirements – primary energy

Building category	Selection of cost optimum [kWh/(m^2.a)]	Requirements for a reference building after 2013 [kWh/(m^2.a)]	Requirements after 2015 [kWh/(m^2.a)]
Residential buildings	86	126	63
Difference compared to requirement		-47 %	27 %
Single-family buildings	131	216	108
Difference compared to requirement		-65 %	17 %
Office buildings (excluding cooling)	94	154	77
Difference compared to requirement		-64 %	18 %
Office buildings (with cooling)	137	240	120
Difference compared to requirement		-75 %	12 %
Educational buildings – schools	85	136	68
Difference compared to requirement		-61 %	20 %
Sports buildings	104	152	76
Difference compared to requirement		-46 %	27 %

Annex 8

Summary of primary-energy-saving measures, their benefit and energy-saving potential in the period from 2015, with an outlook up to 2030

Name of measure/Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Renovation of multi-apartment buildings																
LELC:	15000	15000	15000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	19000	17000
- estimated saving [GWh]	54	54	54	72	72	72	72	72	72	72	72	72	72	72	68.4	61.2
- annual counting of savings [GWh]		108	162	234	306	378	450	522	594	666	738	810	882	954	1022.4	1083.6
ULELC:	1000	1000	2000	2000	3000	5000	5000	5000	5000	5000	5000	7000	7000	7000	8000	10000
- estimated saving [GWh]	5.4	5.4	10.8	10.8	16.2	27	27	27	27	27	27	37.8	37.8	37.8	43.2	54
- annual counting of savings [GWh]		10.8	21.6	32.4	48.6	75.6	102.6	129.6	156.6	183.6	210.6	248.4	286.2	324	367.2	421.2
NZEB:							500	1000	1000	1000	2000	2000	2500	2500	3000	3000
- estimated saving [GWh]							0.6	0.7	0.9	1.1	1.2	1.4	1.6	1.9	2.1	2.4
- annual counting of savings [GWh]								1.3	2.2	3.3	4.5	5.9	7.6	9.5	11.6	14.0
External heat distribution systems	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %	5 %
Renovation of single-family buildings																
LELC:	5000	5000	8000	8000	10000	10000	15000	15000	15000	15000	15000	15000	15000	15000	15000	15000
- estimated saving [GWh]	102	102	163.2	163.2	204	204	306	306	306	306	306	306	306	306	306	306
- annual counting of savings [GWh]		204	367.2	530.4	734.4	938.4	1244.4	1550.4	1856.4	2162.4	2468.4	2774.4	3080.4	3386.4	3692.4	3998.4
ULELC:		500	500	500	500	500	1000	1000	2000	2000	5000	5000	5000	5000	5000	5000
- estimated saving [GWh]		15	15	15	15	15	30	30	60	60	150	150	150	150	150	150
- annual counting of savings [GWh]			30	45	60	75	105	135	195	255	405	555	705	855	1005	1155
NZEB								100	100	100	100	200	200	200	200	200

- estimated saving [GWh]								5.2	7.5	9.8	15.6	21.3	27.1	32.8	38.6	44.4
- annual counting of savings [GWh]									12.7	22.5	38.0	59.3	86.4	119.2	157.8	202.2
Name of measure/Year	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Renovation of the office buildings of central bodies of state administration																
LELC	9	9	9	9	9	9	4	4	4	4	4	4	4	4	4	4
- estimated saving [GWh]	0.7	0.7	0.7	0.7	0.7	0.7	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
- annual counting of savings [GWh]		1.3	2.0	2.7	3.4	4.0	4.3	4.6	4.9	5.2	5.5	5.8	6.1	6.4	6.7	**7.0**
ULELC							5	5	5	5	4	4	4	4	4	4
- estimated saving [GWh]							0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8
- annual counting of savings [GWh]								1.0	1.5	2.1	2.7	3.4	4.1	4.8	5.5	**6.3**
NZEB											1	1	1	1	1	1
- estimated saving [GWh]											0.1	0.1	0.1	0.1	0.1	0.1
- annual counting of savings [GWh]												0.2	0.4	0.5	0.6	**0.7**
Temperature attenuation for LELC	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %
Renovation of schools and school facilities																
LELC	20	20	20	20	20	20	10	10	10	10	10	10	10	10	10	10
- estimated saving [GWh]	2.2	2.2	2.2	2.2	2.2	2.2	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
- annual counting of savings [GWh]		4.4	6.6	8.8	11.1	13.3	14.4	15.5	16.6	17.7	18.8	19.9	21.0	22.1	23.2	**24.3**
ULELC							10	10	7	7	7	5	5	5	5	5
- estimated saving [GWh]							1.7	1.7	1.2	1.2	1.2	0.8	0.8	0.8	0.8	0.8
- annual counting of savings [GWh]								3.3	4.5	5.6	6.8	7.6	8.5	9.3	10.1	**10.9**
NZEB									3	3	3	5	5	5	5	5
- estimated saving [GWh]									0.5	0.5	0.5	0.9	0.9	0.9	0.9	0.9
- annual counting of savings [GWh]												1.4	2.3	3.2	4.1	**5.0**
Temperature attenuation for LELC	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %	30 %

Explanatory notes: LELC – low-energy level of construction
ULELC – ultra-low-energy level of construction

NZEB – construction at the level of nearly zero-energy buildings