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NATIONAL NEARLY ZERO-ENERGY BUILDING PLAN 2015–2020

Sofia, 2015

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Acronyms	
EU/the Union	European Union
the Commission	European Commission
NPSBNPE	National plan for nearly zero-energy buildings
NPDEE	National energy efficiency action plan 2014–2020
MRRB	Ministry of Regional Development and Public Works
ME	Ministry of Energy
ZEE	Energy Efficiency Act
ZEVI	Energy from Renewable Sources Act
ZUT	Spatial Planning Act
ZTIP	Technical Requirements to Products Act
EBRD	European Bank for Reconstruction and Development
FEEVI	Energy Efficiency and Renewable Energy Fund
KIDSF	Kozloduy International Decommissioning Support Fund
NTEF	National Trust Eco-Fund
MF	Ministry of Finance
NZEB	Nearly zero-energy buildings
NZE	Nearly-zero energy demand

1. INTRODUCTION

Bulgaria is actively involved in the formulation and implementation of European policies aimed at achieving compliance with the European energy efficiency standards and requirements, and with the environmental and sustainable development standards aimed at moderating climate change.

The National Nearly Zero-Energy Building Plan 2015–2020 (NPSBNPE) is developed on the basis of Article 9(1) of Directive 2010/31/EU on the energy performance of buildings. The NPSBNPE is based on the concept paper which the Bulgarian authorities submitted to the European Commission in 2013.

The **objective** of the NPSBNPE 2015–2020 is to apply the NZEB concept in practice as an alternative for constructing new buildings in Bulgaria after 2018 and, subject to demonstration of cost efficiency, for renovating various subcategories of existing buildings.

The plan addresses the increasing need for using energy resources efficiently, improving living standards through energy efficiency and reducing the adverse environmental impacts of the use of fossil fuels.

The objectives of the NPSBNPE must be seen within the framework of the overall implementation of national measures aimed at promoting energy efficiency exceeding the minimum requirements set out in the legislation and providing a tangible contribution to Bulgaria's national energy saving target for 2020.

The NPSBNPE adheres to the structure recommended by the European Commission (Guidance document for national plans for increasing the number of nearly zero-energy buildings, Ecofys 2013 by order of the European Commission).

The plan builds on national efforts for continual improvement of energy efficiency policies and for fostering cost-efficient technological innovations in the construction or renovation of buildings. The NPSBNPE also takes into account the factors involved in primary and final energy consumption in buildings.

The plan calls on all stakeholders involved in the implementation of national energy efficiency policies to identify areas for smart application of new construction and energy technologies so that the building sector can play a leading role in achieving the national energy efficiency target.

The NPSBNPE 2015–2020 provides for the implementation of the new European policy on energy efficiency of buildings. The European NZEB concept aims mainly to reverse the ratio between the types of energies used in buildings. This objective, combined with high energy performance building envelopes and an adequate winter-summer balance, should significantly lower the annual energy demand without comprising quality of life.

Member States are required to establish national plans for the construction of NZE buildings since they help to optimise energy use in the long term and will certainly contribute to EU objectives beyond 2020.

Another important effect of NZE buildings is that their occupants tend to develop conscientious energy-use models favouring preservation of energy resources and minimising adverse environmental impacts.

The NPSBNPE was developed using analysis based on practical experience of and contemporary research into the energy performance and estimated annual energy consumption in buildings.

Since many stakeholders and decision-makers at different levels will be involved in implementing the NPSBNPE, the success of the plan will depend on successful planning, political consensus and monitoring of implementation. Failure to achieve a common understanding of the obligations and benefits involved in the plan would lead to obstacles at the institutional level, loss of benefits otherwise available to energy users, and failure to comply with the requirements of Directive 2010/31/EU.

2. BACKGROUND

2.1. The European context of the NZEB plan

The European Union has set ambitious energy and climate targets by 2020 and the decades until 2050, reflecting important expectations regarding its social and economic development. EU energy policy is regarded as a strategic framework for achieving these targets.

The Europe 2020 Strategy sets out a vision for a social market economy in Europe during the twenty-first century. According to the document, Europe can emerge from the economic crisis and be transformed into an ‘intelligent, sustainable and involving’ economy with high levels of employment, productivity and social cohesion only if the EU addresses its main long-term challenges (globalisation, scarcity of resources and an ageing population) collectively.

The interlinked priorities of the Europe 2020 Strategy have made it a fundamental document for development prior to 2020, which at the same time calls on the Member States to look beyond that year. The strategy sets out binding commitments for the Member States at national level. Compliance with the commitments is monitored by the European Commission, which will issue periodical recommendations based on the adequacy of the policies applied.

One of the seven flagship initiatives to encourage progress on the headline themes of Europe 2020 is a ‘resource-efficient Europe’, which aims to ‘decouple economic growth from the use of resources, support the shift towards a low carbon economy, increase the use of renewable energy sources, modernise [the] transport sector and promote energy efficiency’. The initiative defines energy efficiency as a crucial factor for ensuring sustainable use of energy resources.

Subsequently the EU took another decisive step and enhanced its targets by even more ambitious decisions. The European Parliament Resolution on a 2030 framework for climate and energy policies (2013/2135(INI)) called for a binding EU energy efficiency target of 40% by 2030, with individual national targets for the Member States. The European institutions must adopt coordinated actions to achieve targets at EU level and support their achievement at national level, and strongly recommend that this approach is also followed by the Member States to ensure compliance with the commitments.

To achieve the overall EU 2020 target, the Commission updated the energy efficiency framework of the Union with the new Directive 2012/27/EU on energy efficiency, reflecting the Commission’s decision to propose strengthened or new measures to accelerate the effect of energy efficiency after 31 December 2012. The Directive’s provisions on the projected energy consumption of the EU by 2020 were adapted in 2013 in relation to the accession of Croatia. In line with the target of a 20% reduction of primary energy consumption by 2020, EU-28 reduction by 2020 is set at 1483 Mtoe instead of 1853 Mtoe, in other words 370 Mtoe less than the 2007 estimate.

The building stock has been identified as an area with major energy saving potential that could help to achieve the above target. In recitals (15), (16) and (17) of Directive 2012/27/EU, the Commission pays special attention to buildings and in particular those **owned by public bodies**, which 'account for a considerable share of the building stock and have high visibility in public life' and should therefore lead by example with regard to energy efficiency. This focus reflects the fact that buildings continue to account for nearly 40% of the overall final consumption in the EU, as well as the long-term impact of the building stock on the consumption of energy.

Renovation of existing buildings, including government buildings, should be without prejudice to the Member States' NZEB obligations as laid down in Directive 2010/31/EU on the energy performance of buildings. Directive 2010/31/EU requires an increase not only in the number of buildings that fulfil the current minimum energy performance requirements, but also of those that exceed them (recital 17). This requirement to increase the number of buildings that exceed rather than merely fulfil the minimum energy efficient standards is also linked to the implementation of Directive 2009/28/EC on the promotion of the use of energy from renewable sources, Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products and its implementing regulations, Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products, Regulation (EU) No 305/2011 and the applicable European standards, technical criteria, methods and principles of good European practices.

2.2. Overview of Bulgaria's national energy efficiency targets 2020. Role of the building sector in achieving the national energy saving targets

The Council of Ministers formulates state policy in the area of energy efficiency as part of Bulgaria's sustainable development policy. The state's energy efficiency policy in the building sector is implemented by the MRRB, the ME and the Sustainable Energy Development Agency (AUER).

National energy efficiency legislation includes: the Energy Efficiency Act (ZEE), the Spatial Planning Act (ZUT), the Energy from Renewable Sources Act (ZEVI), the Technical Requirements for Products Act (ZTIP) and the National Standardisation Act (ZNS). The implementing regulations of these key energy efficiency laws complete the body of energy efficiency legislation currently in force in Bulgaria.

The Council of Ministers adopts the following plans and programs:

- ✓ the National Energy Efficiency Action Plans (NEEAPs);
- ✓ the National Plan for Nearly Zero-Energy Buildings;
- ✓ the National plan for improving the energy performance of heated and/or cooled buildings owned by the state and used by the state administration;
- ✓ the National long-term programme for promoting investment in the implementation of measures designed to improve the energy performance of the national public and private stock of residential and commercial buildings.

The NPSBNPE is developed within the framework of the following fundamental national documents and their objectives:

- the National Development Programme Bulgaria 2020;
- the Energy Strategy of Bulgaria by 2020;
- the National Energy Efficiency Action Plan 2014–2020;
- the National Renewable Energy Action Plan;
- the National Strategy for Regional Development 2012–2022;
- the National Spatial Development Strategy 2013–2025;
- the Partnership agreement of the Republic of Bulgaria outlining the support from the European Structural and Investment Funds 2014–2020, Operational Programmes 2014–2020 and other relevant sectoral documents.

Bulgaria began regulating the energy efficiency sector in 2004 (12 years ago) by adopting the first

ZEE. Two further ZEEs were adopted by the Bulgarian Parliament, in 2008 and 2015, in addition to interim amendments to accommodate the dynamically evolving requirements of the European energy efficiency Directives and standards (stepwise implementation of Directive 2002/91/EC, Directive 2006/32/EC, Directive 2010/31/EU and Directive 2012/27/EU).

Currently the energy efficiency theme is seen by society as a whole as something relevant, necessary and urgent. The implementation of energy efficiency measures aims to achieve technical, social and economic effects along the entire chain of energy production, transmission, distribution and use.

The NPSBNPE is being developed at a time when Bulgaria has already set its energy efficiency targets by 31 December 2020, the target setting NPDEE 2014–2020 having already been approved by the European Commission. The national indicative energy saving target by 2020 is **716 ktoe** (**8 325.65 GWh**) energy savings at the level of final energy consumption (FEC) and **1 590 ktoe** (**18 488.52 GWh**) at the level of primary energy consumption (PEC), of which **169 ktoe** (**1 965.13 GWh** or 11%) must be saved in the energy sector's transformation, transmission and distribution processes.

Definition of the national 2020 target took account of the overall results from implementation of national measures specifically designed to promote energy efficiency in the period 2007–2015, and of the need for additional measures in order to bring national targets into line with the EU 2020 targets. The NPSBNPE takes account of and is geared towards these processes and results. An analysis of the objectives and results for the building sector in the first and second NDPEE 2008–2015 was undertaken for the purpose of the plan, which revealed that:

- A cautious approach prevailed in the planning and assignment of individual energy efficiency targets to municipal and state buildings in 2008–2016.

- There is a mismatch between the targets and the real need for renovation of the existing building stock (by the end of 2015 nearly 50% of the public buildings with gross floor area (GFA) above 1 000 m^2 were not renovated).

- The NZE concept is not sufficiently popular among investors in new buildings from the quality-cost-benefit point of view, with a few exceptions in the form of projects that meet the voluntary German standard for passive houses.

In 2015, Bulgarian energy efficiency standards saw further important developments, first and foremost the introduction of energy consumption limit values in the individual categories of buildings. For example, Class A — which is included in the national NZEB definition — is now clearly identified within the energy performance scale by an exact PEC value. The two main roles of the NPSBNPE in this context are to act as a catalyst for new construction in the light of technical advancements and to support the renovation of the existing building stock.

3. THE NATIONAL DEFINITION OF NEARLY ZERO-ENERGY

BUILDINGS

3.1. Energy efficiency standards in Bulgaria. Conditions for the application of the definition.

3.1.1. Evolution of the national requirements for the energy performance of buildings

The process of regulating the technical requirements for thermal insulation of buildings, technical building systems and building materials properties began in the early 1960s. Until 1999, the energy performance requirements for buildings were based primarily on requirements for their envelope components. The transposition of Directive 2002/91/EC into Bulgarian law in **2004** marked a **new stage** in the evolution of the national rules, namely determination of an integrated energy performance indicator in the form of **'annual energy consumption'**.

During the next 10 years, the rules for developing the scale of energy consumption classes A to G used two classification indicator values: $EP_{max,\ r}$ and $EP_{max,\ s}$, kWh/m^2. The first value represented the gross annual consumption per square meter of energy for heating, cooling, ventilation, domestic hot water (DHW), lighting and appliances, derived from the thermal properties of the envelope components and from the efficiencies of the individual elements and units of the heating, cooling, ventilation and DHW systems in accordance with the standards applicable at the time of the assessment. The second value represented the gross annual consumption per square metre of energy for heating, cooling, ventilation, DHW, lighting and appliances, derived from the thermal properties of the envelope components and from the efficiencies of the individual elements and units of the heating, cooling, ventilation and DHW systems in accordance with the regulatory acts applicable in the year in which the building was put into service.

The limits of the energy consumption classes were determined using these two classification indicators calculated for each building in accordance with the rules for defining the limits on the scale set out in the European standard EN 15217.

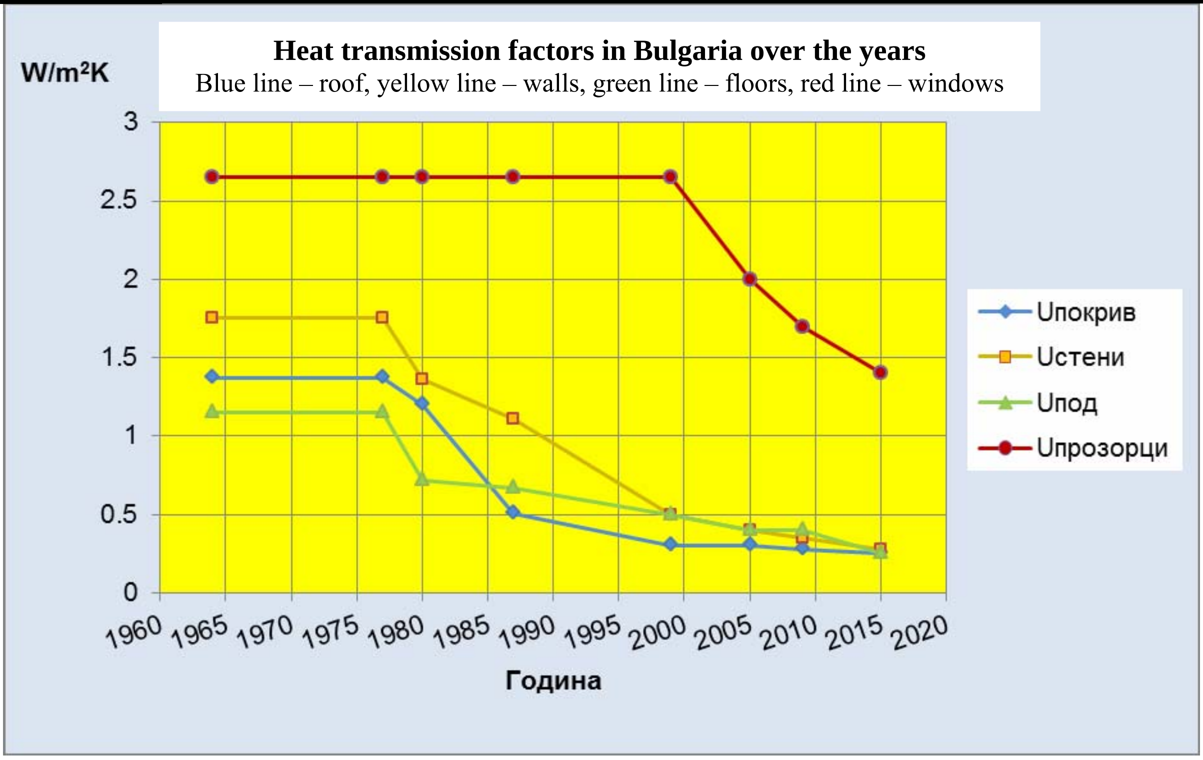
Since **2009** requirements relating to U-values ($W/m^2.K$) have not differentiated between new and existing buildings. In that year the national criteria were substantially updated in the revised 'National methodology for the calculation of energy consumption and energy performance of buildings' in accordance with the European standards implementing the common general framework for calculating the energy performance of buildings referred to in Article 3 of Directive 2010/31/EU.

The next important revision of the Bulgarian criteria took place in **2015** when the Bulgarian regulatory requirements or the buildings were fully harmonised with Directive 2010/31/EU, Commission Delegated Regulation (EU) No 244/2012 and Regulation (EU) No 305/2011 laying down harmonised conditions for the marketing of construction products, as well as with the applicable standards. The technical updates included:

- development of national parameters for the classification indicator ‘specific annual consumption of primary energy’ in kWh/m^2 for the energy performance scale, including numerical limit values calculated and determined for the various categories of buildings indicated in point 5 of Annex 1 of Directive 2010/31/EU;
- development of a national definition and regulatory requirements for the limit values of the classification indicator for the energy performance of NZE buildings, including the relevant share of renewable energy;
- enhanced requirements for the reference values of the heat transmission factor of the building envelope components;
- definition of regulatory requirements for the efficiency of boilers at nominal (rated) and reduced load (BDS EN 15316:3-3 for condensing boilers and BDS EN 15316:4-7 for biomass-fired boilers);
- definition of a regulatory requirement for the minimum efficiency of heat recuperation systems;
- updating national methodology for the calculation of annual energy consumption with a national annex which includes a method for determining the parameters of solar DHW systems;
- determination of a minimum limit value of the average seasonal efficiency of heat pumps with electric compressors in ‘heating’ mode for the energy from these heat pumps to be deemed renewable energy, with a similar limit value for situations where the heat pumps use thermal energy (directly or energy from the combustion of fuels); these values provide a regulatory basis that promotes the high efficiency of heat and cold supply systems with optimised energy consumption by using heat pumps as heating/cooling sources in accordance with Directive 2010/31/EU;
- definition of rules for the heat zoning of buildings;
- definition of rules for the certification of parts of mixed-use buildings by indicators from two or more energy consumption scales;
- refining of the content of ‘Energy efficiency’ chapters developed at the three stages of the new buildings design process;
- updating of templates of energy performance certificates for new and existing buildings to include new parameters intended to provide users with more information about the energy performance of the building and its technical systems, and about the achieved level of compliance with the applicable technical requirements.

Figure 3.1 illustrates the evolution of the regulatory requirements to the heat transmission factors of the main building envelope components over the years.

Figure 3.1	Regulatory requirements for the heat transmission factor U, W/m².K of the envelope components of buildings in Bulgaria



The reference values of the heat transmission factor of the envelope components together with some of the more essential requirements in force concerning the efficiency of the microclimate systems are presented in **Annex 3**.

A major challenge in enforcing the technical requirements for the energy efficiency of buildings in the coming years will be application of the NZEB definition and readiness on the part of the Bulgarian public to accept it as binding. These requirements will become mandatory In Bulgaria within three years and major efforts must be made at all levels of government before then.

3.1.2. Conditions for the application of the NZEB definition

Framework conditions in accordance with the Bulgarian regulations currently in force have been developed to ensure the application of the NZEB definition and recording of relevant parameters. The framework contains the following components (of the system assessed):

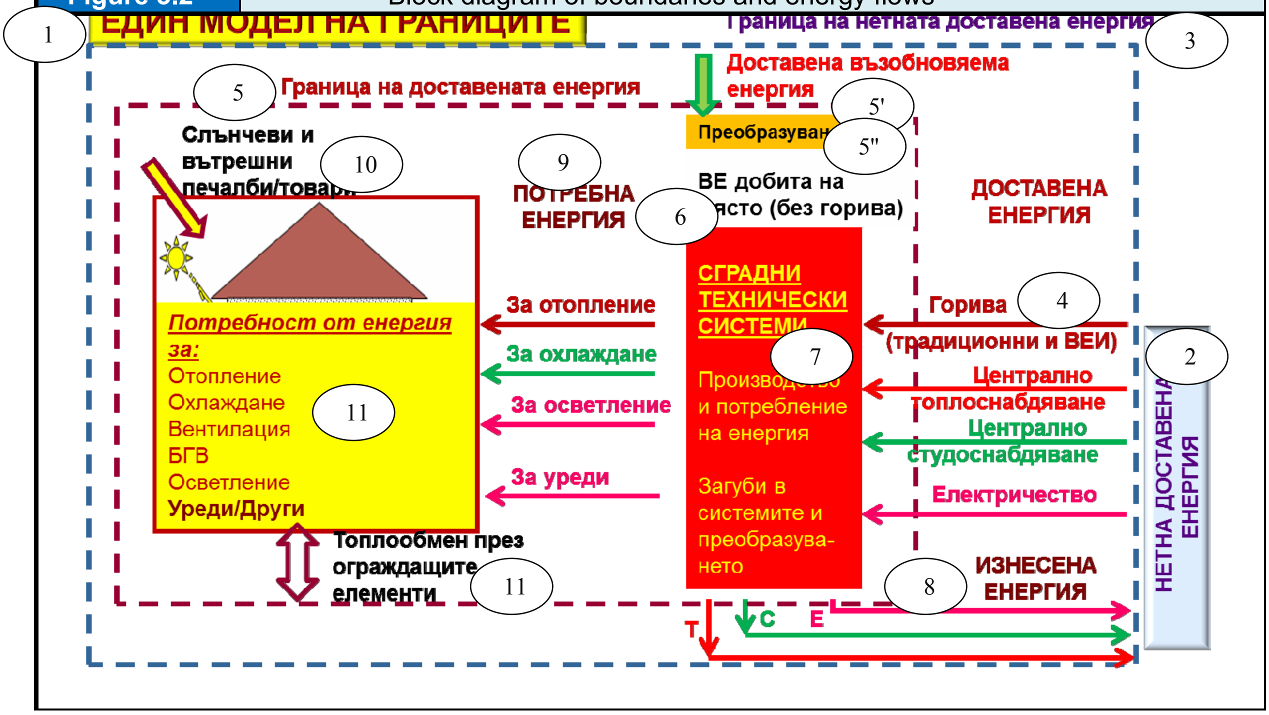
A. Energy balance: Determined by the method used in **BDS EN ISO 13790**.

A.1 Physical boundary: Standalone building.

A.2 Content of the balance: The balance takes into account energy for heating, DHW, ventilation, cooling, lighting, pumps, fans, energy consuming appliances and technical systems. Figure 3.2 depicts the boundaries and energy flows included in the energy balance of the building.

A.3 Microclimate parameters: The balance takes into account only criteria which are based on European standards and are implemented as Bulgarian criteria.

Figure 3.2 Block diagram of boundaries and energy flows



Key: 1) single model of the boundaries; 2) net energy supplied; 3) boundary of net energy supplied; 4) energy supplied: fuels (traditional and RES), district heating, district cooling, electricity; 5) boundary of energy supplied; 5') renewable energy supplied; 5") conversion; 6) renewable energy generated in building (without fuels); 7) technical building systems: energy production and consumption, system/conversion losses; 8) exported energy; 9) energy demand: heating, cooling, lighting and appliances; 10) solar and internal gains/loads; 11) energy demand for heating, cooling, ventilation, DHW, lighting, appliances/other; 12) heat exchange through enclosures.

A package of implementing regulations for the main laws listed above defines the permitted tolerances for the individual microclimate parameters: air temperature, relative humidity, air draft, minimum amount of fresh air, light and noise levels.

A.4 RES generation boundary

The balance takes into account the RES energy generated in the building or within 15 km around the building. This condition will be reviewed in subsequent phases of the application of the national NZEB definition.

A.5 Period and calculation step of the energy balance

The annual energy balance is obtained from calculations made using the monthly balancing method provided in BDS EN ISO 13790 supplemented with an hourly algorithm for calculating the use of energy for ventilation in cooling mode.

B. Conditions for determining the baseline estimated values ('baseline scenario')

B.1 Specific energy consumption: The specific energy consumption is determined for the conditioned area of the building derived from its external dimensions in accordance with BDS EN 15217.

B.2 Primary energy: This parameter is determined for each type of supplied energy using national factors reflecting losses in production, transmission and distribution during the supply process on a constant annual basis.

B.3 CO_2 equivalent emissions: This parameter is determined for each type of supplied energy using national factors. The estimation of the emissions supports the estimation of primary energy consumption by providing additional information about the building.

C. Application area:

C.1 Building categories: Residential and non-residential (public) buildings. Public buildings are divided into functional subgroups in accordance with the official nomenclature of buildings and structures in Bulgaria.

C.2 Status of the buildings: New buildings and buildings that have undergone renovation intended to approve their energy performance.

C.3 Ownership: Private buildings and buildings owned by the state or the municipalities.

The national NZEB definition was developed by the Technical University of Sofia on the basis of a simulation study followed by technical and economic analysis. The analysis included calculation of the optimised costs (**cost-optimal calculation**).

The technical and economic analysis identified potential limitations and corresponding solutions relating to technical, economic, regulatory and management aspects, in accordance with the cost-efficiency requirement set out in Directive 2010/31/EU and the comparative methodological framework for calculating the cost-optimal levels in line with minimum national requirements for the energy performance of buildings and their components.

The Bulgarian NZEB definition complies with the fundamental principles for appropriate formulation of the definition developed at European level, and with the requirements for clearly defined objectives and conditions, technical and financial feasibility, flexibility and adaptation to local climatic conditions, promotion of innovative technologies, etc. ('Principles for Nearly Zero-Energy Buildings published in 2011 by Buildings Performance Institute Europe').

The following inputs were used for the formulation of the Bulgarian NZEB definition:

- the definition and requirements set out in Directive 2010/31/EU;
- existing national regulatory provisions for assessment of the energy performance of buildings;
- the economic and social conditions specific to Bulgaria;
- the influence of local geographic, climatic and seismic conditions and impacts.

Efforts have been made to formulate a definition which enables follow-up and updating of these criteria every five years to accommodate technological advancements, the overall economic performance of Bulgaria and European best practice.

The formulation of the national NZEB definition aims to obtain an economically viable cumulative effect from:

- reducing the energy demand of buildings by improved energy performance of their envelopes, microclimate systems and other energy using systems, units and appliances in the building;
- using renewable energy produced in the building or in its close surroundings.

The national NZEB definition is based on the concept embodied in Directive 2010/31/EU, according to which nearly-zero energy buildings have a very high energy performance and a significant part of the energy requirements of the buildings are covered by energy from renewable sources.

The Bulgarian legal definition of a nearly zero-energy building is provided in the Energy Efficiency Act (§ 1(28) of the Supplementary Provisions of the ZEE):

'A nearly zero-energy building' is a building that **cumulatively** satisfies the following conditions:

a) the building's energy consumption, expressed as **primary energy**, corresponds to energy performance **Class A** for that type of building;

b) at least **55%** of the energy used (supplied) for heating, cooling, ventilation, domestic hot water and lighting is **energy from renewable sources** produced in the building or in its close surroundings.

The definition is based on multiple simulations of energy consumption for reference buildings from the various categories and on scientific research on the energy efficiency of buildings in Bulgaria.

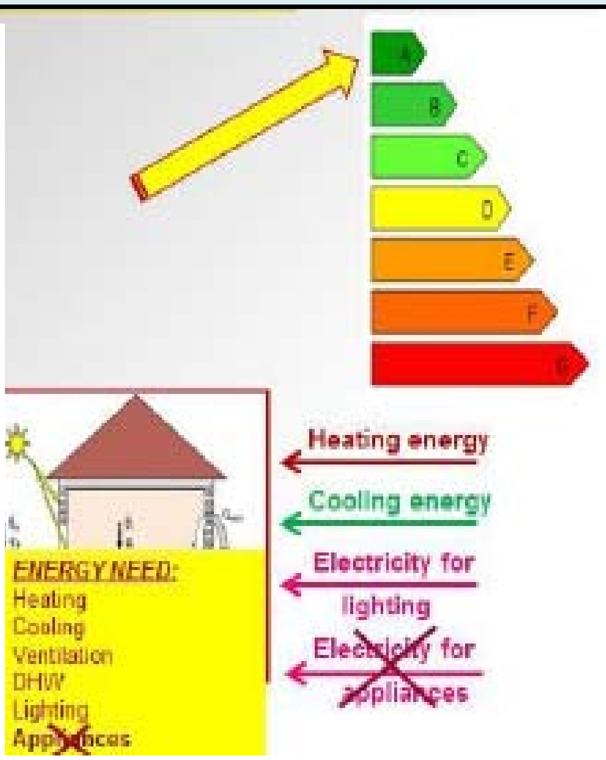
The national NZEB definition is illustrated in Figure 3.3.

Figure 3.1	The Bulgarian NZEB definition

An NZEB building is a building that cumulatively satisfies the following conditions:

A. The building's energy consumption, expressed as primary energy, corresponds to energy performance Class A for that type of building.

B. At least 55% of the energy used (supplied) for heating, cooling, ventilation, domestic hot water and lighting is energy from renewable sources produced in the building or in its close surroundings.



The energy performance indicators for buildings are determined in accordance with the requirements of Regulation No 7 of 2004 on the energy efficiency of buildings, an important part of the ZEE implementing package.

Compliance with the energy efficiency criteria is determined against the **classification indicator 'specific annual consumption of primary energy' expressed in kWh/m^2**, where 'm^2' is the total conditioned area of the building.

For the purpose of determining the specific annual consumption of primary energy, the building is regarded as an integrated system and its energy consumption is a function of the combined effect of the following main components:

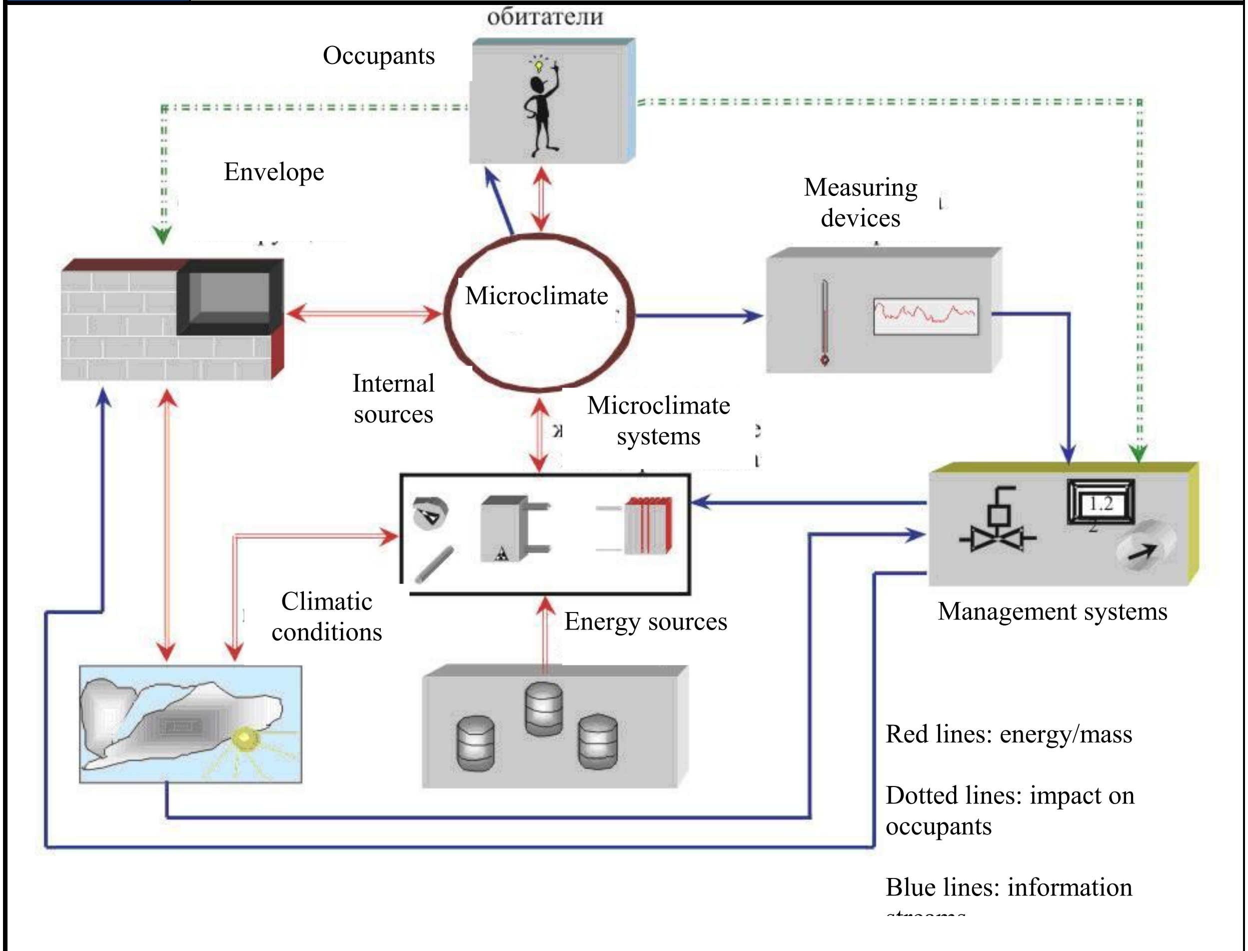
- envelope components of the building
- microclimate systems
- internal heat sources
- occupants
- climatic conditions.

Determination of the specific annual consumption of primary energy takes into account at least the following aspects of **the building as an integrated energy using system**:

- orientation, dimensions and shape of the building;
- characteristics of the envelope, elements and internal spaces of the building;
- thermal and thermal optical characteristics, including those of the internal structural elements, such as thermal capacity, insulation and thermal bridges;
- airtightness;
- heating and DHW systems;
- air conditioning systems;
- ventilation systems and natural ventilation;
- natural light and artificial lighting systems;
- passive solar systems and solar protection;
- systems for the utilisation of renewable energy sources;
- external climatic conditions, including situation and exposure of the building and internal climatic conditions;
- internal energy loads, including energy consuming appliances.

In 2005 the Technical University of Sofia developed a model of the building as an integrated energy using system. The model continues to be used today for the assessment and certification of buildings and for developing the 'Energy efficiency' chapter of the projects for new buildings.

Figure 3.1	Model of the building as an integrate energy using system



A scale with numerical limits for energy performance classes **G** to **A+** was developed for **10 categories of buildings** in accordance with BDS EN 15217 and with the methodology framework provided by Commission Delegated Regulation (EU) No 244/2012 of 2012 supplementing Directive 2010/31/EU 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 (OJ L 81/18 of 21 March 2012).

The numeric values for these categories of buildings are summarised in Figure 3.5:

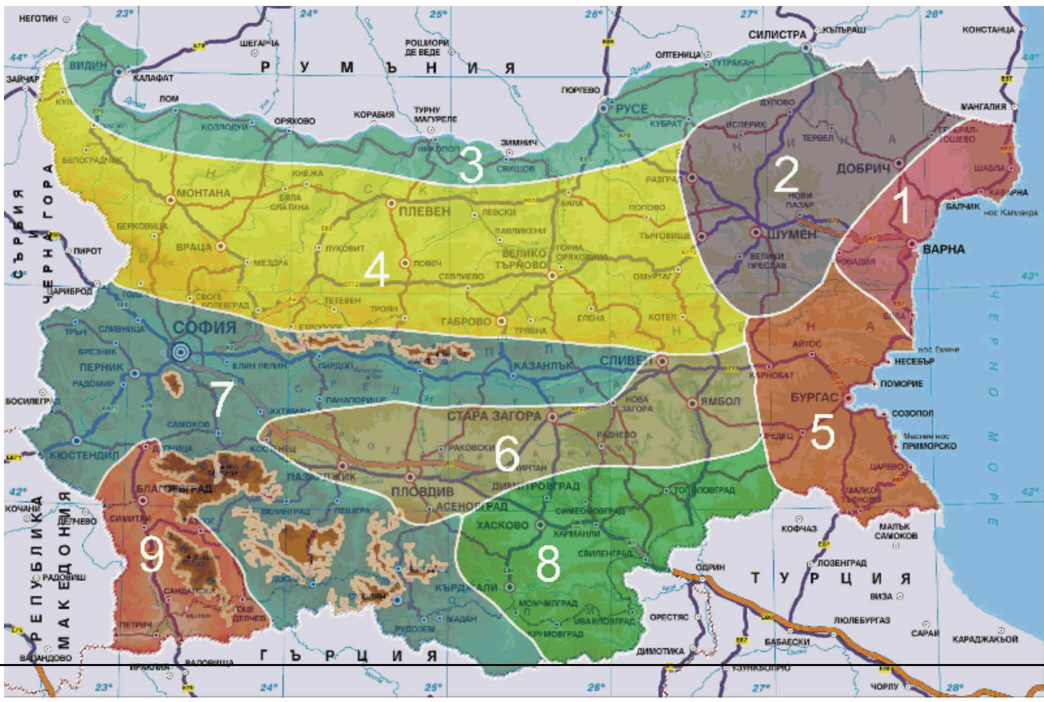
Figure 3.5	Key parameters of energy consumption classes (kWh/m^2) for each category of buildings in Bulgaria

3 Клас	G		F		E		D		C		B		A		A+	
kWh/m² год.	EP_{min}	EP_{max}	EP_{min}	EP_{max}	EP_{min}	EP_{max}	EP_{min}	EP_{max}	EP_{min}	EP_{max}	EP_{min}	EP_{max}	EP_{min}	EP_{max}	EP_{min}	EP_{max}
Жилищни сгради	>	435	364	435	291	363	241	290	191	240	96	190	48	95	<	48
Административни	>	600	501	600	401	500	341	400	281	340	141	280	70	140	<	70
Училища	>	240	201	240	161	200	131	160	101	130	51	100	25	50	<	25
Университети	>	390	326	390	261	325	221	260	181	220	91	180	45	90	<	45
Детски градини	>	390	326	390	261	326	195	260	131	195	66	130	33	65	<	33
Лечебни заведения	>	675	564	675	451	563	366	450	281	365	141	280	70	140	<	70
Хотели	>	660	551	660	441	550	391	440	341	390	171	340	85	170	<	85
Сгради за търговия	>	975	814	975	651	813	601	650	551	600	276	550	138	275	<	138
Сгради за спорт	>	675	564	675	451	563	401	450	351	400	176	350	88	175	<	88
Сгради за културата и изкуството	>	480	401	408	321	400	271	320	221	270	111	220	55	110	<	55

Key: 1) high energy efficiency; 1-1) NZEB standard; 1-2) standard for new buildings and existing buildings dating from after 1 February 2010; 1-3 standard for existing buildings dating from before 1 February 2010; 2) low energy efficiency; 3) (*top to bottom*) residential buildings, administrative buildings, schoolhouses, universities, kindergartens, health facilities, hotels, commercial buildings, sports buildings, cultural and art buildings.

Baseline values have been determined for nine climatic zones of Bulgaria (Figure 3.6).

Figure 3.6	Climatic zones in Bulgaria for the purposes of calculating the energy efficiency of buildings



3.2. Applying the NZEB definition to new buildings

3.2.1. Evolution and snapshot of the Bulgarian construction sector

Definition of a 'new building' according the Energy Efficiency Act (§ 1–14 of the Supplementary Provisions of the ZEE):

A '**New building'** is any newly constructed building put into service **for the first time.**

Requirements for the energy efficiency of new buildings in Bulgaria apply to four phases:

Investment project development

- *Each investment project for the construction of a new building must comply with the energy efficiency requirements laid down in the Energy Efficiency Act and in the Spatial Planning Act.*
- *Investment projects for new buildings must take account of the technical, environmental and economic feasibility of alternative high-efficiency plants and systems for the use of:*

1. decentralised systems for the production and use of energy from renewable sources;
2. electricity and heat cogeneration plants;
3. district or local heating and cooling plants as well as plants that make full or partial use of energy from renewable sources;
4. heat pumps (Article 31 ZEE).

- *An 'Energy Efficiency' chapter, the scope and content of which are specified in Regulation No 7 of 2004 on the energy efficiency of buildings, should be developed as a standalone part of the investment project.*

Verification of compliance of investment projects for new buildings before issuing building permits

In investment projects for new buildings, compliance of the detailed technical plans with the energy efficiency requirements must be checked as part of a separate contract between the investor and natural or legal persons who satisfy the requirements of the Energy Efficiency Act and are listed in the public register of the Sustainable Energy Development Agency (this requirement is laid down in Article 142(11) ZUT).

Construction works

The supervisor of the construction works must suspend any construction projects that fail to comply with Article 169(1) to (3) (including the energy efficiency requirement in Article 169(1)(6).
Building materials used in construction projects must ensure compliance with the essential requirements for construction projects in accordance with Article 169(1) (including the energy efficiency requirement in Article 169(1)(6)) and the technical specifications issued under the Technical Requirements for Products Act (this requirement is laid down in Article 169a ZUT).

New building completion certification

- *The energy performance of a new building must be confirmed by a **certificate of designed energy performance** (Article 32(1) ZEE) before being passed for use.*
- *A 'technical passport' must also be issued for the building on completion of the construction works (under Article 176a ZUT).*
- *On completion of the construction works and, where appropriate, of acceptance testing, the investor must apply to the authority issuing the building permit for a completion certificate, submitting the following documents: the final report of the supervisor of the construction works, the contracts with utility operators for connecting the building to their networks, the technical passport of the building, the **certificate of designed energy performance** and a confirmation from the Geodesy, Cartography and Cadastre Agency that the technical passport of the building is registered in accordance with the ZUT.*

During use of completed new buildings

- *The investor in the new building must obtain a certificate of designed energy performance for the building before it is occupied (under Article 32 ZEE).*
- *Where a new building that has a certificate of designed energy performance or a standalone unit of such building is advertised for sale or rent, the specific annual energy consumption in kWh/m^2 as appearing on the certificate must be indicated in all advertisements (ZEE).*
- *The energy performance of existing buildings must be established by an energy efficiency audit. Certification will be issued on the basis of the audit.*
- *Until a certificate of energy performance has been issued for an existing building, the certificate of designed energy performance is used to determine the energy performance of that building.*
- *The certificate of energy performance of an existing building must be updated after any activities altering the energy performance of the building: reconstruction, major renovation, major repair comprising more than 25% of the surface of the envelope components of the building, and restructuring of existing buildings.*

From 31 December 2018, all new buildings occupied and owned by public authorities must be nearly zero-energy buildings.

By 31 December 2020, all new buildings must be nearly zero-energy buildings.

Directive 2010/31/EU on the energy performance of buildings

Achieving compliance with the requirement of Directive 2010/31/EU for construction of new NZE buildings will be a major challenge to the Bulgarian construction sector. This will certainly involve all participants in the investment process with their relevant competences, responsibilities and powers.

The construction sector has a structural role in the Bulgarian economy, contributing nearly 7% of the national GDP and employing over 5.5% of the workforce. More than 40% of fixed investment is concentrated in the construction sector. The sector also plays a decisive role in national competitiveness and attraction of foreign investment. It is however highly fragmented as over 96% of construction businesses are small and micro-enterprises. The Bulgarian construction sector is among those most heavily affected by the global financial and economic crisis.

According to national statistics, the output of the construction sector has fallen almost twofold, from BGN 21 billion in 2008 to BGN 11 billion in 2011, with overall decline from pre-crisis levels of 47%. According to the National Statistical Institute (NSI), the seasonally adjusted output for the construction sector in July 2015 declined by 0.3% over the previous month, with 0.2% calendar adjusted contraction over July 2014.

Calendar adjusted YOY contraction in construction output to July 2015 was caused mainly by an 8.6% decline in the building segment, contrasting with 9.3% growth in the civil engineering segment.

A study by the Chamber of Bulgarian Builders revealed that contraction in construction activities is concentrated mostly in the private non-residential segment (-4.5%) and to a lesser extent in the residential building segment (-1.2%). The former was affected by a significant decline in business demand and investment, while the latter regained some of its momentum in certain countries, contrary to general expectations.

An overview of new construction in Bulgaria over the past 10 years has been prepared to help assess the applicability of the national NZEB definition. This analysis is based on NSI indicators drawn up in accordance with Council Regulation (EC) No 1165/98 and included in the short-term business survey that relate to three categories of buildings:

Residential buildings, defined as those in which at least half of the useful area is intended for residential purposes and for permanent occupancy. Residential buildings are divided in the following groups:

- buildings with a single residential unit intended for occupancy by one household, i.e. houses, villas or bungalows;
- buildings with two or more residential units, such as blocks or condominiums as well as attached or terraced buildings having more than one residential unit and a single entrance;
- collective buildings with collective residential space and service premises intended for various groups, such as student, worker or pupil hostels, monasteries, retirement homes or homes for socially disadvantaged or homeless people.

A residential unit means one or more rooms and service premises in a permanent building intended for private use. The residential unit must have access to a street either directly or through spaces in the building.

Non-residential buildings are buildings intended for various non-residential purposes such as administrative buildings used for offices or administrative activities by institutions or other organisations and associations, including institutional buildings (e.g. banks, post offices, government buildings, conference/congress centres, court houses, town halls).

Other buildings are all types of buildings other than those described above, used for various activities such as manufacturing, commerce, transport, education, culture, sports, farming as well as buildings intended for holiday or short-term occupancy, e.g. hotels, motels, recreation centres and huts.

The 'gross floor area' (GFA) of a building is the sum total of the surface areas of all internal spaces on all floors measured by external dimensions, including the area of usable under-roof spaces and covered unenclosed spaces.

Figures 3.7 and 3.8 show the trend for new construction in Bulgaria between 2005 and 2015 using the indicators 'number of new buildings' and 'GFA of new buildings' during that period.

Figure 3.7	New building construction in Bulgaria 2005–2014 by number of new buildings (blue line: residential, red line: administrative, green line: other buildings)

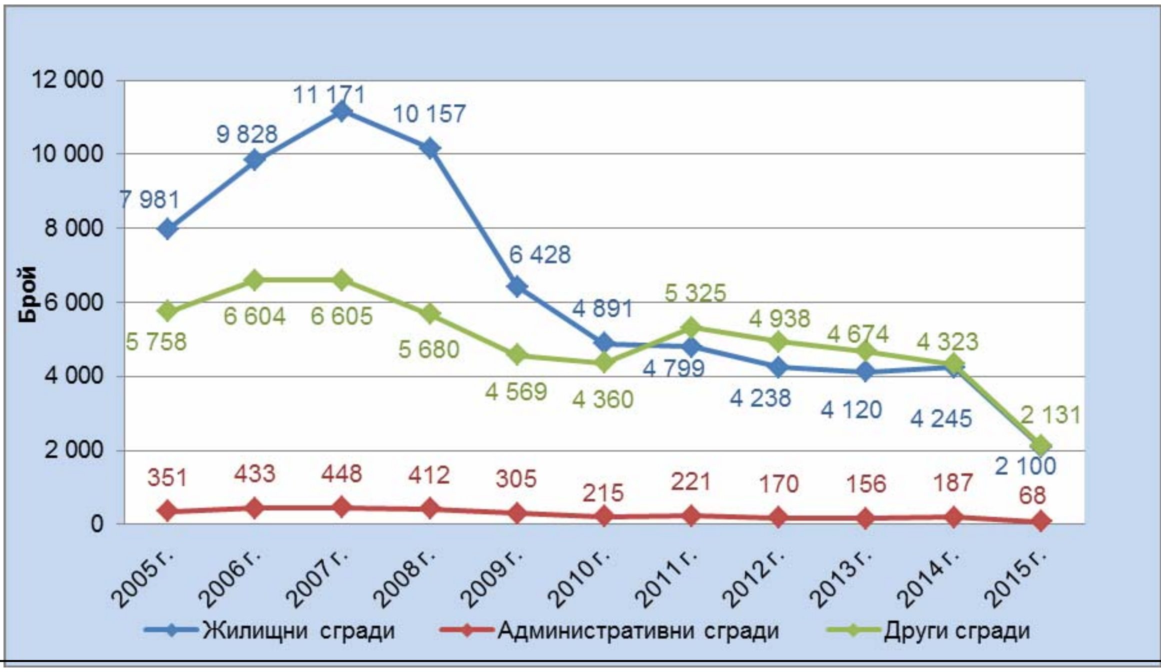
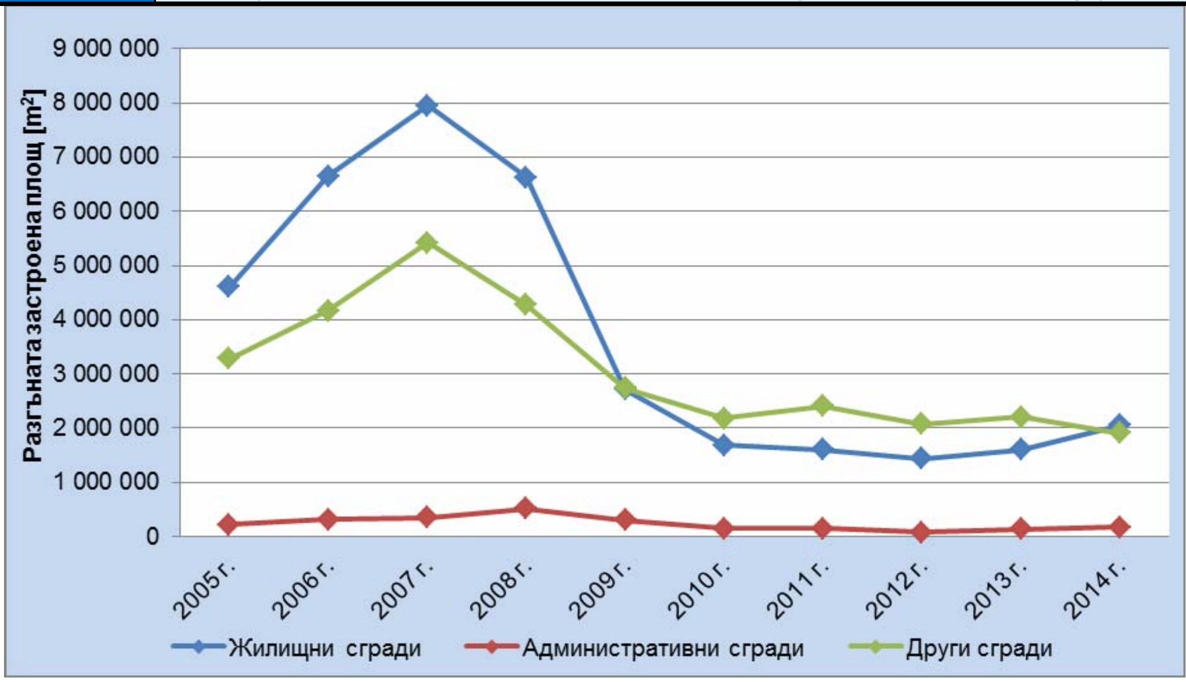

12 000
10 000
8 000
6 000
4 000
2 000
0
Брой
7 981
9 828
11 171
10 157
6 428
4 891
4 799
4 238
4 120
4 245
2 100
5 758
6 604
6 605
5 680
4 569
4 360
5 325
4 938
4 674
4 323
2 131
351
433
448
412
305
215
221
170
156
187
68
2005г.
2006г.
2007г.
2008г.
2009г.
2010г.
2011г.
2012г.
2013г.
2014г.
2015г.
Жилищни сгради
Административни сгради
Други сгради

Figure 3.8	New building construction in Bulgaria 2005–2014 by GFA (blue line: residential, red line: administrative, green line: other buildings)



3.2.2. Outlook and scenarios for application of the national NZEB definition to new buildings

Analysis of new building construction during the past 10 years reveals a fluctuating trend that makes it extremely difficult to produce an accurate projection. The period 2010–2014 was used as a basis for developing several scenarios for the new building segment going forward.

New administrative buildings

- Scenario A: baseline year 2014 and annual growth 1%;
- Scenario B: baseline year 2014 and annual growth 2%;
- Scenario C: baseline year 2014 and zero growth in the next years;
- Scenario D: baseline year 2014 and annual contraction 1%.

Figure 3.9 shows the projections for each scenario in this category expressed as newly built gross floor area (GFA):

2016: 171 300–181 800 m^2

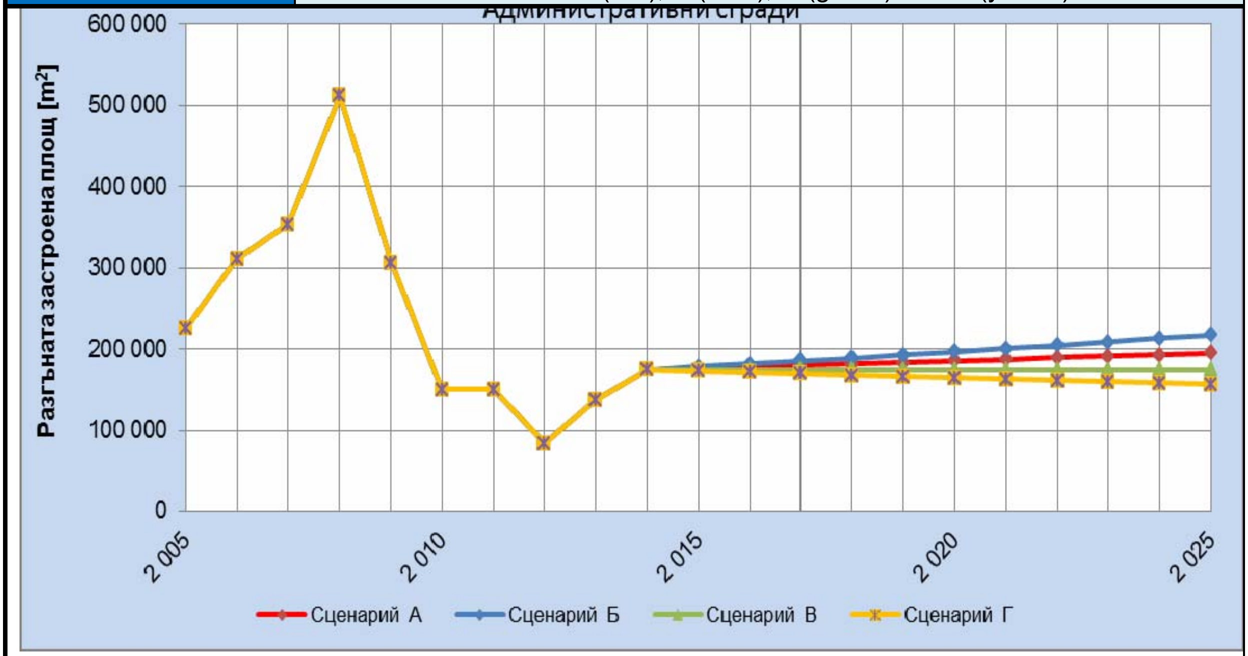
2017: 169 600–193 000 m^2

2018: 167 900–189 200 m^2

2019: 166 200–193 000 m^2

2020: 164 550–196 850 m^2.

Figure 3.9 New construction in the Administrative buildings category (in GFA, m^2). Scenarios A (red), B (blue), C (green) and D (yellow)



Residential buildings

- Scenario A: baseline year 2014 and annual growth 1%;
- Scenario B: baseline year 2014 and annual growth 2,5%;
- Scenario C: baseline year 2014 and zero growth in the next years.

Figure 3.10 shows the projections for each scenario in this category expressed as newly built gross floor area (GFA):

2016: 2 049 600–2 153 400 m^2

2017: 2 049 600–2 207 200 m^2

2018: 2 049 600–2 262 400 m^2

2019: 2 049 600–2 318 950 m^2

2020: 2 049 600–2 376 900 m^2.

Figure 3.10	New construction in the Residential buildings category (in GFA, m^2). Scenarios A (red), B (blue) and C (green)

Other buildings:

- Scenario A: baseline year 2014 and annual growth 1%;
- Scenario B: baseline year 2014 and annual contraction 1%;
- Scenario C: baseline year 2014 and zero growth in the next years.

Figure 3.11 shows the projections for each scenario in this category expressed as newly built gross floor area (GFA):

2016: 1 875 600–1 952 150 m^2

2017: 1 856 850–1 971 650 m^2

2018: 1 838 250–1 991 400 m^2

2019: 1 819 900–2 011 300 m^2

2020: 1 801 700–2 031 400 m^2.

Figure 3.11	New construction in the Other buildings category (in GFA, m^2). Scenarios A (red), B (blue) and C (green)

3.3. Applying the NZEB definition

Analysis and classification of the existing building stock in Bulgaria

The Member States are developing policies and adopting measures, such as having the public sector lead by example, to promote the renovation of existing buildings aimed at achieving the energy-use levels of NZE buildings.

Due to the complex nature of the existing building stock in Bulgaria, the potential for applying the national definition has been assessed on the basis of available building stock data, although this is not comprehensive.

Bulgaria does not maintain a central database of energy consumption by the individual categories and subcategories of buildings.

A general assessment of the indicators used for classification of the buildings was undertaken for the purposes of the NPSBNPE. The classification provided in Regulation No 1 on the nomenclature of buildings and structures in Bulgaria was used in order to identify appropriate distinguishing factors and obtain reliable information about the two main categories covered by the analysis: residential buildings and public buildings (and the subcategories of public buildings).

The classification scheme is shown in Figure 3.12. The figure displays two levels of classification indicators — the first level is the functional use of the building while the second level comprises specific indicators that distinguish the buildings by their structural type, spatial planning characteristics, age, ZUT category and type of heating/cooling system.

In order to arrive at a reliable classification using these indicators, a systematic approach with the following sequence of steps was applied:

a) identification of alternative and mutually complementary databases of a representative nature available in Bulgaria;

b) vetting and verification of the quality and reliability of the information contained in the available databases;

c) adoption of indicators and criteria for creating representative subsets of data on the buildings in the various subcategories;

d) hierarchical processing of the data in order to identify representative groups and reference buildings in each group.

The data sources used include publicly available statistical data of the European Commission, Eurostat (http://ec.europa.eu/eurostat), the National Statistical Institute (www.nsi.bg), the websites of the Sustainable Energy Development Agency (www.seea.government.bg), the Ministry of Energy (http://www.me.government.bg/bg), the Ministry of Regional Development and Public Works (www.mrrb.government.bg), and various information published on the websites of the Bulgarian Council of Ministers (http://www.government.bg/), the Bulgarian Parliament www.parliament.bg and other institutions.

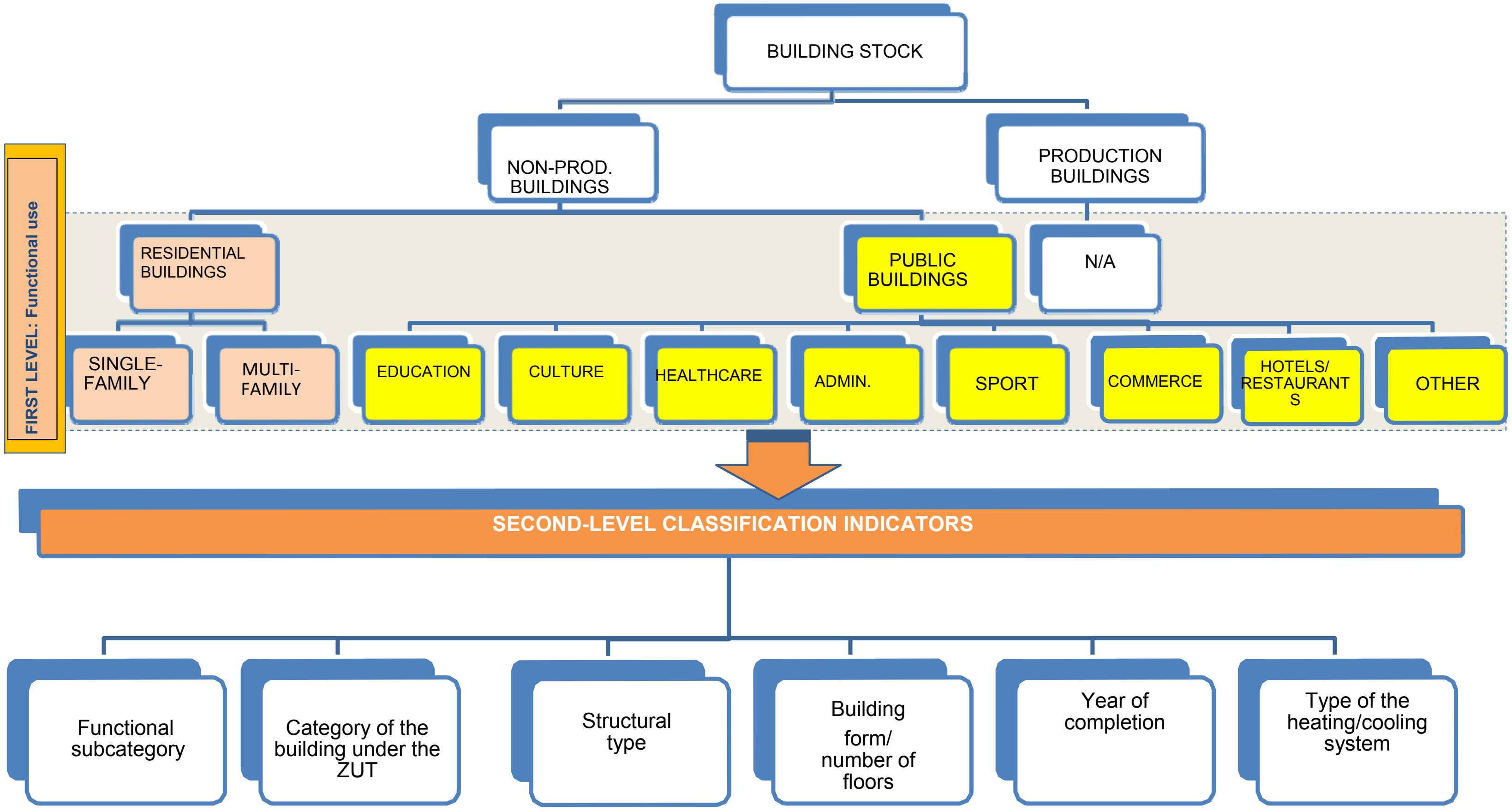

BUILDING STOCK
NON-PROD. BUILDINGS
PRODUCTION BUILDINGS
FIRST LEVEL: Functional use
RESIDENTIAL BUILDINGS
PUBLIC BUILDINGS
N/A
SINGLE-FAMILY
MULTI-FAMILY
EDUCATION
CULTURE
HEALTHCARE
ADMIN.
SPORT
COMMERCE
HOTELS/ RESTAURANTS
OTHER
SECOND-LEVEL CLASSIFICATION INDICATORS
Functional subcategory
Category of the building under the ZUT
Structural type
Building form/ number of floors
Year of completion
Type of the heating/cooling system

Fig. 3.12.

The following system of assessment indicators is derived from the available reliable information on existing building stock:

- ☞categorisation of the buildings in accordance with the regulatory basis;
- ☞distribution by year of completion, differentiating between buildings constructed before and after two consecutive changes in the constructional/technical standards;
- ☞ distribution by type of the heating/cooling system;
- ☞ distribution by GFA of the building;
- ☞ distribution by structural type;
- ☞ distribution by functional use.

Assessment of non-residential buildings is based on data provided by the AUER, while assessment of residential buildings is based on statistical data provided by Project No BG161PO001/5-01/2008/076 'Analysis, assessment and update of regulatory acts in support of OPRD 2014–2020' completed by the MRRB in 2013.

Systematised details of the statistical assessment of the buildings in Bulgaria are provided **Annex 1** for non-residential buildings and in **Annex 2** for residential buildings.

4. ESTIMATION OF ADDITIONAL INVESTMENT REQUIRED TO ACHIEVE THE NZEB STANDARD

Drawing up a plan for the construction of NZE buildings requires a quantitative assessment of energy, environmental and financial indicators reflecting the costs and benefits for the various categories (groups) of buildings. This assessment is obtained by a modelling study followed by an economic analysis (in accordance with the methodology framework in Commission Delegated Regulation (EU) No 244/2012).

Reference buildings from the following categories were selected for the purposes of the assessment:

- single-family buildings
- multifamily buildings
- administrative buildings
- hospitals
- kindergartens
- schools.

Packages of energy-saving measures in combinations tailored for each building were assessed in accordance with the relevant requirements laid down in Directive 2010/31/EU. Table 4.1 indicates the key features of the individual energy-saving measures included in the packages (variants).

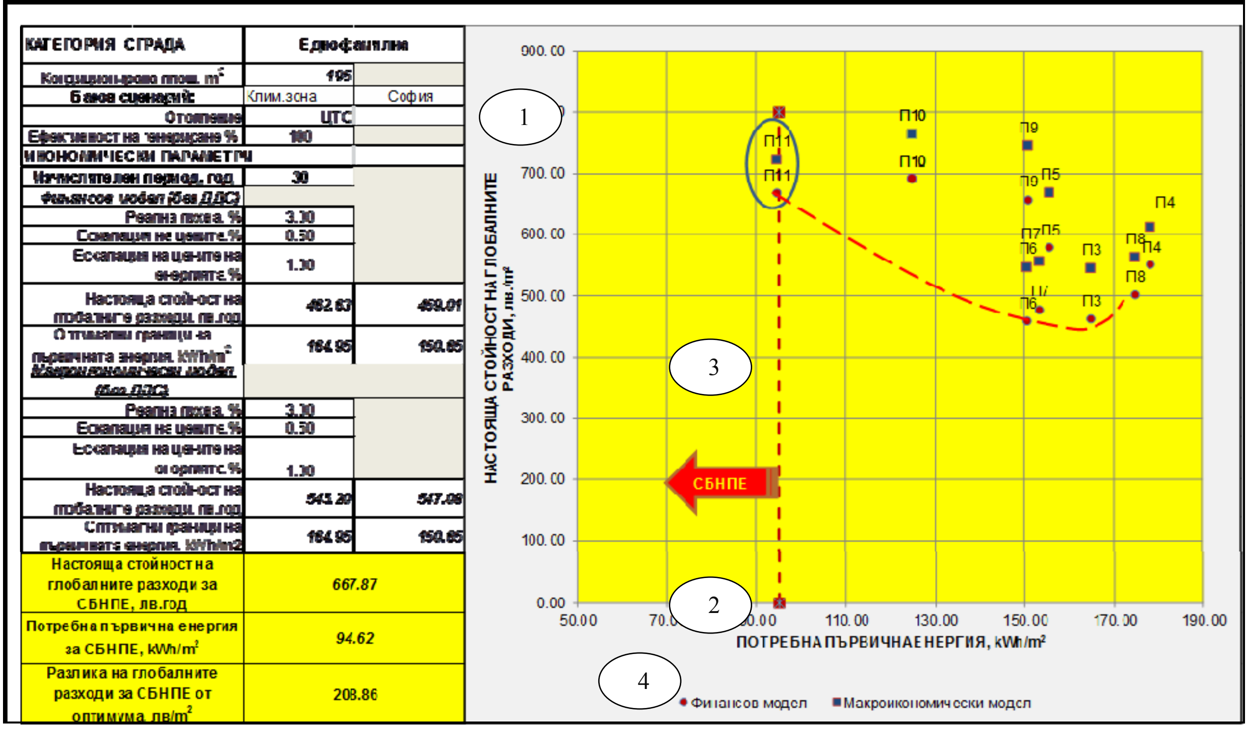
Table 4.1

No	Ref.	Level	ESM	Parameter	Value
1	B1.1	1	Replacement of windows and doors	U_{win}	1.4
	B1.2	2	Replacement of windows and doors	U_{win}	1.1
	B1.3	3	Replacement of windows and doors	U_{win}	0.9
2	B2.1	1	Thermal insulation of walls	U_w	0.25
	B2.2	2	Thermal insulation of walls	U_w	0.22
	B2.3	3	Thermal insulation of walls	U_w	0.15
3	B3.1	1	Thermal insulation of roof	U_r	0.28
	B3.2	2	Thermal insulation of roof	U_r	0.22
	B3.3	3	Thermal insulation of roof	U_r	0.15
4	C1	C1	Central heating (substation)		
5	C2	C2	Installation of biomass-fired boiler (pellet plant)		
6	C3.1	1	Installation of gas-fired boiler	η	0.93
	C3.2	2	Installation of gas-fired boiler	η	1.03
7	C4	C5	Installation of boiler fired by liquid fuel		
8	C5.1	1	Installation of direct evaporation heat pump	COP/EER	4/3.5
	C5.2	2	Installation of direct evaporation heat pump	COP/EER	5/4
	C5.3	3	Installation of direct evaporation heat pump	COP/EER	5.5/5
9	C6	C6	Installation of water-water heat pump		
10	C7	C7	Installation of ground-water heat pump		
11	C8	C8	Central heating		
12	C9.1	1	Installation of air-air heat pump	COP/EER	3.5/3
	C9.2	2	Installation of air-air heat pump	COP/EER	4/3.5
	C9.3	3	Installation of air-air heat pump	COP/EER	4.5/4
13	C10	C10	Installation of water-air heat pump		
14	C11	C11	Installation of ground-air heat pump		
15	C12	C12	Heat recuperation		
16	C13	C13	Central heating		
17	C14	C14	Installation of biomass-fired boiler (pellet plant)		
18	C15	C15	Installation of gas-fired boiler		
19	C16	C16	Installation of ground-water heat pump		
20	C17	C17	Installation system to utilise solar heat		
21	C18.1	1	Air-water air cooler	EER	3.5
	C18.2	2	Air-water air cooler	EER	4
	C18.3	3	Air-water air cooler	EER	5
22	C19	1	Installation of water-water heat pump		
23	C20	1	Installation of direct-evaporation heat pump		
24	C21	1	Energy efficient lighting		

The economic analysis of the variants is made using the indicator ‘present value of the global costs’ over a calculation period of 30 years, with analysis of vulnerability to fluctuations in interest rates, inflation and rising energy prices.

Some of the results obtained are shown in Figures 4.1 — 4.3.

Figure 4.1 Global costs of the variants for a single-family building

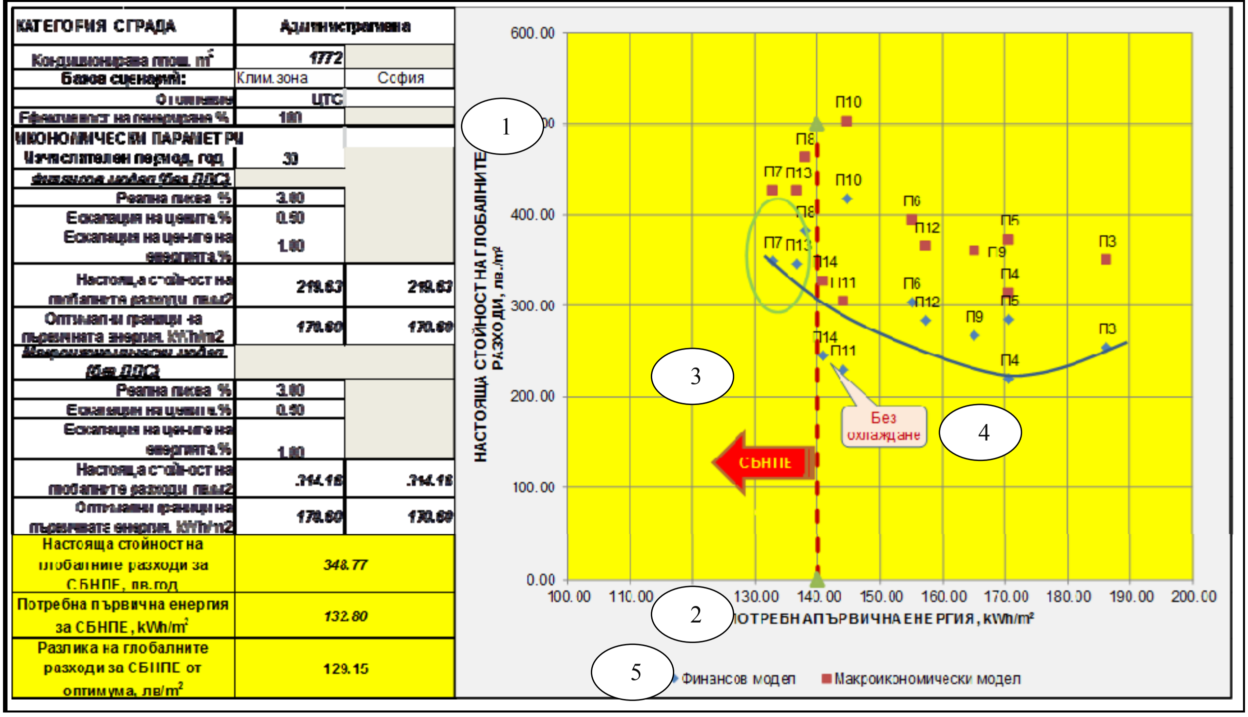


1 – present value of global costs, BGNm²; 2 – primary energy demand, kWh/m²; 3 – NZEB; 4 – financial model, macroeconomic model.

Key to table:

CATEGORY OF BUILDING	Single-family building	
Conditioned area, m²	***195***	
Baseline scenario	Climate zone	Sofia
Heating	District heat supply	
Generation efficiency,%	100	
ECONOMIC PARAMETERS		
Calculation period, years	**30**	
Financial model (w/o VAT) (red colour)		
Interest rate,%	3.00	
Inflation,%	0.50	
Energy price rises,%	1.00	
Present value of global costs, BGN/y	***462.63***	***459.01***
Optimal limits of primary energy, kWh/m²	***164.95***	***150.65***
Macroeconomic model (w/o VAT) (blue colour)		
Real interest rate,%	3.00	
Price escalation,%	0.50	
Escalation of energy prices,%	1.00	
Present value of global costs, BGN/y	***545.20***	***547.08***
Optimal limits of primary energy, kWh/m²	***164.95***	***150.65***
Present value of global costs for NZEB, BGN/year	***667.87***	
NZEB primary energy demand, kWh/m²	***94.62***	
Difference between the global NZEB costs and the optimum, BGN/m²	**208.86**	

Figure 4.2 Global costs of the variants for an administrative building

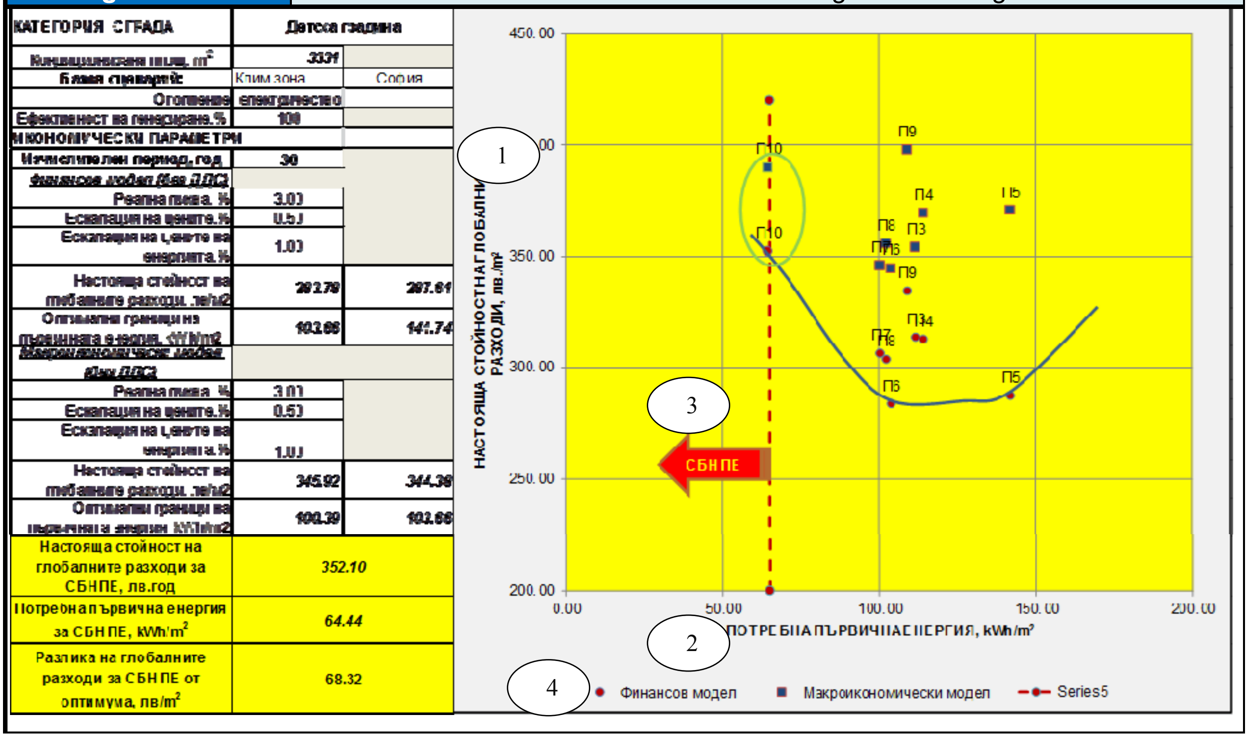


1 – present value of global costs, BGNm²; 2 – primary energy demand, kWh/m²; 3 – NZEB; 4 – without cooling; 5 – financial model, macroeconomic model.

Key to table:

CATEGORY OF BUILDING	Administrative building	
Conditioned area, m²	***1772***	
Baseline scenario	Climate zone	Sofia
Heating	District heat supply	
Generation efficiency,%	100	
ECONOMIC PARAMETERS		
Calculation period, years	**30**	
Financial model (w/o VAT) (red colour)		
Interest rate,%	3.00	
Inflation%	0.50	
Energy price rises,%	1.00	
Present value of global costs, BGN/y	***219.63***	***219.63***
Optimal limits of primary energy, kWh/m²	***170.60***	***170.60***
Macroeconomic model (w/o VAT) (blue colour)		
Interest rate,%	3.00	
Inflation,%	0.50	
Energy price rises,%	1.00	
Present value of global costs, BGN/y	***314.16***	***314.16***
Optimal limits of primary energy, kWh/m²	***170.60***	***170.60***
Present value of the global costs for NZEB, BGN/year	***348.77***	
NZEB primary energy demand, kWh/m²	***132.80***	
Difference between the global NZEB costs and the optimum, BGN/m²	***129.15***	

Figure 4.3 Global costs of the variants for a kindergarten building



1 – present value of global costs, BGNm²; 2 – primary energy demand, kWh/m²; 3 – NZEB; 4 – financial model, macroeconomic model.

Key to table:

CATEGORY OF BUILDING	Kindergarten	
Conditioned area, m²	***3331***	
Baseline scenario	Climate zone	Sofia
Heating	Electricity	
Generation efficiency,%	100	
ECONOMIC PARAMETERS		
Calculation period, years	**30**	
Financial model (w/o VAT) (red colour)		
Interest rate,%	3.00	
Inflation,%	0.50	
Energy price rises,%	1.00	
Net present value of the global costs, BGN/y	***283.78***	***287.61***
Optimal limits of primary energy, kWh/m²	***103.66***	***141.74***
Macroeconomic model (w/o VAT) (blue colour)		
Interest rate,%	3.00	
Inflation,%	0.50	
Energy price rises,%	1.00	
Present value of global costs, BGN/y	***345.92***	***344.38***
Optimal limits of primary energy, kWh/m²	***100.39***	***103.66***
Present value of global costs for NZEB, BGN/year	***352.10***	
NZEB primary energy demand, kWh/m²	***64.44***	
Difference between the global NZEB costs and the optimum, BGN/m²	***68.32***	

B Table 4.2 presents the estimated energy savings after renovation of existing buildings (upgrade to Class B) and of the energy savings achieved with NZE buildings

Table 4.2

Expected energy savings after renovation/new construction in each category (per energy-consumption class)	Savings after renovation from Class F to Class B		Savings after renovation from Class E to Class B		NZEB savings compared to Class B
	Primary energy	Final energy	Primary energy	Final energy	Primary energy
	kWh/m²	kWh/m²	kWh/m²	kWh/m²	kWh/m²
Administrative buildings	340.00	170.85	240.00	120.60	105.50
Healthcare buildings	409.00	205.53	296.50	148.99	105.50
Cultural and art buildings	275.00	138.19	195.00	97.99	83.00
Kindergartens	260.00	130.65	195.00	97.99	49.00
Hotels	350.00	175.88	240.00	120.60	128.00
Residential buildings	256.50	128.89	184.00	92.46	71.50
Sport buildings	356.50	179.15	244.00	122.61	131.50
Commercial buildings	481.50	241.96	319.00	160.30	206.50
Schools	145.00	72.86	105.00	52.76	38.00
Universities	222.50	111.81	157.50	79.15	68.00
State-owned buildings	286.86	144.15	204.71	102.87	82.93

The modelling study and the economic analysis of the global costs estimated the investment (excl. VAT) required to implement the energy saving measures needed to achieve the NZEB definition, given the relevant environmental conditions. The results are summarised in Table 4.3.

Table 4.3

Buildings	Investment required to achieve the NZEB definition, BGN/m² GFA	NZEB CO_2 savings against the baseline year 1999, kgCO_2/m² GFA	NZEB CO_2 emissions (without appliances) kgCO_2/m² GFA	NZEB CO_2 emissions (with appliances) kgCO_2/m² GFA
Residential				
Single family	300-400	35-40	10-14	20-25
Multifamily	200-250	30-40	15-18	22-30
Public				
Administrative	200-250	20-25	10-12	35-40
Kindergartens	200-250	30-45	12-15	16-19
Schoolhouses	150-180	14-22	3-6	4-10
Hospitals	180-220	22-30	7-9	12-15

The simulation analysis shows that the 2015 reference values for the heat transmission factors of the building envelopes guarantee sufficient energy savings to allow the additional energy savings required to reach the NZEB level to be achieved by measures related to heating, ventilation, DHW, cooling and lighting systems.

The analysis also demonstrated that reduction of heat transmission factors should not be the main goal given the climatic conditions of Bulgaria. These specific conditions require that optimal heat transmission values should be sought year-round and not just for the winter period, in contrast to the broad consensus among designers and builders. Results also suggest that reducing the heat transmission factors below the reference values provided for in the legislation leads to higher energy consumption in summertime, which during that period is mostly electric. This in turn requires additional investment in measures such as systems for additional external shading of facades admitting the required levels of daylight to the conditioned volume, as well as in highly efficient cooling technologies.

The solutions for district heating of NZE buildings are an important topic of research and discussion. While the EU encourages high-efficiency cogeneration of heat and electricity, such generation does not apply to renewable energy. Until Bulgaria has heat plants that utilise renewable energy sources, it will be very difficult for any building planned for construction in an area with district heating to achieve the NZEB standard. There is a need to consider preferences for heating of buildings using district solutions where the cogeneration technology used is highly efficient.

5. NATIONAL TARGETS FOR ACHIEVING THE REQUIREMENTS OF THE NZEB DEFINITION IN THE NEW BUILDINGS SEGMENT

The scenarios projected for the development of the new building construction segment and relevant global costs analysis allowed estimation of the investment required if the NZEB definition is to be achieved for the three main categories of building.

The results are presented in Figures 5.1–5.3

Figure 5.1: Investment required for administrative buildings (new construction), BGN (red: Scenario A, blue: Scenario B, green: Scenario C , purple: Scenario D)

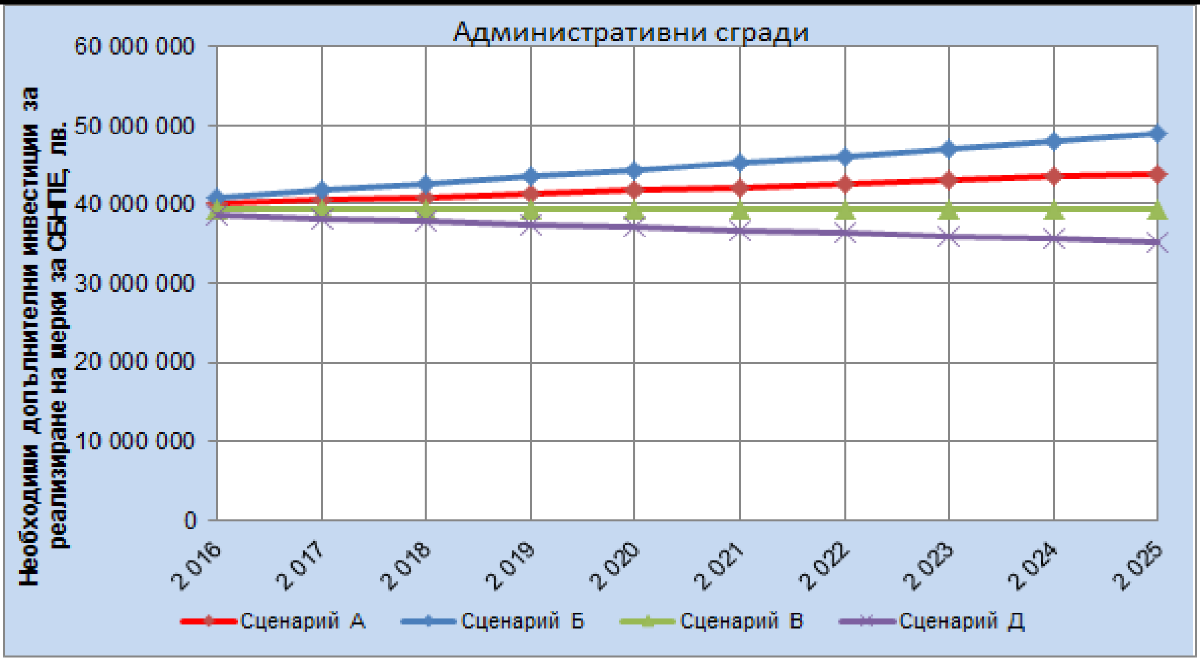


Figure 5.2 Investment required for residential buildings (new construction), BGN (red: Scenario A, blue: Scenario B, green: Scenario C)

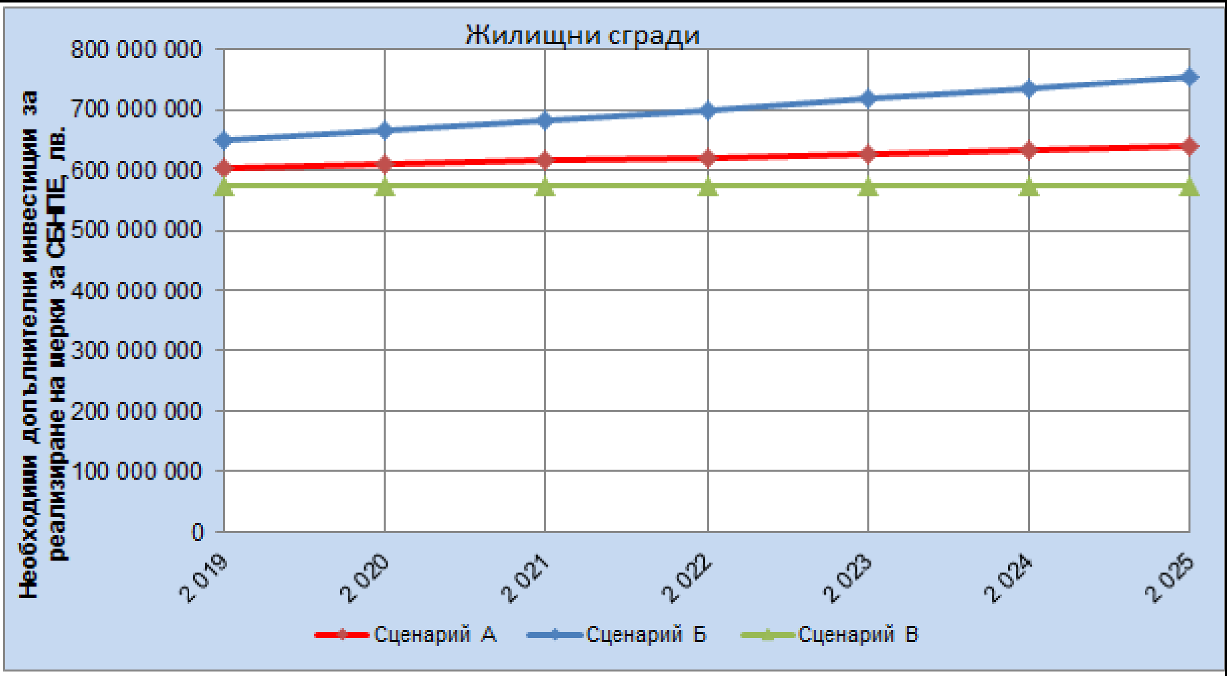
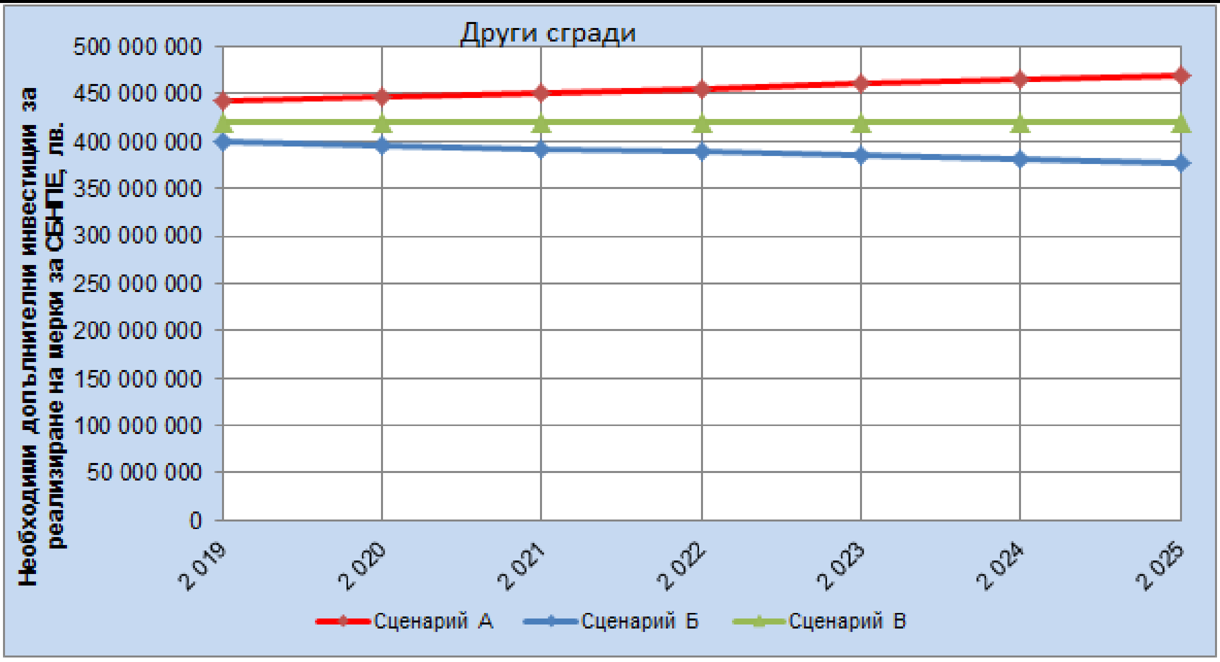


Figure 9.3	Investment required for other buildings (new construction), BGN (red: Scenario A, blue: Scenario B, green: Scenario C)



To help prepare for the upcoming entry into force of the requirements for new buildings under Directive 2010/31/EU, an assessment was made of the following **interim targets** (in terms of GFA, investment requirements, annual savings):

New administrative buildings

Table 5.1

Table 5.1					
	Administrative buildings				
			Savings (FEC and emissions)		
Year	GFA m^2	Investment, BGN	ktoe	GWh	t CO_2
2016	9 092	2 045 677	0.15	1.80	204.57
2017	27 821	6 259 773	0.43	5.04	625.98
2018	66 214	14 898 259	1.00	11.63	1 489.83
2019	192 968	43 417 784	3.29	38.208	4 341.78
2020	196 800	44 286 140	3.35	38.97	4 428.00
Total	492 896	110 907 634	10.56	122.76	14 445.63

Projected new GFA per year is as follows:

2016: 5% (of the projected new construction for the year in scenario B);

2017: 15% (of the projected new construction for the year in Scenario B);

2018: 35% (of the projected new construction for the year in Scenario B);

2019: 100% (of the projected new construction for the year in Scenario B);

2020: 100% (of the projected new construction for the year in Scenario B).

New residential buildings:

Table 5.2:

Table 5.2					
	Residential buildings				
			Savings (FEC and emissions)		
Year	GFA m^2	Investment, BGN	ktoe	GWh	t CO_2
2016	0	0	0.00	0.00	0.00
2017	4 414	1 236 036	0.06	0.64	154.50
2018	11 312	3 090 091	0.14	1.65	395.92
2019	23 189	6 493 054	0.29	3.386	811.63
2020	35 654	6 655 380	0.45	5.21	1 247.88
Total	74 570	17 474 562	1.19	13.83	3 314.87

The distribution of the projected new GFA by year is:

2017: 0.2% (of the projected new construction for the year in Scenario B);

2018: 0.5% (of the projected new construction for the year in Scenario B);

2019: 1% (of the projected new construction for the year in Scenario B);

2020: 1.5% (of the projected new construction for the year in Scenario B).

Other new buildings:

Table 5.3					
	Other buildings				
			Savings (FEC and emissions)		
Year	GFA m^2	Investment, BGN	ktoe	GWh	t CO_2
2016	0	0	0.00	0.00	0.00
2017	19 717	4 337 646	0.30	3.47	443.62
2018	29 871	6 571 533	0.45	5.26	672.09
2019	40 226	8 849 665	0.61	7.080	905.08
2020	50 785	11 626 358	0.77	8.94	1 142.66
Total	140 598	31 385 202	3.18	36.94	4 722.79

The distribution of the projected new GFA by year is:

2017: 1% (of the projected new construction for the year in Scenario B);

2018: 1.5% (of the projected new construction for the year in Scenario B);

2019: 2% (of the projected new construction for the year in Scenario B);

2020: 2.5% (of the projected new construction for the year in Scenario B).

Table 5.4 provides an overview of the construction of new NZE buildings and the expected energy and environmental savings by 2020:

Table 5.4					
			Savings (FEC and emissions)		
Buildings	GFA m^2	Investment, BGN	ktoe	GWh	t CO_2
Administrative	492 896	110 907 634	10.6	122.8	14 445.6
Residential	74 570	17 474 562	1.2	13.8	3 314.9
Other	140 598	31 385 202	3.2	36.9	4 722.8
Total by 2020	708 063	159 767 398	15	174	22 483

The achievement of the above targets by 2020 will save **15 ktoe** (**174 GWh**) of final energy or **6.52%** of the national energy-saving target 2020, excluding energy traders.

Stakeholders should not overlook the need, in addition to the significant investment requirements, for relevant professional knowledge, skills and a creative approach to finding solutions. The national NZEB definition cannot be achieved directly and in all cases solely by a combination of the above energy-saving measures, but requires a creative integrated approach by architects, engineers, builders and consultant teams working to combine energy efficient building designs with advanced construction materials, products and technologies. Furthermore, design solutions for new buildings allow a much greater diversity of approach than renovation of existing buildings.

An essential aim of the updated theoretical and practical training programmes for energy efficiency consultants and designers provided in Bulgaria since 2005 under the ZEE is the continual improvement of qualification, knowledge and skills in the area of NZEB.

6. NATIONAL TARGETS FOR ACHIEVING THE NZEB DEFINITION IN EXISTING BUILDINGS

An analysis of existing state and municipal buildings using AUER data reveals that in 2015 there were still 5660 buildings (each with GFA of over 250 m^2) with combined GFA of 9162308 m^2 that did not comply with the minimum energy efficiency requirements and were still awaiting implementation of energy-saving measures. These measures will be implemented in the coming years. Article 23(1) of the ZEE provides for the achievement of the national energy saving target by improving the energy performance of state-owned heated and cooled buildings at a minimum rate of **5%** of the total GFA of these buildings.

The research work carried out confirmed the applicability of the national NZEB definition to the existing stock of public buildings. Based on the opportunities for financing NZEB projects as described reviewed in Section 7, the present plan sets the following targets for existing buildings (Table 6.1).

Table 6.1					
	Renovation of public buildings owned by the state and municipalities to the NZEB standard				
			Savings (FEC and emissions)		
Year	GFA m^2	Investment, BGN	ktoe	GWh	t CO_2
2016	0	0	0	0	0
2017	45 810	14 659 200	0.65	7.56	1 145
2018	91 620	29 318 400	1.30	15.11	2 291
2019	109 950	35 184 00	1.56	18.138	2 749
2020	137 450	43 984 000	1.95	22.68	3 436
Total	**384 830**	**123 145 600**	**8.1**	**93.7**	**14 201.8**

Achievement of this target by 2020 will save **8.1 ktoe** (**93.7 GWh**) of final energy or **3.52%** of the national energy saving target for 2020, excluding energy traders.

7. POLICIES, FINANCIAL MECHANISMS AND MEASURES FOR INCREASING THE NUMBER OF NZE BUILDINGS

Subject to the state aid rules, Article 71(1) of the ZEE provides the following schemes and mechanisms for promoting energy efficiency at the level of final users, also applicable to NZE buildings:

- energy savings performance contracts (ESCO);
- energy saving certificates;
- financing by the Energy Efficiency and Renewable Sources Fund (FEEVI) and other financial intermediaries;
- financing from other national and European support schemes and mechanisms.

In 2014–2020 the EU Structural Funds are expected to remain a major source of financing of measures to achieve energy efficiency in state and municipal buildings as well as in the residential sector.

The interim energy efficiency targets for the various groups of buildings and the investment required will be implemented and financed each year from available national budget allocations in accordance with the medium-term budget forecast approved by the Council of Ministers until 2018. Implementation after 2018 is based on projections.

7.1. Operational Programme 'Regions in Growth' 2014–2020.

http://www.bgregio.eu/

7.1.1. Grant procedure BG16RFOP001-1.001-039 'Implementation of integrated plans for urban regeneration and development'

Financing for NZE buildings is available under grant procedure BG16RFOP001-1.001-039 'Implementation of integrated plans for urban regeneration and development' within the framework of Priority Axis 1 'Sustainable and integrated urban development' of OPRR 2014–2020.

The grant procedure aims to support implementation of integrated plans for urban regeneration and development for sustainable and long-lasting resolution of the high concentration of economic, environmental and social problems in **39 cities of hierarchical level 1, 2 and 3** in accordance with the National concept for spatial development of Bulgaria 2013–2025 (NKPRE).

In accordance with the scheme's objectives and the amounts allocated to the participating Bulgarian municipalities, local administrations can plan projects for the construction or renovation of public or commercial buildings in urban areas, including compliance with the NZEB criteria. Such projects would still fulfil the grant procedure requirements since the objective to raise energy efficiency of the residential sector, student hostels and state or municipal administrative buildings to at least Class C does not preclude raising energy efficiency above that minimum level.

While each project has its specific characteristics, it is recommended that municipalities develop their NZEB projects based on cost-benefit analysis (CBA). CBA has been used in Cohesion policy since 1990 and has been a mandatory requirement in the EU since 2000. Such analysis weighs expected costs and benefits over a certain period of time, typically 20–30 years. The calculations should take into account the eligible energy-saving measures and their economic life as provided for under Article 18(2) ZEE.

7.1.2. Grant procedure BG16RFOP001-2.001 'Energy Efficiency in peripheral areas'

Priority Axis 2 'Support for energy efficiency in support centres in peripheral areas' is designed to support the implementation of energy efficiency measures in public and residential buildings in small municipal centres providing services to the surrounding peripheral areas. It corresponds to Thematic Objective 4 'Support for transition to a low-carbon economy in all sectors'. Interventions within the framework of this priority axis will contribute to the achievement of the national energy saving targets for 2020 in accordance with the NPDEE 2014–2020. The activities planned will lead to improved energy efficiency of buildings in the target territories, contributing directly to reducing final energy consumption and indirectly to reducing greenhouse gases in small towns operating as support centres of the polycentric system in accordance with the NKPRE.

The support provided by this priority axis aims to address adequately the problems of increased migration towards large and medium cities, ensure better quality of life and better services, modernise the public infrastructure in the peripheral areas of the country and promote urban-rural interactions.

The priority axis has two specific objectives: 'Improvement of the energy efficiency of the residential sector in support centres at level 4 of the national polycentric system', and 'Improvement of the energy efficiency of public buildings in support centres at level 4 of the national polycentric system'.

The specific beneficiaries of this grant procedure are **28 municipal administrations** of small towns which are support centres at level 4 of the national polycentric system in accordance with NKPRE 2013–2025.

The procedure is currently at the financing stage.

7.2. Residential energy efficiency credit line (REECL)

http://www.reecl.org/bg/

The REECL credit facility is operated by the EBRD. The EBRD participation in the credit resources available from the facility amounts to EUR 50 million. Financing by Kozloduy International Decommissioning Support Fund (KIDSF) amounts to EUR 24.6 million.

The REECL was created with a EUR 14.6 million grant from the KIDSF and a EUR 50 million loan provided by the EBRD for implementation of energy efficiency measures in residential buildings, the beneficiaries being natural persons and households.

The credit resources are available to borrowers through six Bulgarian banks — Bulgarian Post Bank, DSK Bank, Unicredit Bulbank, UBB, Procredit Bank and Raiffeisenbank.

This credit line is ideal for financing of NZEB projects.

The REECL line was opened in May 2005 and will be available until December 2019.

7.3. Energy Efficiency and Renewable Sources Fund

http://www.bgeef.com/displaybg.aspx

The Energy Efficiency and Renewable Sources Fund (FEEVI) was established on the basis of the Energy Efficiency Act (adopted by the Bulgarian Parliament in February 2004) as a legal entity independent from state institutions. The fund operates in accordance with the provisions of the ZEE, the ZEVI and the agreements concluded with its donors, and is not included in the national budget. The initial capital of the FEEVI was raised entirely from grant contributions. The main donors are the UN Global Environment Fund through the International Bank for Reconstruction and Development (the World Bank). which contributed USD 10 million, the Government of Austria with EUR 1.5 million, the Government of Bulgaria with BGN 3 million and private Bulgarian sponsors.

The FEEVI operates as a financing institution by providing loans or loan guarantees and as a consultation centre. It assists Bulgarian companies, municipalities and private individuals in developing energy efficiency investment projects. The fund provides financing, co-financing or guarantees to other financial institutions.

The main principle in the management of the FEEVI is public-private partnership. The fund operates in accordance with arrangements and rules developed with the technical assistance of the World Bank and approved by the Bulgarian government.

Users of the fund are central and local authorities, enterprises, institutions (including educational institutions and health facilities), non-government organisations and individuals.

A specific feature is that the fund develops and manages a wide range of financial products designed to support its clients: investment grants, loans, bridge financing, loan guarantees, capital investment and so on. Favourable terms for the various financing instruments are achieved by cooperation with and involvement of other financial institutions (banks).

In accordance with the policy of the FEEVI, the main instrument by which the fund supports projects is debt financing, allowing the fund as to be ‘renewable’ and guaranteeing its financial stability.

7.4. National Trust Ecofund (NDEF)

https://ecofund-bg.org/

The National Trust EcoFund was established in October 1995 by the Debt-for-Environment Swap Agreement between the Government of the Swiss Confederation and the Government of the Republic of Bulgaria.

Pursuant to Article 66(1) of the Environment Protection Act, the objective of the fund is to manage the proceeds from debt-for-environment and debt-for-nature swaps, from international trade in GHG assigned amount units, from the sale of GHG emission allowances for aviation activities, as well as proceeds from other types of agreements with international, foreign or Bulgarian sources for financing environmental protection activities in the country. The fund contributes to the implementation of the Bulgarian government's policy and the country's international commitments in the area of environmental protection. To date the fund has financed 100 projects with a total amount of about BGN 24 million. The National Trust EcoFund is an independent institution that has the support of the Bulgarian government. The Fund operates five programmes:

- Climate Investment Programme (CIT)
- National Green Investments Scheme (NGIS)
- Debt-for-Environment
- Pilot programme for rehabilitation of the environment
- Fund for protected territories.

The concept of the national NZEB definition is fully coherent with the ideas and objectives of the programmes operated by the NDEF.

7.5. Energy savings performance contracts (ESCO)

This financing mechanism is regulated in Article 72 of the ZEE.

ESCO contracts support the implementation of energy efficiency measures in buildings, enterprises, and industrial and outdoor lighting systems where the means for repayment of the investment and of the remuneration due to the contractor come from the energy savings achieved.

The client party to an ESCO contract can be the final user and the contractor can be a provider of energy efficiency services.

An ESCO contract is concluded after an energy efficiency audit is carried and an energy performance certificate establishing the actual energy use status of the building is issued.

ESCO contracts are concluded in writing and contain at least the following elements:

- normalised energy consumption as established by the energy efficiency audit;
- a list of energy efficiency measures to be implemented, including the steps to be undertaken for implementing the measures and where appropriate the related costs;
- guaranteed energy savings, procedure and time limits for determining the savings after the implementation of the measures envisaged in the contract, as well as arrangements for measuring and verifying energy savings, guaranteed economies, quality assurance and guarantees;
- obligation to fully implement the measures in the contract and documentation of all changes made during the project;
- description of the financial implications of the project and distribution of the financial savings achieved between the two parties;
- financing method;
- method for payment of the remuneration;
- other clauses such as provisions related to amendment of the framework conditions, content or performance of the contract, inclusion of equivalent requirements to any subcontracting arrangements with third parties, detailed description of the obligations of each contracting party and penalties for non-performance of these obligations.

A specific feature of these contracts is that the ESCO contractor arranges for the provision of all or part of the service with its own financial resources and/or commits to securing financing from a third party. The contractor bears all financial, technical and commercial risks associated with the implementation of the energy efficiency measures and activities provided in the contract and with achievement of guaranteed result.

If a contract under Article 72(1) is concluded for state and/or municipal buildings, the state and/or the municipalities **should allocate an amount in their budgets corresponding to the normalised energy consumption of these buildings during the term of the contract**.

The Ministry of Energy has issued instructions on the application of this financing mechanism. The providers of energy saving performance services (known as ESCO contractors) use their own resources for the provision of ESCO services and for investments (surveying, implementation, operation and maintenance), and guarantee sufficient energy savings so that the investment can be repaid and a certain profit obtained. The agreement for the provision of energy efficiency services takes the form of a contract between the service provider and the client. Implementation of the measures leads to reduction of energy-related, operational and building maintenance costs. Under ESCO services contracts, the investment costs are repaid from the savings achieved. These projects are characterised by quick implementation and are in the mutual interest of both parties.

The measures to fulfil the requirements laid down in Article 9 of Directive 2010/31/EU on the energy performance of buildings are presented in Table 7.1.

Progress in the implementation of NPSBNPE measures is reported to the European Commission every three years.

An estimation of the projected overall contribution (in FEC) of each RES technology in Bulgaria towards the binding targets for 2020 and the indicative curve of RES shares in heating and cooling energy during the period 2010–2020 (ktoe) is provided in the **National Renewable Energy Action Plan** (the plan is based on a template for national action plans in the area of renewable energy in accordance with Directive 2009/28/EC of the European Parliament and of the Council).

Table 7.1: Measures to fulfil the requirements laid down in Article 9 of Directive 2010/31/EU on the energy performance of buildings

Title of the Measure	*Category of the measure*	*Status of the measure*	*Target group or activity*	*Implementing period*	*Institution or organisation leading the measure*	*Intended outcome*	*Potential financing sources*
1. Develop a national NZEB definition	Regulatory	Existing	Investors	December 2015	MRRB	NZEB definition developed	OP 'Regional Development' 2007–2013
2. Simulation study on the applicability of the national NZEB definition to new buildings	Applied science	Existing and continuing	Investors State institutions	December 2016	Technical University Sofia (TU Sofia)		Budget resources
3. Simulation study on the applicability of the national NZEB definition in existing buildings	Applied science and research	Existing and continuing	Investors State institutions	December 2016	TU Sofia		Budget resources
4. Analysis and market positioning, including prices and advantages of innovative technologies ensuring very good energy performance of building envelopes	Research	Existing and continuing	Investors State institutions	December 2016	Chamber of Bulgarian Builders, Chamber of Bulgarian Architects, Chamber of Investment Design Engineers, University of Geology, Architecture and Civil Engineering, other universities	Costs-benefit analysis in the indicated application field	Projects of NGOs and professional associations
5. Analysis and market positioning, including prices and advantages of innovative technologies for cooling and heating of buildings	Research	Existing and continuing	Investors State institutions	December 2016	Technical universities accredited in the area of energy	Costs-benefit analysis in the indicated application field	Projects of NGOs and professional associations
6. Review and where necessary	Regulatory	Existing	Investors,	December	ME	Up-to-date	The ME budget

Title of the Measure	Category of the measure	Status of the measure	Target group or activity	Implementing period	Institution or organisation leading the measure	Intended outcome	Potential financing sources
update the national factors for energy losses in the extraction/production and transmission of energy resources and energy		and continuing	builders, designers and EE consultants	2016	in cooperation with the AUER, NGOs and universities	data for Bulgaria	
7. Draw up indicative lists of potential NZEB projects	Organisational	Planned	Investors	December 2016	Municipalities	Updated energy efficiency plans at municipal level	Public-private partnerships, OP projects
8. Implement new NZEB demonstration projects	Investment	Planned	Investors	December 2018 – December 2020	Municipalities State institutions	Projects implemented under the investment programmes of grant procedure 'Implementation of integrated plans for urban regeneration and development'	OP 'Regions in growth' (OPRG) 2014–2020
9. Implement new NZEB projects	Investment	Planned	Users of residential and public buildings	December 2018	Private investors	New NZEB projects implemented	Private capital
10. Implement projects for the renovation existing buildings to the NZEB standard	Investment	Planned	Users of residential and public	December 2018 – December	Municipalities	Projects implemented under the	OPRG 2014–2020

Title of the Measure	Category of the measure	Status of the measure	Target group or activity	Implementing period	Institution or organisation leading the measure	Intended outcome	Potential financing sources
			buildings	2020		investment programmes of grant procedure 'Implementation of integrated plans for urban regeneration and development', OPRG 2014–2020	
11. Set up a national expert board to coordinate the implementation of the NPSBNPE	Administrative	Planned	State institutions responsible for implementing EE policies	May 2016	MRRB in cooperation with ME, MF, MOSV, AUER and universities	New NZEB policies and financing measures	National budget
12. Create financial incentives for NZE buildings	Regulatory	Planned	Investors, users	2016–2017	AUER assisted by MF	New financial incentives	National budget Trading in white certificates
13. Improve the credit environment and provide low-interest loans for the construction of NZE buildings	Regulatory	Planned	Investors, users	Preparatory period 2016, deadline December 2018	AUER assisted by MF	Improved regulatory framework of the banking sector	Banks

Title of the Measure	*Category of the measure*	*Status of the measure*	*Target group or activity*	*Implementing period*	*Institution or organisation leading the measure*	*Intended outcome*	*Potential financing sources*
14. State support for housing loans, preferential fees/interest rates of housing loans for the purchase of residential units in NZE buildings	Regulatory	Planned	Networks, investors, users	January 2017	AUER assisted by MF	Provision of guarantees to housing loans from commercial banks	Bank loans at preferential terms
15. Business preferences for the construction of NZE buildings	Regulatory	Planned	Investors, energy traders	January 2017	AUER assisted by MF	Changes of legislation	-
16. Interoperability of institutional functions, objectives and actions for the implementation of efficient legislative and other measures to increase the number of NZE buildings	Administrative	Planned	State institutions	July 2016	MRRB, ME, AUER, MF, MOSV	Improved coordination	-
17. Raise public awareness on the importance of NZEB financing	Information	Planned	Investors, users, energy traders		AUER	Information campaigns carried out	-
18. Draw up a list of ESCO service providers	Information	Planned	Investors, users, energy traders	January 2017	ASED	List published on the AUER website	-
19. Training and development of NZEB competences	Information	Planned	Investors, users, designers, consultants, energy traders,	2016 - 2020	Universities	Improved administrative capacity, knowledge and skills	Operational Programmes

Title of the Measure	*Category of the measure*	*Status of the measure*	*Target group or activity*	*Implementing period*	*Institution or organisation leading the measure*	*Intended outcome*	*Potential financing sources*
			State and municipal administrations				
20. Maintain a database of new NZE buildings to enable assessment, analysis and updating of the national rules and standards (where applicable)	Regulatory			2018 – 2020	MRRB, universities	Updated technical standards (reviewed every five years)	National budget
21. Scientific research on the application of the national NZEB definition	Applied science	Planned	State institutions responsible for implementing EE standards	2016 – 2020	Technical universities	Up-to-date scientific basis of EE technical standards	Technical assistance under the OPs
22. Coordinate opportunities for financing NZEB projects with financing institutions and commercial banks	Information	Planned	Investors, users, designers, consultants, energy traders, state and municipal administrations	2016 – 2020	AUER, MRRB, ME	Improved credit terms and financial environment	AUER project, state budget

The above measures are implemented within the confines of the budgets available to the responsible institutions in the relevant year.

8. CONCLUSION

Together with the significant investment requirements, stakeholders should not overlook the need for relevant professional knowledge, skills and a creative approach in the pursuit of solutions. The national NZEB definition cannot be achieved directly and in all cases solely by a combination of individual energy-saving measures, but requires a creative integrated approach by architects, engineers, builders and consultant teams working to combine energy efficient building designs with advanced construction materials, products and technologies.

The implementation of the National NZEB plan is expected to achieve **final energy savings** of **23.1 ktoe** (**267.7 GWh**), and **primary energy savings** of **46.2 ktoe** (**535.4 GWh**), which accounts for 10.04% of the national energy saving target for 2020, excluding energy traders.

The expected environmental contribution of the NPSBNPE is CO_2 emission savings of 36 685 t by 2020.

ANNEX 1

General characteristics of existing public buildings with GFA above 250 m^2

Information Source: AUER

Distribution of the existing non-residential buildings by form of ownership

An analysis was made of **9 555** entries in a database provided by the AUER containing information about the basic technical parameters of municipal and state buildings. A sample of 8 611 entries considered sufficiently reliable for information analysis purposes was extracted from the initial dataset.

The buildings were divided by form of ownership and assigned to the following subsets:

- Form of ownership — number of buildings — buildings in which energy saving measures have been applied (ESM buildings) — buildings without any energy saving measures applied (non-ESM buildings);
- Form of ownership — GFA of the buildings — GFA in respect to which energy saving measures have been applied (ESM GFA) — GFA without any energy saving measures applied (non-ESM GFA).

Figure P1.1 Distribution of non-residential public buildings by form of ownership. Number of ESM (red bars) and non-ESM buildings (blue bars)

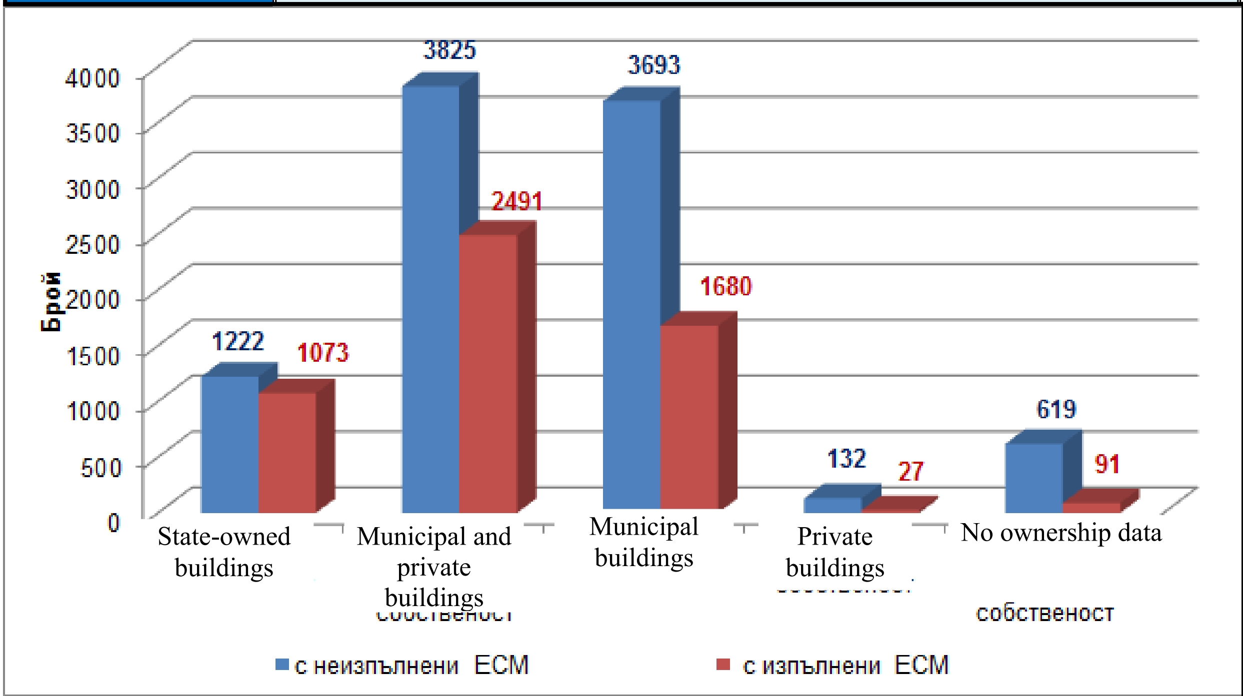
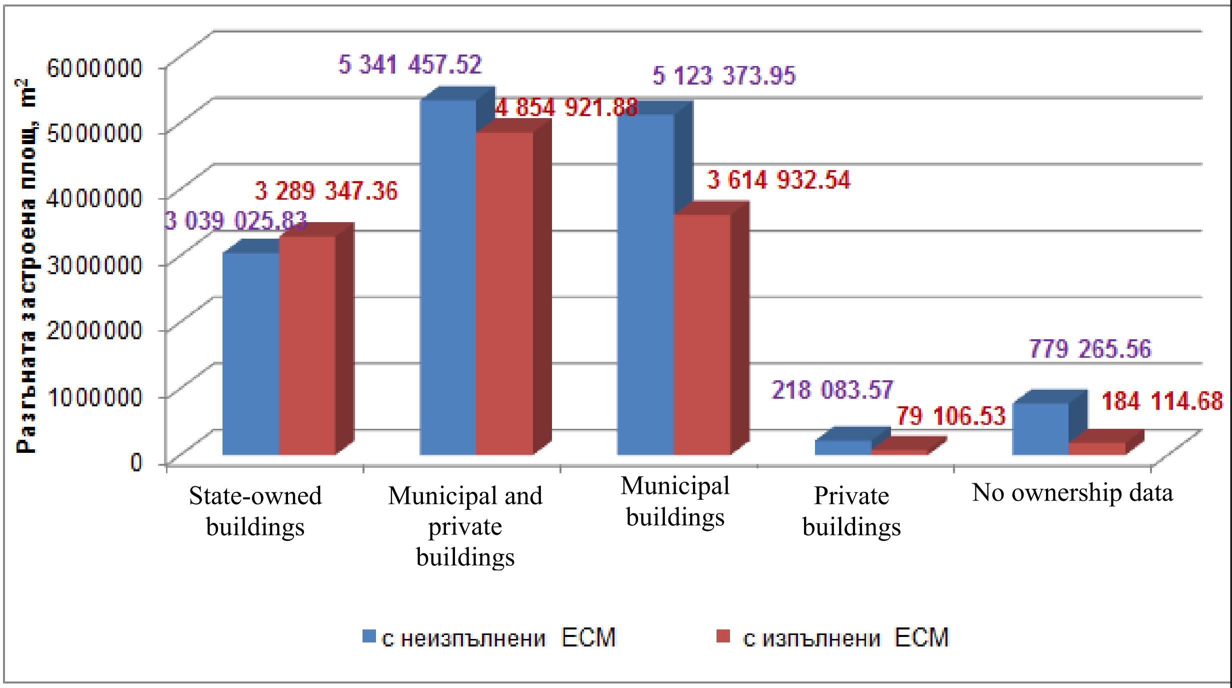
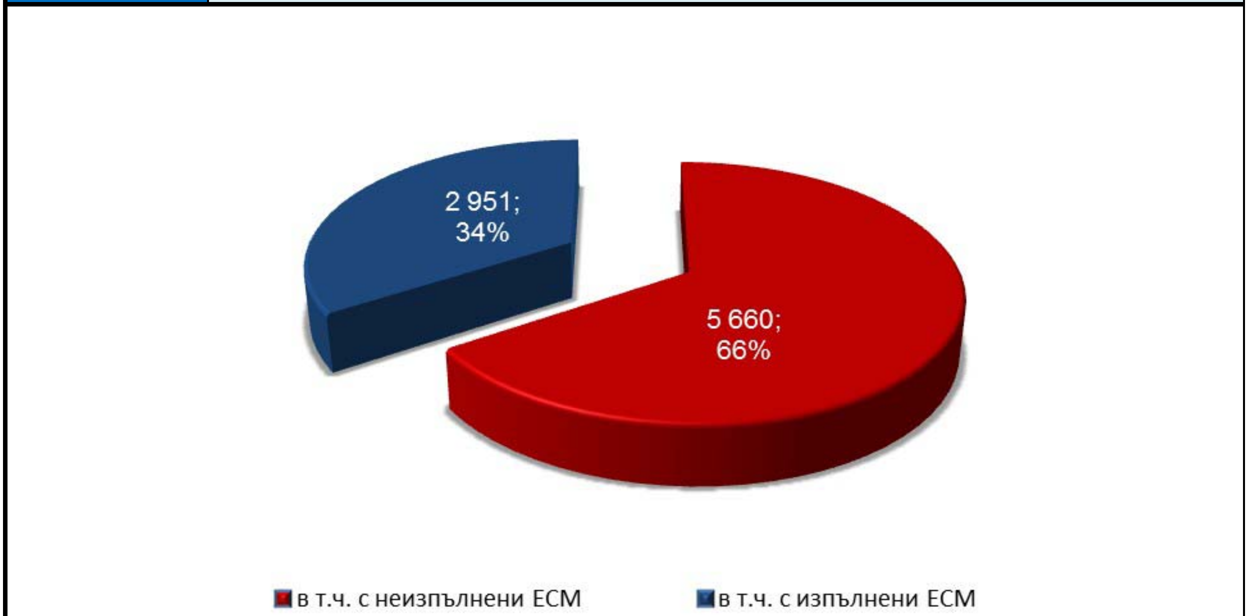


Figure P1.2	Distribution of non-residential public buildings by form of ownership. ESM GFA (red bars) and non-ESM GFA (blue bars)



A significant portion of state and municipal buildings were still non-ESM in the end of 2015, representing **5 660** buildings with combined GFA **9 162 307.72 m^2.** ESM have been applied in **2 951 buildings** with combined GFA **7 362 444.87 m^2** (Fig. P1.3).

Figure P1.3	Distribution of ESM (blue pie) and non-ESM (red pie) state and municipal buildings with GFA above 250 m^2 as of 2015



ANNEX 2

General characteristics of the existing residential buildings in Bulgaria

According to the most recent census, as at 1 February 2011 there were 3 887 149 residential units in Bulgaria, including 3 839 342 (98.8%) in residential buildings, 22 103 (0.6%) in student hostels, 21 339 (0.5%) in non-residential buildings, as well as 818 collective housing units and 3 547 (0.1%) primitive and mobile units. As at 1 February 2012 most of the residential units (65.9%) had two or three rooms.

National statistics divide the residential buildings into five main structural types:

- **Panel buildings** are those made of panels (prefabricated elements).
- **Reinforced concrete buildings** (reinforced concrete structure with slabs and columns) are monolithic buildings (with reinforced concrete slabs, large-size formwork (EPK), package-hoisted slabs (PPP), **skeleton buildings** – frame buildings, beamless-skeleton buildings, special structure buildings, etc.).
- **Brick buildings** (with concrete slabs) are buildings having brick walls and concrete slabs between the floors, but not having reinforced-concrete columns.
- **Brick buildings with trimmer joists without reinforced concrete** are buildings having brick walls and concrete slabs between the floors, but not having reinforced concrete columns.
- **Other buildings** are those made of stone, clay, timber, wooden boards or chipboards.

In the statistical information from the 2011 census the ‘other buildings’ group was further subdivided in accordance with the methodology of the National Statistical Institute (NSI).

Reinforced concrete buildings have a load bearing frame structure and floors of reinforced concrete, with walls made of panels, bricks or other materials.

Monolithic buildings have load bearing walls of brickwork or stonework and girders, beams and floors of reinforced concrete, but do not have reinforced concrete columns. Where only the floor structure of the buildings is made of prefabricated elements they also considered monolithic buildings.

Residential buildings are those initially built or subsequently reconstructed for occupancy by one or more households. The survey includes inhabited and uninhabited residential buildings, summer kitchens (if they are standalone units), hostels, pensions, monasteries and retirement homes inhabited by collective households.

A residential unit is a structurally individualised and standalone space initially built or subsequently reconstructed for residential occupancy, consisting of one or more premises (living or service rooms) and has one or more independent exits to a common area (staircase, yard or directly to a street), regardless of whether it has a purpose-built kitchen.

A residential unit is also any standalone space (room) that is not connected to other spaces, has an independent exit to a common area (staircase, yard or directly to a street), and is used both as a kitchen and for living or only for living.

The reported numbers include inhabited and uninhabited but inhabitable residential units: hostels, pensions, monasteries, retirement homes occupied by collective households, summer kitchens provided that they are standalone units and residential units in non-residential buildings (administrative, farm and other buildings such as schoolhouses, hospitals, hotels and military barracks) and provided that they are permanently occupied by households.

A residential unit with two or three floors located in one residential building and occupied by a single household is considered as one residential unit. If each floor of such a building is occupied by a single household, each floor is deemed a separate residential unit.

In hotel-type buildings (corridor system) the rooms inhabited by separate households are considered standalone residential units. In the case of buildings inhabited by collective households (pensions, specialised homes, monasteries, prisons, etc.) all rooms occupied by persons belonging to the collective household and all service rooms used by these persons form one residential unit.

When the residential units are assigned to groups based on the number of rooms, a room is any living room (hall), excluding vestibules, kitchens and rooms with an area below 4 m^2.

The living area includes the area of living rooms, bedrooms, sleeping quarters, canteens, dayrooms, rooms used by scholars as work offices and libraries, guestrooms and halls.

The service area includes the area of service premises, rooms, kitchens with an area below 4 m^2, vestibules with a portal or other partition, corridors, hallways, bathrooms, toilets, combined bathrooms and toilets, larders, cloakrooms and other service premises (drying rooms, laundry rooms, balconies and loggias) regardless of their area.

Kitchen areas include kitchens with an area above 4 m^2.

The useful area of a residential unit is the sum total of living, service and kitchen areas.

Primitive residential units include those accommodated in basements or garrets of residential buildings, cabins (assembled from individual boards), huts, buildings deemed unfit for habitation, buildings under construction occupied by workers fitting out the building and so on.

- ***Classification by structural system***

Figure P2.1	Distribution of useful residential area in 2011 by structural system

Key: brickwork (with concrete slabs) 37%, brickwork (with trimmer joists) 26%, panel buildings 22%, reinforced-concrete buildings 9%, other 6%.

The analysis demonstrated that four structural systems are prevalent:

- panels (prefabricated panels for residential units);
- reinforced concrete (monolithic reinforced concrete, large-area formwork, package-hoisted slabs, area formwork);
- brickwork (with concrete slabs) (monolithic reinforced concrete);
- brickwork (with trimmer joists) (metal joists).

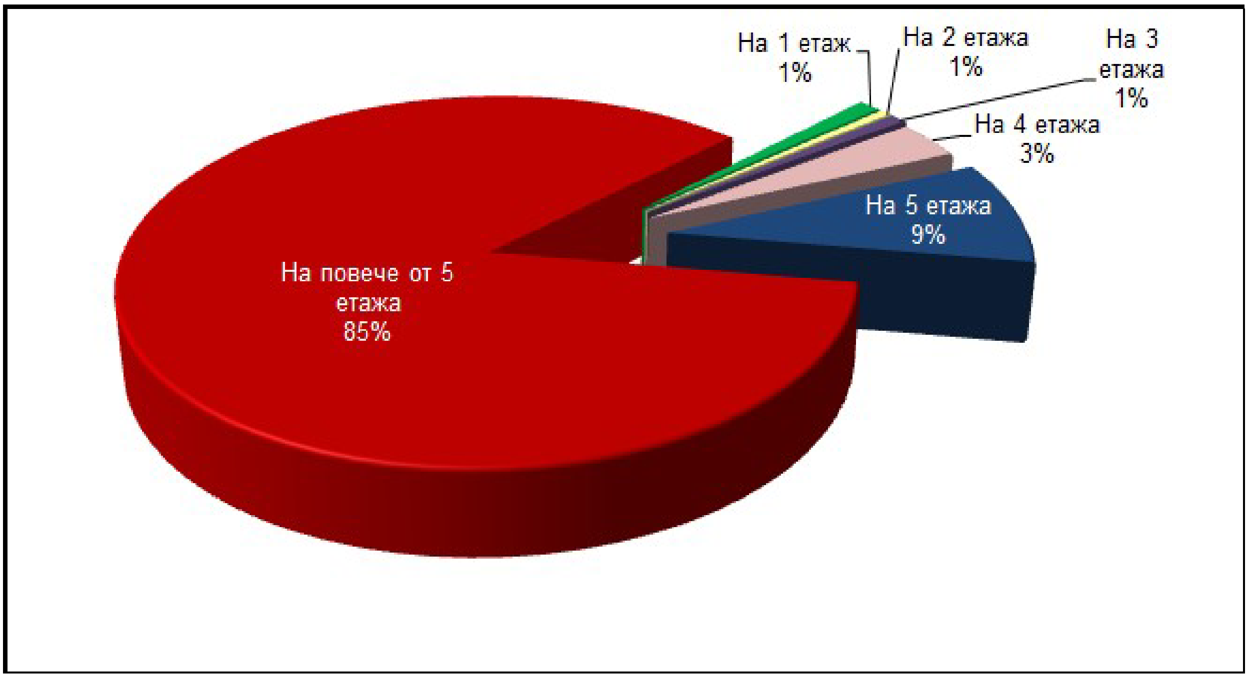
These accounted for 93.8% of the combined useful area of all residential units in 2011, an increase of 3.3% since 2001.

The following analysis of indicators focuses on these four main groups.

❖ *Classification by number of floors*

This technical indicator is relevant to appraisals used for the purposes of the Condominium Management Act (ZUES) for estimating the costs related to the maintenance and management of the building as well as for assessing the applicable energy saving measures. Figure P2.2 presents the distribution of panel buildings by number of floors.

Figure P2.2	Distribution of residential panel buildings number of floors

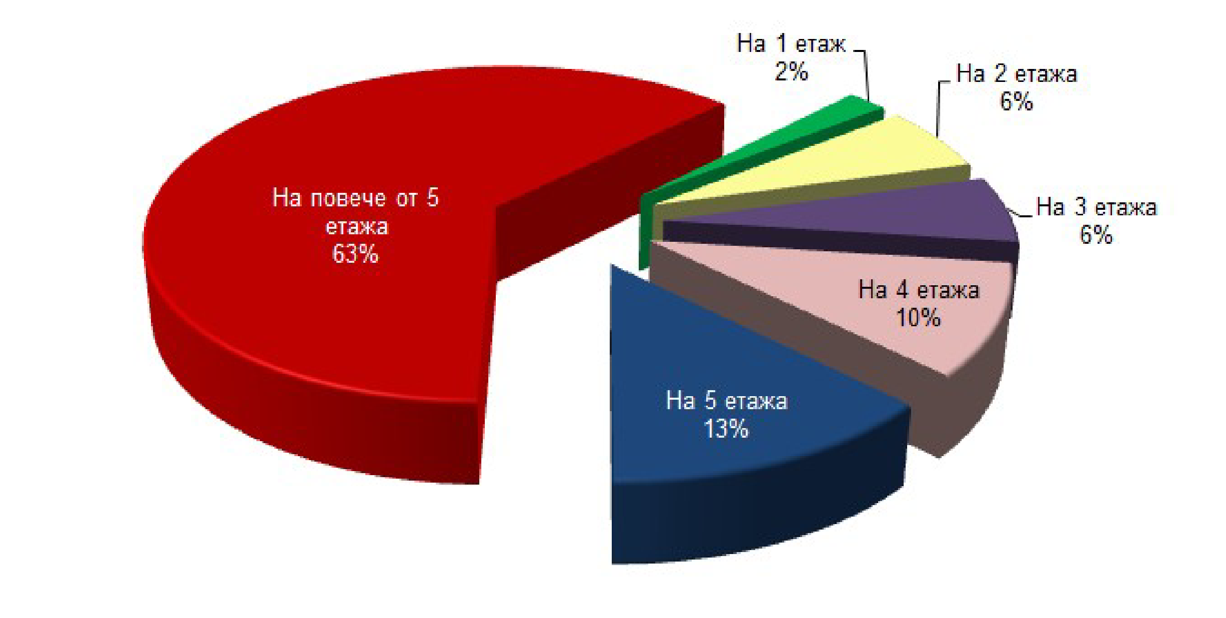


Key: more than 5 floors 85%, 5 floors 9%, 4 floors 3%, 3 floors 1%, 2 floors 1% and 1 floor 1%.

National specificities: More than **85%** of the panel buildings have **more than 5 floors**. These buildings are occupied by families of diverse social and cultural status, which largely prevents the proper management either of the common areas or the individual residential units.

Figure P2.3 presents the distribution of buildings with reinforced-concrete structure by number of floors.

Figure P2.3	Distribution of residential buildings with reinforced concrete structure by number of floors



Key: more than 5 floors 64%, 5 floors 13%, 4 floors 10%, 3 floors 6%, 2 floors 6% and 1 floor 2%.

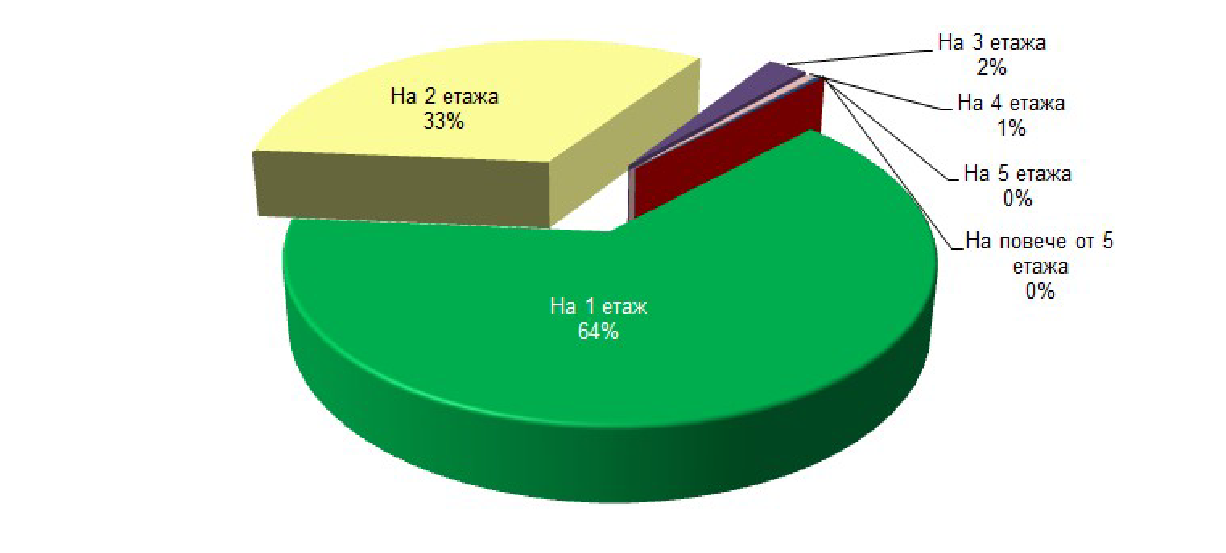
Figure P2.4 presents the distribution of brickwork buildings (with concrete slabs) by number of floors.

Figure P2.4	Distribution of residential brickwork buildings (with concrete slabs) by number of floors

Key: more than 5 floors 18%, 5 floors 10%, 4 floors 10%, 3 floors 12%, 2 floors 33% and 1 floor 17%.

Figure P2.5 presents the distribution of buildings with external brick walls and trimmer joist by number of floors.

Figure P2.5	Distribution of residential brickwork buildings (with timber joists) by number of floors



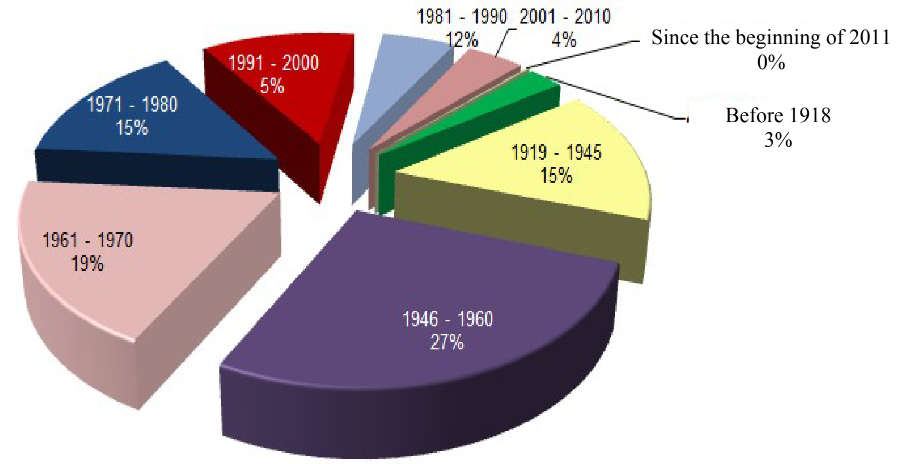
Key: more than 5 floors 0%, 5 floors 0%, 4 floors 1%, 3 floors 2%, 2 floors 33% and 1 floor 64%.

❖ *Classification by age (year of completion)*

This indicator is relevant for assessment of the overall operational condition of the residential building stock, planning of programmes for the renovation of existing residential buildings and the related financial parameters. At the level of individual buildings the impact of this indicator on the costs related the building and to the residential units in the building is variable since the indicator is strongly influenced by individual factors such as user behaviour.

Figure P2.6 presents the distribution of residential buildings in Bulgaria by the period in which they are built.

Figure P2.6	Distribution of buildings by the period in which they were built based on the 2011 Census



❖ Overall condition and common problems with existing residential buildings

The technical state of the buildings made of large prefabricated panels is far from perfect. The problems with these buildings have been exacerbated over the years by inadequate management, withdrawal of owners from communal life, lack of any maintenance of the common areas in the vast majority of cases, piecemeal interventions on façades without clear quantitative and qualitative measurement of their effect, frequent non-payment of contributions to a repair and maintenance fund as required by the Condominium Management Act, occupant misbehaviour, lack of financial means for routine and major maintenance as well as for energy and other audits required by different laws.

Many expert assessments and analyses have confirmed that the internal heating systems of more than 10% of the panel-type residential buildings are in urgent need of repair. Roofs, facades, electrical and lighting systems are in poor order. The energy performance of these buildings is substandard with much heat loss through windows and doors. These are only some aspects of the serious decline in the thermal and sanitary comfort of these buildings, leading to a much shorter lifecycle and the need for serious in-depth engineering assessments.

Accordingly and in order to spread the impact of renovation initiatives, the National Programme For Energy Efficiency of Multifamily Buildings, financed by the European Investment Bank through the Bulgarian Development Bank, supports energy saving measures aimed at achieving the minimum requirements, in other words energy consumption Class C.

Due to the very large number non-renovated residential buildings and their large GFA, the programme is involved mainly in repairs and maintenance and currently finances very few measures aimed at achieving nearly-zero energy consumption.

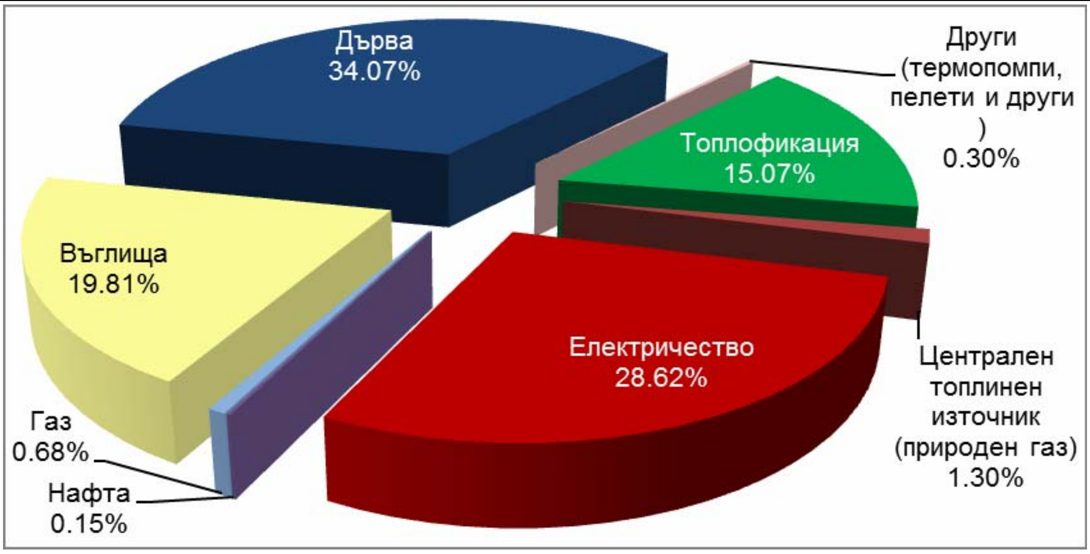
❖ *Classification of residential buildings by heat-supply systems*

This indicator is relevant for the energy consumption in buildings and assessment of the level of technologies used, the serviceability and efficiency of heat generators and of the systems distributing the heat within the buildings, the microclimate parameters maintained and the level of living comfort. The indicator has a direct impact on the quality of life in the residential units, on thermal and sanitary comfort and on addressing energy shortcomings.

Although access to energy is a **universal right**, energy is also a traded commodity. The issues related to energy quality at end-user level and security of the energy supply therefore have to do with the notion of a 'dignified home'.

Figure P2.7 shows a breakdown by type of the various heat-supply systems used for residential heating in Bulgaria.

Figure P2.7 Relative shares of energies/systems used for residential heating in Bulgaria



Key

Firewood	34.07%	Heating oil	0.15%
Electricity	28.62%	District heat source (natural gas)	1.30%
Coal	19.81%	Gas	0.68%
District heating	15.07%	Other (heat pumps, pellets, etc.)	0.30%

The analysis of statistical data related to the heat supply of 2 666 733 residential units in 2011 revealed **a major imbalance in the use of fuels and energies for residential heating**. The energy mix is dominated by four sources: firewood, electricity, coal and district heating.

The use of electricity for heating remains relatively high while the use of natural gas for generating heat by combustion in local or district heat sources is marginal. The share of electricity in the final energy consumption of Bulgarian households is the highest in Europe, **39%** against an EU-average of 30%. This applies to EU-27 as the assessment was made before Croatia joined the EU.

Household gasification is making a slow progress. A snapshot for December 2013, made on the basis of data from the Bulgarian Natural Gas Association (BAPG), reveals that the blue fuel is used by as few as 1.5% of Bulgarian households in 20 cities against an EU-average of 50%. The Bulgarian gas industry expects to deliver gas to 30% of the Bulgarian population by 2020 in implementation of the National Concept for Accelerated Gasification of Bulgaria, a BAPG initiative. If this end-use level is reached, the national consumption of natural gas will rise to 6 billion Nm^3 per year or **750** Nm^3 per capita, i.e. Bulgaria will approach average EU gas consumption, with its concomitant environmental and social benefits.

District heating remains **the most efficient heating option in cities with developed heat transmission networks,** despite the many controversies over the distribution, measurement and reporting of heat in the homes of final users. The service is available in **12** Bulgarian cities. Just **16%** of Bulgarian citizens receive district heating services while in some EU Member States this share varies from **23% to 64%**. Households use **74%** of the heat supplied by district heating companies. Although the substations in the majority of buildings connected to district heating networks have been replaced and fully modernised, the internal heating systems connected to the substations are in poor condition and much heat is lost in the internal distribution networks due to the characteristics of these condominiums. The common heating systems in multifamily buildings are based on traditional designs. In the majority of buildings they are in poor order, with obsolete elements and pipe networks. A national system has been introduced for individual reporting (**heat allocation**) of heat in the standalone units in the buildings. It is difficult to operate this system due to the uneven distribution of heat loads because some subscribers have opted out of the district heating service while others abuse the system by declaring that they have opted out while continuing to use the heat.

The NDPEE 2014–2020 also shows that households are the third largest users of energy, with their consumption remaining essentially constant at **2.1–2.2 Mtoe** per year. The share of the residential sector in final energy consumption also has also remained constant at **25–26%**. Energy use per residential unit is rising, mostly driven by electricity use, which is growing at a particularly fast rate. The drivers of this tendency have not been examined thoroughly, although one possible explanation is the increasing use of energy for cooling in summertime.

The risk associated with exacerbated energy poverty has been the subject matter of an in-depth analysis of household spending during a period of 14 years, from 1999 to 2014, using data from the NSI. The analysis revealed that during the 14-year period the average household spend is BGN **5 854.64** per year, while consumer spending on this basis is **84.5%** of that figure or BGN **4 948** per year.

Average spending on housing, water, electricity and fuels for residential purposes was **41%** of that for food and non-alcoholic beverages, nearly **three times** the annual expenditure on healthcare, nearly **four times** the annual expenditure on culture and education and more than **four times** the annual expenditure on clothing and shoes. Spending on housing, water, electricity and fuels for residential purposes roughly equalled spending on transport, communications, taxes, cigarettes and alcoholic beverages during the period under consideration.

ANNEX 3

Source: Regulation No 7 of 2004 on the energy efficiency of buildings (amended State Gazette No 85 of 2009 and SG 27 of 2015)

Reference values of the heat transmission factor of blind-type envelope components applicable to the design of new buildings, to be met when undertaking reconstruction, major renovation, major repair or restructuring of existing buildings

Ref.	Types of envelope components	U, W/m²K	
		Buildings with average temperature of the internal volume $\theta_i \geq 15$ °C	Buildings with average temperature of the internal volume $\theta_i \geq 15$ °C
1.	External walls bordering with external air	0.28	0.35
2.	Walls of heated spaces bordering with unheated spaces where the delta between the average temperatures of the internal volumes of the heated and unheated spaces is equal to or greater than 5 °C	0.50	0.63
3.	External walls of heated underground floors bordering with ground	0.60	0.75
4.	Floor slabs above unheated underground floors	0.50	0.63
5.	Floors of heated spaces directly bordering with ground in buildings without underground floors	0.40	0.50
6.	Floors of heated basements bordering with ground	0.45	0.56
7.	Floors of heated spaces bordering with external air and floors above passageways, other open-air spaces and cantilevers	0.25	0.32
8.	Walls, ceilings and floors with embedded heating systems and bordering with external air	0.40	0.50
9.	Flat roofs without air layers or with air layers with thickness $\delta \leq 0{,}30$ m; ceilings of inclined or pitched roofs with heated under-roof spaces intended for living	0.25	0.32
10.	Ceiling slabs of unheated flat roofs with thickness $\delta > 0{,}30$ m Ceiling slabs of unheated, ventilated or non-ventilated inclined/pitched roofs with or without envelope components in the under-roof spaces	0.30	0.38
11.	Blind external doors bordering with external air	2.2	2.75

12.	Blind doors bordering with unheated spaces	3.5	4.38

Source: Regulation No 7 of 2004 on the energy efficiency of buildings (amended SG 85 of 2009 and SG 27 of 2015)

Reference values of the heat transmission factor of transparent enclosures (windows and doors) of residential and non-residential buildings

Ref.	Type of the assembled element — finished window system	U_w, W/m^{2}K
1.	External windows, glazed doors and panes with wings rotating around a vertical or horizontal axis, with frames of extruded polyvinylchloride (PVC) and three or more void chambers; variously openable roof windows with PVC frames	1.4
2.	External windows, glazed doors and panes with wings rotating around a vertical or horizontal axis and with wooden frames; variously openable roof windows with wooden frames	1.6/1.8
3.	External windows, glazed doors and panes with wings rotating around a vertical or horizontal axis with aluminium frames and interrupted thermal bridge	1.7
4.	Curtain walls/enhanced curtain walls	1.75/1.9

- ***Regulatory requirements for heat generation systems and systems intended for maintaining the microclimate in buildings***

Source: ***Regulation No 7 of 2004 on the energy efficiency of buildings*** (amended SG 85 of 2009 and SG 27 of 2015)

The assessment of the annual energy consumption of buildings with planned or existing HVAC systems includes inter alia the recovery of heat from spent air (heat recuperation effect). The average seasonal thermal efficiency ($n_{r,min}$) of the plants (air-air recuperators) that recover heat from the spent air of ventilation systems operated in heating mode cannot be lower than 70%: $\eta_{r,min} \geq 70\%$.

Requirements for the efficiency factors of boilers including condensation boilers and biomass-fired boilers at rated and partial load

Boiler types	Capacity (kW)	Efficiency at rated capacity, Pn		Efficiency at partial load	
		Average water temperature, °C	Required efficiency,%	Average water temperature, °C	Required efficiency,%
Standard boilers	4–400	70	>= 84+2*logPn	>= 50	>= 80+3*logPn
Low-temperature boilers[1]	4–400	70	>= 87.5+1.5*logPn	40	>= 87.5+1.5*logPn
Gas condensation boilers	4–400	70	>= 91+1*logPn	30[2]	>= 97+1*logPn
Improved condensation boilers	4–400	70	9.,0 +1.0*logPn		
	Year of manufacture				
Biomass-fired boilers with natural draft	Made before 1978	70	78.0 +2.0* log(Φ_{Pn}/1000)	50	72.0 +3.0* log(Φ_{Pn}/1000)
	Made in 1978–1994	70	80.0 +2.0* log(Φ_{Pn}/1000)	50	75.0 +3.0* log(Φ_{Pn}/1000)
	Made after 1994	70	81.0 +2.0* log(Φ_{Pn} /1000)	50	77.0 +3.0* log(Φ_{Pn}/1000)
Biomass-fired boilers with forced draft	Made before 1978	70	80.0 +2.0* log(Φ_{Pn}/1000)	50	75.0 +3.0* log(Φ_{Pn}/1000)
	Made in 1978–1986	70	82.0 +2.0* log(Φ_{Pn} /1000)	50	77.5 +3.0* log(Φ_{Pn} /1000)
	Made in 1986–1994	70	84.0 +2.0* log(Φ_{Pn} /1000)	50	80.0 +3.0* log(Φ_{Pn} /1000)
	Made after 1994	70	85.0 +2.0* log(Φ_{Pn} /1000)(3)	50	81.5 +3.0* log(Φ_{Pn} /1000)

*Notes: * — multiplication sign*
(1) Including gas condensation boilers fired by liquid fuels.
(2) Temperature of the feed water in the boiler.
(3) Thermal capacity of the boiler at rated pressure.

The energy generated by heat pumps is deemed renewable energy at FEC level if the minimum value of the average seasonal efficiency of heat pumps with electric compressors in heating mode is not lower than **SPF_{min}=3.5**.

Where the heat pumps use thermal energy (directly or from the combustion of fuels), the energy generated by them is deemed renewable energy at FEC level if the minimum value of the average seasonal efficiency of the heat pump is not lower than **SPF_{min}=1.15.**

The calculation of the transformation coefficient (SCOP) takes into account the energy consumed by heat pump circulators in accordance with Commission Regulation (EC) No 641/2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for glandless standalone circulators and glandless circulators integrated in products, and with BDS EN 14511. The methodology for absorption heat pumps is according to BDS EN 12309-2.

The amount of primary energy is determined by applying a factor e_p that reflects the losses in the extraction and/or production and transmission of energy resources and energy. The primary energy demand of a building (Q_p) in kWh is calculated using the following formula:

$$Q_p = \sum_i Q_i \cdot e_{p,i} ,$$

Where:

Q_p is the primary energy demand, kWh;

Q_i is the gross demand for the i-th energy, kWh;

$e_{p,i}$ is a factor reflecting the losses in the extraction/production and transmission of the i-th component of the gross energy demand.

The values of the e_p factor are as follows:

Energy resource/energy	e_p factor	Environmental Equivalency Factor f_i
	-	g CO_2/KWh
Industrial gasoil, petrol and diesel	1.1	267
Fuel oil	1.1	279
Natural gas	1.1	202
Propane-butane	1.1	227
Black coal	1.2	341
Lignite/brown coal	1.2	364
Anthracite	1.2	354
Coal briquettes	1.25	351
Wooden pellets and briquettes, firewood	1.05	43
Heat obtained from district heating systems	1.30	290
Electricity	3.0	819

❖ *Relevant definitions:*

'Conditioned area' is the floor area of the conditioned volume;

'Thermal zone' is a standalone part of a building that comprises spaces with identical functional use, receives heat and/or cold from the same system, is occupied in the same manner, has envelope components with the same orientation to the sky (if cooling is required) and is subject to specific requirements for ensuring uniform parameters of the microclimate in heating and cooling mode where the difference between the temperatures of the various spaces in a given mode is lower than 4 K.

'Conditioned volume' is a volume of the building that is subject to regulatory requirements relating to all or part of the microclimate parameters (temperature, air mobility, relative humidity, air cleanness (amount of fresh air), lighting and noise levels).

'Energy from renewable sources' is the energy obtained from renewable sources: wind energy, solar energy, energy stored as heat in the atmospheric air (aerothermal energy), energy stored as heat under the surface of firm soil (geothermal energy), energy stored as heat in surface water (hydrothermal energy), oceanic energy, hydropower energy, biomass, gas from renewable sources, landfill gas and gas from wastewater treatment plants.

'Major repair within the meaning of the ZEE' is repair of more than **25%** of the area of the external envelope components of a building.

'Primary energy' is the amount of unconverted and/or untransformed energy. For the purposes of determining the energy consumption class of a building, primary energy does not include energy from renewable sources (i.e. it includes only conventional energy sources).

'Air change rate' is the amount of indoor air replaced with outdoor air in one hour, calculated on the basis of the net volume of the building.

'Energy efficiency in buildings' is the achievement and maintenance of standards related to the microclimate in the buildings at minimum financial expenses for energy.