UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE

Joint Task Force on Energy Efficiency Standards in Buildings

Study on Mapping of Energy Efficiency Standards and Technologies in Buildings in the UNECE Region

Annex III: Countries Information Sheets

Geneva, 2018

Austria

Austria has had prescriptive energy efficiency requirements for buildings within each of the 9 regions (Lander) since the 1970's. The first nationwide performance-based code was introduced in 2006, to be individually implemented by each of the Lander. The latest 2011 code and supporting policies encompass many dynamic aspects including, air-tightness testing, thermal bridging considerations, well established EPC programs and incentive schemes, voluntary low energy classes and the implementation of Passive House standards by 2015 for residential buildings. National Target date for Zero Energy Buildings (nZEB): 2018 public buildings, 2020 all other buildings [1].

Main regulatory documents related to building energy codes

OIB - Richtlinie 6, National Code

- 2011
- Climate zones
- Performance Codes for Refurbishments
- Performance Codes for New Builds

The OIB is a performance-based code that requires a mandatory energy frame calculation to establish the expected primary energy consumption of residential and non-residential building as well as existing buildings undergoing renovation (25-38% higher than new builds).

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Passive cooling
- Heat recovery
- Thermal bridges

Software: No data

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

EPBD Energy Performance Certificate: Class A, A++, C, E, G

Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Residential buildings:
  One family;
  Multiple family buildings
- Commercial buildings:
  Offices; Retail and wholesale; Hotels; Hospitals; Educational buildings
- Public buildings:
  Offices; Hospitals; Educational buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Energy used for: Space cooling, Space heating, Ventilation

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Boiler/AC system
- Specified thermal comfort levels for summer and winter
- Solar gains (G-values)
- Building parts (lifts, pumps etc)
- Appliances
- Renewable Energy (solar, PV, others):

Values for New Buildings
Residential Buildings
U-values (W/(m2·K): Roof – 0.24; Wall – 0.35; Floor-0.4; Window – 1.4
Energy Performance: 66kwh
Non-Residential Buildings
U-values (W/(m2·K): Roof – 0.2; Wall – 0.35; Floor-0.4; Window – 1.4
Energy Performance: 22.75kwh
Other Requirements Set for Thermal Bridge demands
Ventilation: Requirements depend on type and size of system.
Domestic Hot Water COP - Heat Pump:
Requirements depend on type and size of system.
Value for airtightness: n50 is 3.0 & n50 is 1.5 (residential and non-residential)
Heat Recovery, Technical HVAC systems, Efficient Lighting

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Refusal of permission to occupy, Refusal of permission to construct

Energy performance monitoring requirements: Yes, during construction, Post completion

Belgium

Belgium is divided into three regions: the Flemish Region that occupies the northern half with Dutch-speaking communities; the Walloon Region, which occupies the southern-half and is made-up largely of French-speaking communities, with a small German-speaking community in the southeast; and Brussels, the administrative capital region, an officially tri-lingual city inside the Flemish region. The most recent numbers by the FPS Economy, SMEs, Self-Employed and Energy indicate a housing stock of 5,318,905 residential units in Belgium in 2015. 58.2% of all residential units are located in Flanders, 31.2% in Wallonia and 10.6% in Brussels. The proportion of apartments in the total Belgian housing stock has increased by 30% in the last 10 years. Each region and community has a separate Law regulating the energy performance of buildings [2].

Main regulatory documents related to building energy codes

Réglementation sur la Performance Energétique des Bâtiments (PEB Wallonia) 2012
Energieprestatie en Binnenklimaat (EPB Flanders) 2012
Performance Energétique des Bâtiments (PEB Brussels) 2011

- 2011-2012

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridges

Software: Yes, Flanders EPB Software version 1.6.2

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

PEB Energy Performance Certificate (Brussels) 2011
EPB Energy Performance Certificate (Flanders) 2011
PEB Energy Performance Certificate (Wallonia) 2010

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

End-uses energy: Auxiliary devices, Space cooling, Space heating, Water heating, Ventilation

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Specified thermal comfort levels for summer and winter
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewable (Cogeneration, biomass and SPV are considered in calculating E values)

PEB Wallonia, Insulation:

U-Values (W/m2.K)	Windows	Walls	Roof	Door	Floor
All climate zones	1.3	0.32	0.27	2.2	0.35

EPB Flanders, Insulation:

U-Values (W/m2.K)	Floor	Roof	Door	Windows
All climate zones	0.35	0.27	2.2	2.2

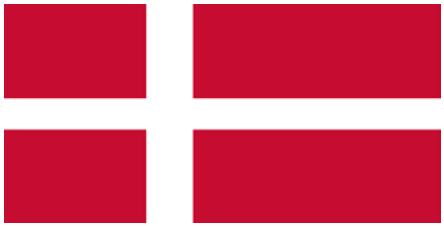
Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country:
Ggrants (Belgium Flanders Building Renovation Grant (Flanders) 2007); Tax rebate (Tax reduction according to energy savings - Recipient Types: E60 buildings receive 20% reduction, E40 buildings receive 40% reduction)

Energy performance monitoring requirements: No data

Denmark



The Danish building code plays a key role in ensuring energy efficiency in both new and existing buildings. The code is reviewed and updated at least every five years to reflect developments in technology and prices. It contains minimum energy performance requirements for new buildings and rules for upgrading energy efficiency as part of the renovation of existing buildings. The energy requirements have been strengthened considerably over the last 25 years for new buildings. A norm "lavenergiklasse 2015" (low-energy class 2015) became a legal requirement in 2015, and "bygningsklasse 2020" (building class 2020) is currently voluntary [3, 4].

Main regulatory documents related to building energy codes

Building Regulations 2010 (BR10)
Building Regulations 2015 (BR15)

- 2010, 2016
- Climate zones

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions

Software: Yes, SBi-Direction 213

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Building Regulations 2010: Dwellings: 52.5 kWh/m2/year+ (1650 kWh/year divided by heated floor area)
Low energy residential buildings (2015): 30 kWh/m2/year+ (1000 kWh/year divided by heated floor area)
EBPD energy performance certificate. Class: A1, A2, B, C, D, E, F, G
Passive House Class: Maximum cooling demand: 5 kWh/m².year
Maximum space heating demand: 15 kWh/m².year
Maximum total primary energy demand: 120 kWh/m².year
Swan: Relative to national regulations - at least 25% below regulated annual energy consumption
Zero Energy Buildings (ZEB):
25%reduction in energy consumption compared to 2008 levels (2010)
50% reduction in energy consumption compared to 2008 levels (2014)
75% reduction in energy consumption compared to 2008 levels (2020)

Stringency: Mixed (both voluntary and mandatory)

Existence of national registry database for EPC in your country: No data

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Energy used for: Space cooling, Space heating, Water heating, Ventilation, Auxiliary devices, Lighting interior, Humidification

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Boiler/AC system
- Specified thermal comfort levels for summer and winter
- Solar gains (G-values)
- Renewables

Insulation

U-Values (W/m2.K)	Walls	Windows	Floor	Roof
All climate zones	0.3	1.8	0.2	0.2

Windows (kWh/m2/year)	Solar energy gains
All climate zones	33

Skylights: Energy gains through rooflights must not be less than -10kWh/m2/year, in 2015 it should not be less than - 17kWh/m2/year
Air Leakage
Dwellings: 1.5 l/(s.m2) at 50 Pa
Low energy residential buildings (2015): 1.01 l/(s.m2) at 50 Pa
Space Heating System: Ventilation installations must incorporate heat recovery with a dry temperature efficiency of no less than 70% (80% for single dwellings) Heat pumps for heat recovery must have a minimum coefficient of performance of 3.6 in heating mode.
Water Heating System: Domestic water systems supplied by a domestic ventialtion heat pump must have a minimum COP (coefficient of performance) at the draw off point of 3.1.
Lighting: No requirement
Renewable Energy: Solar heating systems must be provided when the expected hot water consumption exceeds 2000l per day and able to meet 95% of demand

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: No data

Energy performance monitoring requirements: No data

Finland

At the end of 2016, there were 2,968,000 dwellings in Finland. Most dwellings have been built in the 1970s- and 1980`s. Residential building construction has centred in urban municipalities. In all, 78 per cent of the dwellings completed in the 1995 to 2016 period are located in urban areas. At the end of 2016, 46 per cent of all dwellings were in blocks of flats, that is 198,000 more dwellings in blocks of flats than in detached houses. The share of district heating (DH) in Finland is quite high, almost half of the population uses the services of the DH. The main technology of low-rise housing in Finland is a wooden frame-panel. Finland has had prescriptive energy efficiency requirements for buildings since the 1990's. The first performance-based code is the latest 2012 code installment [5].

Main regulatory documents related to building energy codes

National Building Code of Finland 2012
Energy performance of buildings undergoing renovation or alteration

- 4 Climate zones: 1: Cool, Dry, Marine; 2: Cold, Dry; 3: Very Cold; 4: Subarctic.

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge
- Dehumidification
- Heat recovery
- Passive cooling

Software: No data

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Energy Performance Certificate (2008): Buildings are classified into 7 categories, and the calculation of energy efficiency is based on a so-called E-number. The E-number is made up of a building's annual calculated consumption of purchased energy weighted with various types of energy coefficients.
Nordic Ecolabel (Swan) (2009): Relative to national regulations - at least 25% below regulated annual energy consumption.
Nearly Zero Energy Buildings: New public buildings have to be nearly zero-energy buildings (2018); all new buildings have to be nearly zero-energy buildings (2020)

Stringency: Mixed (both voluntary and mandatory)

Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Residential buildings: One family, Multiple family buildings
- Commercial buildings: Offices, Retail and wholesale, Hotels, Hospitals
- Educational buildings
- Public buildings: Offices, Hospitals, Educational buildings
- E-value must be calculated.

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Energy used for: Space cooling, Space heating, Water heating, Appliances, Equipment, Lighting interior, Ventilation

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Boiler/AC system
- Specified thermal comfort levels for summer and winter
- Solar gains (G-values)
- Renewables

Insulation

U-Values (W/m2.K)	Walls	Floor	Roof
Building elements of warm and cooled cold spaces	0.17	0.09	0.09
Building elements of semi-warm spaces	0.26	0.14	

Windows

U-Values (W/m2.K)	Windows
Building elements of warm and cooled cold spaces	1
Building elements of semi-warm spaces	1.4

Total window area should not exceed 50% of total area of external walls
Air Leakage: 4 m3/(h.m2) at 50 Pa

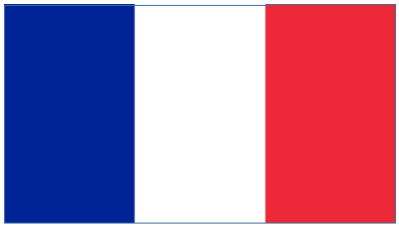
Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Penalties Non. Grants from the state budget, which cover up to 25 % of approved costs. Tax rebate.

Energy performance monitoring requirements:
Yes, during construction, Post completion

France



Thermal regulations RT 2005 set insulation, envelope, and HVAC standards for energy efficiency for all new and existing buildings in France. France has had prescriptive building energy efficiency requirements since 1955. The first performance-based standard was implemented in 2005 following the release of the Energy Performance of Buildings Directive (EPBD) requirements in 2002. The RT2012 reflect the demands of the EPBD recast, with compliant buildings aiming to be approximately 40% more efficient than buildings built according to the 2005 regulations. The bioclimatic coefficient Bbio is a new indicator introduced along with RT 2012. It measures the building's efficiency in terms of the need for heating, air conditioning and lighting, regardless of the energy systems in place and light [6].

Main regulatory documents related to building energy codes

Decree of 24 may 2006 on the thermal characteristics of new buildings and new parts of buildings
Decree of 26 October 2010 concerning the thermal characteristics and energy performance requirements of new buildings and new parts of buildings
French Thermal Regulation RT 2012

- Climate zones: H1a, H1b, H1c, H2a, H2b, H2c, H2d, H3

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions

Softwares: Yes, Clima-Win, Cypebat, DesignBuilder, Lesosai, Visual TTH, ArchiWisard, Pleiades & Comfie, U22WinRT 2012

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses (One Family)
- Apartment blocks (Multifamily)
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: Yes, HQE, EN 15804 and EN 15977 – in the aim of generating a standardized environmental quality evaluation tool for construction materials and products

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses (One Family)
- Apartment blocks (Multifamily)
- Commercial buildings
- Public buildings

- new residential (No in RT 2006 & 2010)
- new non-residential
- existing residential (No in RT 2006 & 2010)
- existing non-residential

Stringency: Mandatory

The coefficient U-values of mean reference loss through the walls, floors and the door and window openings of the building: Yes

Space cooling, Space heating, Water heating, Lighting interior, Ventilation. The conversion of primary energy

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Specified thermal comfort levels for summer
- Solar gains (G-values)
- Renewables

Insulation: Average U value <=0.36 W/m2.K Ratio of global average linear thermal transmittance <=0.28 W/m2.K
Air Leakage: 0.60 m3/h.m2 at 4 Pa for single family building 1 m3/h.m2 at 4 Pa for multi-family building
Space Heating System: To be connected to urban heating system supplied for more than 50% by renewable energy source Or Boiler (micro-cogeneration) with COP>=90%
Water Heating System: Solar hot water (2 m2 of solar panels) or Electric hot water (COP=2)
Lighting: Total glazed area >= 1/6 of the total floor area
Renewable Energy: More than 5 kWh primary energy/m2.yr

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Yes,

Fine Refusal of permission to occupy, Incentives/rewards to go beyond minimum required performance level. The 2012 thermal regulations added recognition for low-energy buildings (LEB), which can receive a special label. A "high energy performance renovation" label has also been introduced.

Energy performance monitoring requirements: Yes

Germany

In Germany, 50 per cent of all existing residential are single-family and double-family houses, 39.5 per cent of the apartments are located in multifamily houses with the number of apartments up to 13 and 10.5 per cent of the apartments are in apartment blocks. Of the total number of houses under construction, 88 per cent are single-family houses, 11 per cent are double-family houses and 1 per cent are multifamily houses. The main technology of low-rise housing is frame-panel technology. In Eastern Germany, 85 per cent of apartment blocks are residential after substantial refurbishment. For such houses, "Energy efficiency modernization" was carried out on the basis the WSVO thermal protection regulation, the law on energy efficiency (EnEV) in accordance with the requirements of modern building standards and energy consumption codes [7].

Main regulatory documents related to building energy codes

The building energy code in Germany (since 2009) is the EnEV, a performance-based code that requires a mandatory (equivalent model building) energy frame calculation to establish the expected primary energy consumption of residential and non-residential buildings.

- EnEV (Energy Saving Ordinance): Adopted 2014; last amendment 2016 EEWärmeG: Adopted 2011
- For all buildings: 1) DIN V 18599 (Energy efficiency)
- Only for residential buildings: 2.1) DIN V 4108-6 (Thermal protection and energy economy) 2.2) DIN V 4701-10 (Energy efficiency of heating and ventilation systems in buildings) 2.3) DIN V 4701-12 (Energetic evaluation of heating and ventilation systems in existing buildings
- Climatic zones are not used, Subregion: only 1 federal state

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
  Air-tightness (there is a mandatory requirement for air tightness testing: Yes)
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Software used for compliance verification: Yes

The gap between predicted and actual performance levels: 20%

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new non-residential

Stringency: Mixed (both mandatory and voluntary)

EPC applies to residential and non-residential buildings, both new and existing
Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: European Union standards used for CE Marking

Requirements to test building materials and products by certified test laboratories: No

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings
- All buildings that require energy for heating or cooling (irrespective of forms of ownership, size etc. - requirements differ for new/existing and residential/non-residential). Notable exceptions: temporary buildings, commercial buildings for raising animals and plants, religious buildings

- New non-residential
- New residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Thermal bridges
- External solar protections
- Solar gains (G-values)
- Renewables

The EnEV Standard is not as stringent as the Passive House Standard, which requires as little as 10% of the heating and cooling energy used by typical buildings and only 1.5 litres of heating oil per square meter. Passive House considers only the usable living area and requires the building not to exceed 15kWh annually OR 10W (peak demand) per square metre. Passive House stipulates Primary Energy use of no more than 120 kWh/m2yr. There are no fixed absolute values for energy performance of buildings in Germany. A building may not exceed the primary energy demand (including heating, cooling, hot water and ventilation) and overall transmission heat loss of a so called “reference building” which is identical to the planned building in geometry, area and orientation. Requirements for the reference building (e.g. U-values and building services) are specified in EnEV.

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes, for both heating and A/C systems

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Yes, Financial incentive schemes provide additional motivation for energetic standards higher than the existing minimum standard.

Energy performance monitoring requirements: No

Greece

The buildings constructed before 1980 represent the two thirds of the building stock in Greece and are classified in the first category that represents buildings with no thermal insulation protection. The second category consists of dwellings constructed during the period 1980-2001, which in the majority are partially insulated. Only the buildings that were constructed from 2001 are well insulated with no thermal bridges and with double glazed windows. Residential dwellings represent fourth part of the total energy consumption of the Hellenic building stock and consume more than 30 per cent of the total electricity produced in Greece. Greece has been one of the last countries to adopt the Directive on the Energy Performance of Buildings [8, 9].

Main regulatory documents related to building energy codes

Regulation for Energy Performance of Buildings (KENAK Residential) 2010
Regulation for Energy Performance of Buildings (KENAK Non-residential) 2010

Performance-based requirements in building energy codes

No data

Compliance Software: Yes, KENAK (based on EN 13790), KENAK (based on EN 13790)

End-uses considered: Space cooling, Space heating, Water heating, Lighting interior, Humidification, Ventilation

Minimum requirement - Reference Building Class B (or higher)

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

EPBD Energy Performance Certificate (2010), Class:
Scale relative to modelled consumption values. E.A. is total primary energy consumption of existing building. K.A. is the reference building A=>0.33K.A < E.A. ≤ 0.50K.A; A+ => E.A. ≤ 0.33K.A; B=>0.75K.A < E.A. ≤ 1.00K.A; B+=> 0.50K.A < E.A. ≤ 0.75K.A; E=> 1.82K.A < E.A. ≤ 2.27K.A; H=>2.73K.A< E.A; Γ=> 1.00K.A < E.A. ≤ 1.41K.A; Δ=>1.41K.A < E.A. ≤ 1.82K.A; Z=> 2.27K.A < E.A. ≤ 2.73K.A.
Passive House (1990), Zero Energy Buildings (ZEB) -Voluntary
Existence of national registry database for EPC: No data

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- New residential
- New non-residential
- Existing residential
- Existing non-residential

Stringency: Mandatory

Prescriptive requirements in building energy codes

No data

Residential and Non-Residential Buildings
Energy Requirements:
Insulation
Defined per building element in Tables of TGTC No 1
Windows: Thermal characteristics of windows (incl shading) and walls calculated for Reference Building (see TGTCG 1 & 3)
Skylights: No requirement. Air Leakage: TGTCG No 1 defines ventilation rates per building type / room use and infiltration rates are given per opening type, chimney existence etc.
Residential Buildings
Space Heating System: Min EER of 3.0, with ESEER being introduced to be enforced at later stage (see TGTCG No 1)
Water Heating System: 60% produced by Solar collectors, methodology for the rest and DHW needs defined in TGTCG No 1
Lighting: No requirement for residential buildings
Renewable Energy: 60% of DHW from solar energy
Non-Residential Buildings
Space Heating System: Min EER of 2.8 air-cooled, 3.8 water-cooled, with ESEER being introduced to be enforced at later stage (see TGTCG No 1). Water Heating System: Methodology and DHW needs defined in TGTCG No 1. Lighting: In general 16 W/m2 for 500 lux, Table per building use is given in TGTCG No 1
Renewable Energy: Specific study for introduction of RES and CHP is part of the Building permit issue process

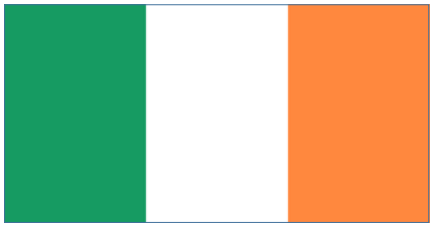
Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: No data

Energy performance monitoring requirements: No data

Ireland



Ireland has had prescriptive energy efficiency requirements for buildings since 1991. The first performance-based code was introduced following the release of the EPBD in 2002, with the latest code being further strengthened to reflect the requirements of the 2010 EPBD recast. Part L and the surrounding national policies encompass many progressive and dynamic aspects including, mandatory computer modeling for new buildings, low u-value requirements, air-tightness testing requirements for all new dwellings, bioclimatic design considerations, mandatory renewable energy requirements, robust pre-occupancy commissioning and a national target to build nZEB by 2013 [10].

Main regulatory documents related to building energy codes

Conservation of Fuel and Energy: Buildings other than Dwellings -2008
Conservation of Fuel and Energy: Dwellings (2011)

- Ireland's Part L is a performance-based code that requires a mandatory energy frame calculation to establish the Energy Performance Coefficient (EPC) and Carbon Performance Coefficient (CPC) in comparison with a relevant reference building. The code is split into two sections, 'dwellings' (2011) and 'buildings other than dwellings' (2008) with specific requirements outlined for each type of building.

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Passive cooling
- Heat recovery
- Thermal bridges
- Renewable

Stringency: Mandatory

Software: Yes, SBEM Software
Energy use for: Space cooling and heating, Water heating, Ventilation

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Energy Performance Certificate support BC; Positive labeling for building beyond the minimum BC level; Energy Offsets/Green Certificates; Number of certified buildings: 295269
Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Residential buildings: One family, Multiple family
- Commercial buildings: Offices, Retail and wholesale, Hotels, Hospitals, Educational buildings
- Public buildings: Offices, Hospitals, Educational buildings

- new residential
- new non-residential
- existing non-residential
- existing non-residential

Stringency: Mandatory

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Specified thermal comfort levels for summer and winter
- Solar gains (G-values)
- Artificial lighting system, lighting density
- Boiler/AC system
- Thermal bridge
- Renewable Energy - 10 kWh/m2/annum for thermal energy, or 4 kWh/m2/annum of electrical energy)

Stringency: Mandatory
Dwellings
U-values (W/(m2·K): Roof – 0.16; Roof2 – 0.2; Wall – 0.2; Floor-0.21; Window – 1.6. Ventilation: Minimum performance levels for mechanical ventilation systems include; Residential - Specific Fan Power (SFP) for continuous supply only and continuous extract only - 0.8 W/litre/sec, SFP for balanced systems - 1.5 W/litre/sec.
Buildings other than Dwellings
U-values (W/(m2·K): Roof – 0.16; Roof2 – 0.22; Wall – 0.27; Floor-0.25; Window – 2.2. Ventilation: Non-residential, the SFP of ACMV systems should be no greater than 2.0 W/litre/second, For new ACMV systems in refurbished buildings the SFP should be no greater than 3.0 W/litre/second.
Other Requirements Set for (Dwellings and Buildings other than Dwellings): Thermal bridge demands. Domestic Hot Water COP - Heat Pump: Hot water systems should be as efficient in use as reasonably practicable. For fully pumped hot water-based central heating systems utilizing oil or gas, the boiler seasonal efficiency should be not less than 90% as specified in the DEAP manual. Value for airtightness:
7 m3/hr/m2 at 50 Pascals
Heat Recovery, Technical HVAC systems, Efficient Lighting, Energy Performance: 60.00kwh (Dwellings); 100.00kwh

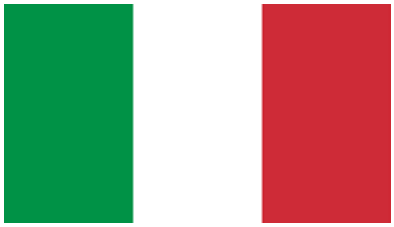
Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Inspection of boilers, Inspection of HVAC systems

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Yes, Grant, Grants is subject to a SEAI survey, Fine, Refusal of permission to occupy

Energy performance monitoring requirements: Yes, During construction, Post completion

Italy



The Italian government implemented the European Directive on energy efficiency of buildings in 2005 and defined the relevant national guidelines in 2009. In Italy, regions and municipalities have developed in recent years a number of local regulations aimed at promoting building energy regulation. Unlike most European countries, where the criterion characterizing the energy efficiency of buildings, use of primary energy use expressed in kWh/m2 per year, in Italy is used as a criterion indicator calculated in kWh/m3 per year. For residential buildings, there are no requirements for air consumption. Also in Italy does not use heat meters and there are no requirements for air consumption. With regard to renewable, to Italy at their expense covered half of the heat energy going into the hot water [11].

Main regulatory documents related to building energy codes

Decreto Inter- Ministeriale 26 giugno 2015. This decree (Law) defines the procedures for applying the methodology for calculating the energy performance of buildings, including the use of renewable sources, as well as the minimum requirements and requirements regarding the energy performance of buildings and building units.
The Standards UNI/TS 11300 1, 2, 3 and 4 are the references of calculation methodologies.

- The current set of regulations adopted 26 June 2015, in the following 2 years the UNI/TS 11300 standards
- The Standards are National, but part of the limit values are different region from region. Based on heating degree-days Italy is divided in 6 climatic zones (A to F). The National Standard UNI 10349 provides the climatic data.

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Set of Energy Performance in Buildings (EPB) standards: The full set of CEN EPB standards
The International Performance Measurement & Verification Protocol (IPMVP): No

There software used for compliance verification: Yes

The average percentage gap: It depends on the amount of information available to the modeler, the skill and time available to the modeler, the level of predictability of users' behavior

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Type of energy is referred to the EPC: Non-renewable primary energy

Existence of national registry database for EPC in your country: No

Building Materials and Products

Rating/certification of building materials: No answer

Harmonization with other technical standards: No answer

Requirements to test building materials and products by certified test laboratories: No answer

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- New non-residential
- New residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

Based on DPR 412/93 buildings are classified in 8 categories Residential; office; hospitals and similar; recreational, associative or religious activities and similar activities; commercial; sport related buildings; educational; industrial and similar

Stringency: Mandatory

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Ventilation or air quality
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Thermal bridges
- Solar gains (G-values)
- Periodic transmittance and time lag of walls and roof
- Renewables
- Solar absorbance of external surfaces (e.g. cool paintings for roofs and streets)

Mandatory requirement: Yes

Comfort levels are not thoroughly specified as a starting point for the energy calculations, and in some regulation, only PMV is considered, in spite of EN15251 which suggests the use of the adaptive model of comfort for naturally ventilated buildings.
Values for the prescriptive requirements: There is no space allocated for specifying the values. There are different values for the different climatic zones, which are attributed to the reference building, to which each building has to be compared
Individual energy metering and control units: Partially (approximate share of equipped buildings in the country)
DECRETO 26 giugno 2015 defines the procedures for applying the methodology for calculating the energy performance of buildings, including the use of renewable sources

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes, for both heating and A/C systems

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country:
There are fiscal detractions if you go beyond the minimum requirements (about 60%), but also if you just do retrofit work (50%). The difference is small so it does not incentives quality work sufficiently. Refusal for occupancy or construction permit

Energy performance monitoring requirements: No

Luxembourg

In 2016, 38.4 percent of the population of Luxembourg lived in detached houses, 27.5 percent occupied semi-detached houses and 30.4 percent - in apartments of Apartment blocks. In conjunction with tighter building codes, the construction of many energy-efficient new homes and the renovation of older buildings helped improving the overall energy efficiency of the completely housing sector. The Ordinance of the Grand Duchy of 21 December 2007 on promoting rational energy use and renewable energy sources, aims at improving cavity wall insulation in existing buildings according to the ordinance on improving the overall energy efficiency of dwellings (Ordinance from 30 November 2007) [12,13].

Main regulatory documents related to building energy codes

Energy Performance of Functional Buildings (2010)
Règlement grand-ducal modifié la performance nergétique des bâtiments (2008)

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Passive cooling
- Heat recovery
- Thermal bridges

Software: No data
End-uses energy: Appliances, Auxiliary devices, Space cooling, Space heating, Water heating, Lighting interior, Ventilation

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

EPBD Energy Performance Certificate (2010) - Total primary energy performance:

kWh/m2/year	A	B	C	D	E	F	G	H	I
Multi-family	45	75	85	100	155	225	280	355	355
Single-family	45	95	125	145	210	295	395	530	530

Passive House (1990) - Maximum demand (kWh/m².year): cooling-15; space heating-15; total primary energy-120.
Zero Energy Buildings (ZEB) - Passive House standards in development
Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Specified thermal comfort levels for summer and winter
- Solar gains (G-values)
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewable

U-Values (W/m2.K)	Walls	Floor	Roof
Building elements exposed to outside air	0.32	0.32	0.25
Building elements adjacent to weakly heated rooms	0.5	2.5	0.35
Building elements adjacent to unheated rooms or soil	0.4	0.4	0.3

U-Values (W/m2.K)	Windows	Door
Building elements exposed to outside air	1.5	2
Building elements adjacent to weakly heated rooms	2	0.5
Building elements adjacent to unheated rooms or soil	2	2.5

Buildings without ventilation equipment: 5 m3/(h.m2) at 50 Pa
Buildings with outlet air ventilation equipment: 3 m3/(h.m2) at 50 Pa
Buildings with income/outlet air ventilation systems:2 m3/(h.m2) 50 Pa
Requirements for primary energy demand are related to the ratio area / volume: Multi-family residential 80.0 - 160.0 kWh/m2/year
Single-family residential 90.0 - 160.0 kWh/m2/year
Requirements for heating energy demand are related to the ratio area / volume: Multi-family residential 40.0 - 95.0 kWh/m2/year
Single-family residential 55.0 - 95.0 kWh/m2/year

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Grant, Reduced interest rate on loans: 0.125%,

Energy performance monitoring requirements: No data

Netherlands

In the Netherlands with a share of 87.3 per cent, residential property dwellings constitute the bulk of the total building stock. At the end of 2013, non-residential property made up approximately one eighth of the total building stock. Since the 1990s, the Netherlands has had strong taxation mechanisms in place to support energy efficiency efforts. Energy saving measures have also become more beneficial for households due to substantial energy taxes being initiated. The public building targets refer to the objectives of the recast EPBD, which requires nearly-zero energy performance for new government buildings by the end of 2018 and for all other buildings including residential by the end of 2020 [14,15].

Main regulatory documents related to building energy codes

Bouwbesluit 2012 - Chapter 5 (NEN 7120:2011)
The Housing Law refers to the Building Decree: this is the document containing all technical regulations for new and existing buildings. For Energy: there is the Energy performance regulation. This includes a reference to a national standard (Energy Performance Norm) with the calculation method. In 2021 the performance will be on the level of nZEB: 25 kWh/m2

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Stringency: Mandatory
Software: NEN 7210
Energy use for: heating, cooling, hot water, lighting- Only for communal area, ventilation, Total primary energy use, Non-renewable primary energy use
The gap between predicted and actual performance levels: ~ 20%
Airtightness testing required prior to compliance: Yes

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory and Voluntary
http://wetten.overheid.nl/BWBR0023734/2016-07-01
Energy Offsets/Green Certificates; EPBD Energy Performance Certificate (2011); Zero Energy Buildings (ZEB) On 31 December 2018 governmental buildings will have to be nearly zero energy buildings (NZEB); Energy neutral buildings (proposal) (2020)
Existence of national registry database for EPC in your country: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential (e.g. after substantial refurbishment) => same as new
- existing non-residential (e.g. after substantial refurbishment) => same as new

Stringency: Mandatory

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Solar gains (G-values)
- Air-tightness
- Ventilation or air quality
- External solar protections
- Periodic transmittance and time lag of walls and roof
- Ventilation for summer comfort
- Solar absorbance of external surfaces (e.g. cool paintings for roofs and streets)
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewables
- Thermal bridges

U-Value (W/m²K): Roof-0.4; Wall-0.4; Floor-0.4; Window/Window2-1.4/6; Overall U-Value-0.4.
Thermal bridge demands
Overall Thermal bridge max value: 0.5
Ventilation:
Depends on the type and size of system.
Domestic Hot Water COP - Heat Pump:
Depends on the type and size of system.
Value for airtightness:
200 dm3/s @10 Pa or 200 dm3/s per 500 m3 @10 Pa For residential buildings, 200 dm3/s @10 Pa and for non-residential buildings 200 dm3/s per 500 m3 @10 Pa
Technical HVAC systems
Efficient Lighting
EPN Energy Performance Standard

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: European Union standards used for CE Marking, International technical specifications, such as those prepared by ISO for other countries, NEN standards

Requirements to test building materials and products by certified test laboratories: Yes, There are several certification institutes

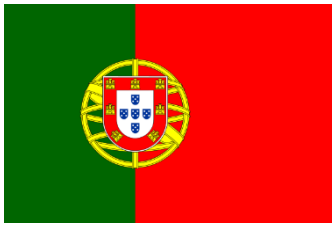
Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Refusal of permission to occupy, Refusal of permission to construct

Energy performance monitoring requirements: Yes

Portugal



According to the statistics Institute of Portugal, the housing stock of the country is divided into three parts in the following proportion: 68.2 per cent belongs to the category of permanent housing, 19.3 per cent are houses and apartments of seasonal residence, and 12.5 per cent of housing is not used at all. Almost the entire housing stock of the country belongs to the individual housing stock. Only 0.2 per cent can be attributed to the communal stock, which includes nursing homes, social support institutions, hotels, health resorts, monasteries, educational institutions and dormitories. Portuguese cities are experiencing a building Renaissance thanks to strong economic growth, which contributes to the development of new commercial and office space and an increase in the number of repurchase of old buildings for renovation. Portugal has developed new methods and achieved high efficiency in all sectors of production of building materials [16].

Main regulatory documents related to building energy codes

42 laws, acts, regulations, notices: see the end of the manual responses

- The current set of regulations was adopted during the time of 2009-2017 (see the end of the manual responses)
- Climate zones

Performance-based requirements in building energy codes

Energy use for: heating, cooling, hot water, lighting, ventilation. Total primary energy use, Non-renewable primary energy use.

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: Yes,

Harmonization with other technical standards: European Union standards used for CE Marking, International technical specifications, such as those prepared by ISO for other countries

Requirements to test building materials and products by certified test laboratories: Yes, LNEG
Input control of construction materials and acceptance control of structures on the construction site: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

Energy codes are mandatory for housing buildings and services and commercial buildings being new, sold or rented or under deep renovation.

- New non-residential
- New residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Solar gains (G-values)
- Air-tightness
- Ventilation or air quality
- External solar protections
- Periodic transmittance and time lag of walls and roof
- Ventilation for summer comfort
- Solar absorbance of external surfaces (e.g. cool paintings for roofs and streets)
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewables
- Thermal bridges

Individual energy metering and control units: Yes

Mandatory requirement: Yes

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for both heating and A/C systems, Yes, for heating systems only

Specific incentives that complement or motivate compliance with building energy codes: Yes, Incentives on buildings renovation and integration of renewables.

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Fines for non-compliance

Energy performance monitoring requirements: Yes, Mandatory

Spain

Spain first implemented prescriptive energy efficiency requirements for buildings in 1979. Recent updates have increased requirements in order to meet the expectations of the EPBD and the subsequent recast in 2010. The 2009 CET and supporting policy encompasses progressive aspects including, mandatory renewable energy requirements (solar hot water and photovoltaic systems), compulsory post occupancy testing of boilers and HVAC systems, bioclimatic design considerations, mandatory performance requirements for existing buildings and low energy classes through Energy Performance Certification levels A, B & C. The Spanish Association for standardization and certification (AENOR) develops technical standards, is also successfully operating in the country [17].

Main regulatory documents related to building energy codes

Plan de Acción de Ahorro y Eficiencia Energética
Escala de calificación energética

- 2006 with the Spanish Building Code
- Climate zones, Sub-regions

Spain has different climatic áreas. The áreas are precisely defined and the energy code depends on the determined one.

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Space heating system and hot water supply units
- Mechanical and natural ventilation
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

The full set of CEN EPB standards

Software used for compliance verification: Llider-Calener y Cerma

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential

Types of buildings that are covered by EPC in your country: It is compulsory for new building and for existing only when the building/property is sold, rented or belong to public institution. Also in a voluntary certification

Stringency: Mandatory

Existence of national registry database for EPC: No

Two regulations reflect the transposition of the EU directives 2002/91/CE into the Royal Decree 47/2007 of January 19 to apply the energy efficiency certification to buildings

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: European Union standards used for CE Marking

Requirements to test building materials and products by certified test laboratories: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

The existing stock should obtain the energy code when: (1) they are sold or rented, (2) they have to be refurbished and (3) they are public buildings. New building is submitted to minimum requirements to guarantee a minimum energy efficiency

The national classification of buildings covered by the energy codes: All buildings. Minimum energy consumption saving determined by building code

Refurbishing is submit to an obligation to implement energy efficient installations and works. Only high-energy efficient installations and devices can be installed. Non-renewable primary energy use.

Stringency: Mixed (both voluntary and mandatory)

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Solar gains (G-values)
- Periodic transmittance and time lag of walls and roof
- Solar absorbance of external surfaces (e.g. cool paintings for roofs and streets)
- Artificial lighting system, lighting density
- Boiler/AC system
- Thermal bridges

House building is much regulated and minimum quality in construction is required to obtain building permissions.

District heating and other external heating systems, the buildings equipped with individual energy metering and control units: No

Mandatory requirement: Yes

Requirements for enforcement and compliance

Building energy codes contain requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes, for heating systems only

Refusal for occupancy or construction permit
Penalties, incentives and other mechanisms for improving compliance: No

Energy performance monitoring requirements: Yes

Sweden

Sweden has a long history of energy efficiency requirements for buildings, with the first prescriptive requirements being implemented in 1946. The first performance-based code arose following the EPBD in 2002. The latest BBR encompasses many dynamic aspects including low overall u-values requirements, mandatory energy measurement, Specific Fan Power requirements, performance requirements for buildings undergoing renovation and interim (2015) performance targets for most building types in preparation for the nZEB target of 2020. The Swedish Energy Performance Certificates are quite reliable because they are based on energy bills and not on theoretical calculations [18, 19].

Main regulatory documents related to building energy codes

Boverket's Building Regulations, BBR18 - (BFS 2011:26)
Building Regulations BBR10 (2012)

- 2010
- Three climate zones: North - Very Cold/subarctic, Middle - Cold, and South - Cold marine, Cold. All are heating based.

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge
- Dehumidification
- Heat recovery
- Passive cooling

Software: No data

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses (One Family)
- Apartment blocks (Multifamily)
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Energy Performance Certificate support BC; Positive labeling for building beyond the minimum BC level; Energy Offsets/Green Certificates; Number of certified buildings: 280000; EPBD Energy Performance Certificate (2010); Swan (2009).

Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Residential buildings: One family; Multiple family buildings
- Commercial buildings: Offices; Retail and wholesale; Hotels; Hospitals; Educational buildings
- Public buildings: Offices; Hospitals; Educational buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Space cooling, Space heating, Water heating, Lighting interior, Ventilation. The conversion of primary energy

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Specified thermal comfort levels for summer
- Solar gains (G-values)
- Renewables

U-values (W/(m2·K): Roof – 0.4; Wall – 0.4; Window – 0.4
Air Tightness – 0.61 l/(s.m2) at 50 Pa
Climate Zone 3 - Residential, Non-Electrically Heated
U-values (W/(m2·K): Roof – 0.13; Wall – 0.18; Floor – 0.15; Window – 1.3; Overall U-Value – 0.4. Energy Performance: 90kwh
Climate Zone 3 - Residential, Electrically Heated
U-values (W/(m2·K): Roof – 0.08; Wall – 0.1; Floor – 0.1; Window – 1.1; Overall U-Value – 0.4.Energy Performance: 55kwh
Climate Zone 3 - Non Residential, Non Electrically Heated
Overall U-Value – 0.6. Energy Performance: 80kwh
Climate Zone 1 - Residential, Electrically Heated
U-values (W/(m2·K): Roof – 0.13; Wall – 0.18; Floor – 0.15; Window – 1.3. Energy Performance: 95kwh
Primary Energy Performance Frame (Residential):55 -75 kWh/ m2a or 30 -50 kWh/ m2a *(depending on climate zone)*; (Non-Residential): 50-105 kWh/ m2a or 30 -75 kWh/ m2a

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Fine, Refusal of permission to occupy, Refusal of permission to construct

Energy performance monitoring requirements: Yes, use by a method of measurement.

United Kingdom

Each constituent part of the UK (England Wales, Scotland and Northern Ireland, Scotland, Wales) sets its own requirements. As a member of the European Union, the United Kingdom must comply with the Energy Performance of Buildings Directive (EPBD). England and Wales, Scotland as well as Northern Ireland are responsible for incorporating European directives at their own national levels. The UK housing stock is old relative to most European countries with many houses dating from the Victorian era. As a result, many houses have poor insulation with properties resulting in additional consumption to maintain a given level of comfort. Houses built prior to 1918 represented 25 per cent of the housing stock in 1970 compared to 17 per cent built prior to 1919 in 2015 [20].

Main regulatory documents related to building energy codes

Each constituent part of the UK (England Wales, Scotland and Northern Ireland, Scotland, Wales) sets its own requirements. Statutory guidance - Conservation of fuel and power: Approved Document L. Building Regulations 2010 in England setting standards for the energy performance of new and existing buildings.

- Approved Document L1A: conservation of fuel and power in new dwellings, 2013 edition with 2016 amendments;
- Approved Document L1B: conservation of fuel and power in existing dwellings, 2010 edition (incorporating 2010, 2011, 2013 and 2016 amendments);
- Approved Document L2A: conservation of fuel and power in new buildings other than dwellings, 2013 edition with 2016 amendments;
- Approved Document L2B: conservation of fuel and power in existing buildings other than dwellings, 2010 edition (incorporating 2010, 2011, 2013 and 2016 amendments).

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- existing residential
- existing non-residential

Stringency:

Mixed (both voluntary and mandatory)

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- existing residential
- existing non-residential

Stringency: Mandatory

Existence of national registry database for EPC: Yes

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for A/C systems only

Penalties, incentives and other mechanisms for improving compliance: Yes, incentives and fines for non-compliance

Energy performance monitoring requirements: No

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: European Union standards used for CE Marking

Requirements to test building materials and products by certified test laboratories: Yes

Bulgaria

Bulgaria's housing stock is divided into old and new housing stock. In recent years, the Ministry of regional development and public works has set as one of its main objectives the creation of positive regulatory, institutional and financial conditions in order to facilitate the process of modernization and energy-efficient reconstruction of the country's housing stock. Bulgaria plans to implement pilot projects for new public buildings with near zero energy as part of the solution of these tasks, and financing of these projects should be planned for the program period 2014-2020 [21].

Main regulatory documents related to building energy codes

Energy Efficiency Act (EEA), spatial development act, ordinance no. 7 of 2004 on energy efficiency of buildings, order № e-rd-04-1 of 22 January 2016 for energy efficiency, certification and evaluation of energy savings of buildings

- The current set of regulations was adopted: In the amendment of the EEA from 2015
- Year 2004, 2009, 2015
- Climate zones

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Using the set of Energy Performance in Buildings (EPB) standards: A selection of the set of CEN EPB standards; The subset of ISO EPB standards
Using the International Performance Measurement & Verification Protocol (IPMVP): On a voluntary basis
Software for compliance verification: Yes, EAB V 1.0 - Product of the Technical University - Sofia
The average percentage gap: up to 3% while preserving incoming forecast conditions

Mandatory requirement to assess post-construction requirement of the thermal bridge: Yes
Mandatory requirement for air tightness testing: Yes

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Apartment blocks
- Public buildings

- new non-residential

Stringency: Mixed (both mandatory and voluntary)

Existence of national registry database for EPC: Yes

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: European Union standards used for CE Marking

Requirements to test building materials and products by certified test laboratories: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

1. Residential buildings (also used for dormitories)
2. Buildings for public service: 2.1 buildings for administrative service, 2.2 buildings for education and science -schools - universities -kindergartens and nurseries 3. Medical establishments 4. Buildings for public service in the hospitality sector. 5. Buildings in the area of trade. 6. Buildings for sports. 7. Buildings in the field of culture and art

Stringency: Mandatory

Energy use for hot water, Total primary energy use

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Solar gains (G-values)
- Air-tightness
- Ventilation or air quality
- External solar protections
- Periodic transmittance and time lag of walls and roof
- Ventilation for summer comfort
- Solar absorbance of external surfaces (e.g. cool paintings for roofs and streets)
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewables
- Thermal bridges

Individual energy metering and control units: Yes, Mandatory
The main legislative documents relating to EPC: ORDINANCE No E-RD-04-1 of 22.01.2016.
ORDINANCE No 7 of 15 December 2004 on the energy efficiency of buildings
Through Methodology for the calculation of energy consumption and energy performance indicators of buildings based on EN 13790

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for both heating and A/C systems

Penalties, incentives and other mechanisms for improving compliance: Refusal for occupancy or construction permit, Fines for non-compliance, Exemption from building tax for older buildings that meet certain energy efficiency requirements and are not publicly funded

Energy performance monitoring requirements: Yes

Croatia

The share of buildings in Croatia accounts for about 40 per cent of the total energy consumption. During the first decade of this century, there was no improvement in energy efficiency in the household sector in Croatia. The law on construction adopted in the country (OG 153/2013) fully transposes Directive 2010/31/EC of the European Parliament and of the Council of 19 may 2010 on energy efficiency of buildings into the legal system of the Republic of Croatia. Under this law, new buildings must be designed and constructed in such a way that during their life cycle they meet the basic requirements for buildings, the main of which is declared energy saving and thermal insulation [22].

Main regulatory documents related to building energy codes

Directive 2010/31/EU of the European Parliament and of the Council and Article 6 of Regulation (EU) 244/2012 of 16 January 2012 and Reports according Article 5(2) of Directive 2010/31/EU.

- First transposition activities of the EPBD started in 2005 but official implementation of the EPBD started in 2008 under the Ministry of Construction and Physical Planning (MCPP)
- Climate zones for all localities in the Republic of Croatia with average monthly outdoor temperature of the coldest month ≤ 3 °C, for all localities in the Republic of Croatia with > 3 °C, the annual energy demand is calculated on the basis of reference climate data for littoral Croatia.

Performance-based requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

The subset of ISO EPB standards, The Building Act set the legislative basis for implementation of the EPBD in all parts

The International Performance Measurement & Verification Protocol (IPMVP): Yes

Software used for compliance verification: Yes,
MGIPU Energetski Certifikator
There is mandatory requirement to assess post-construction requirement of the thermal bridge: Yes
There is mandatory requirement for air tightness testing: Yes

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

Existence of national registry database for EPC: Yes

Type of energy that the EPC refer to: Total primary energy

Stringency: Mandatory

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: European Union standards used for CE Marking

Requirements to test building materials and products by certified test laboratories: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- New non-residential
- New residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

Stringency:

Mandatory

Energy use for: heating, cooling, lighting, ventilation. Total primary energy use, Non-renewable primary energy use.

Prescriptive requirements in building energy codes

No answers

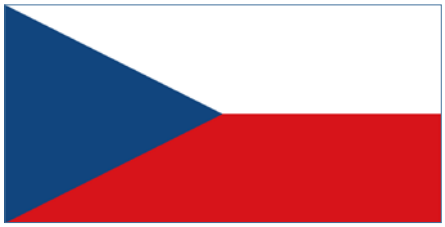
Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for both heating and A/C systems

Penalties, incentives and other mechanisms for improving compliance: Yes, Fines for non-compliance

Energy performance monitoring requirements: Yes

Czech Republic



According to the results of the 2011 Population and Housing Census, the dwelling stock of the Czech Republic totaled 4,756,572 dwellings, with 4,104,635 occupied dwellings, of which 43.7 percent were in family houses and 55 percent in multi-dwelling buildings. The average age of occupied multi-dwelling buildings was 52.4 years and of family houses 49.3 years. In the context of implementing the requirements of Directive 2010/31/EU, new buildings must meet the requirement met by nearly zero-energy buildings by 2020. Under the Act No 406/2000 a "nearly zero-energy building" (NZEB) is defined as a 'building that has a very high-energy performance whose energy consumption is covered to a very significant extent by energy from renewable sources [23, 24].

Main regulatory documents related to building energy codes

Energy Management Act No. 406/2000 Coll.
Decree no. 78/2013 Coll. on Energy Performance of Building
ČSN EN 73 0540 Thermal Protection of Buildings (standard)

- Transposition of the EPBD II directive entered into force 1. 1. 2013 on the national level

Performance-based requirements in building energy codes

New buildings – C level or already NZEB level in some cases. Existing buildings – when undergoing major renovation – C level-is the minimum based on the cost-optimum calculation.

- Thermal characteristics and geometry of the building
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Stringency: Mandatory

Energy use for: heating, cooling, hot water, lighting, ventilation; total primary energy use; Non-renewable primary energy use

Using the set of EPB standards: None; Using the IPMVP: No

Software: No

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings, Buildings occupied by public authorities

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

Type of EPC energy: total primary energy, non-renewable primary energy, total delivered energy. Stringency: Mandatory

Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: Yes, European Union standards used for CE Marking

Harmonization with other technical standards: Construction products for which harmonised standards according to point a) do not exist, must follow the Government Decree No. 163/2002 Coll., laying down technical requirements for selected construction products.

Requirements to test building materials and products by certified test laboratories: Czech Office for Standards, Metrology and Testing, Czech Accreditation Institute

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings, Buildings occupied by public authorities

- new residential
- new non-residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Solar gains (G-values)
- Air-tightness
- Ventilation or air quality
- External solar protections
- Artificial lighting system, lighting density
- Boiler/AC system
- Thermal bridges

Stringency: Mandatory

Individual energy metering and control units: Yes,

The values of the prescriptive requirements are given in the Table "Parameters and values of reference building for the energy performance calculation".

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems:
Yes, for both heating and A/C systems. The Energy Management Act implements the whole EPBD II directive, mandatory requirement. Any new building cannot be built if does not comply with national legislation. CZ also runs several financial instruments such as financing from structural or national funds to reach higher than minimum energy performance requirements in construction. For example New Green Savings Programme http://www.novazelenausporam.cz/en/.

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country:
Yes, Fines for non-compliance, construction permit. The EPC must be part of the construction permit to prove compliance with the minimum energy performance requirements. If isn't, permit is not issued.

Energy performance monitoring requirements: Yes

Hungary

In the 2010–2013 period, the Government of Hungary prepared the essential documents in which the domestic energy policy, the set of conditions for establishing sustainable energy supply systems, the main tasks for improving energy efficiency and increasing the share of renewable energy as well as energy-related environmental targets are defined for the long term. These documents put the task of improving building energy performance into a wider energy policy, economic and social context. Discussion of these strategic Government documents will be limited in this Chapter to a summary of the main propositions and tasks formulated in them, which have relevance for the energy performance of buildings, without presenting the documents themselves in detail. [25].

Main regulatory documents related to building energy codes

Országos Településrendezési és Építési Követelmények' (OTÉK)

Performance-based requirements in building energy codes

No data

Stringency: Mandatory

Software: No data

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory and Voluntary

EPBD certification (2012)
Percentage efficiency scale based on primary consumption. 100% = 2006 requirements
Class:
A=>56-76%; A+ => <55%; B=>77-95%; C=> 96-100%; D=>101-120%; E=> 121-150%; F=> 151-190%; G=> 191-250%; H=> 251-340%; I=> >341%
Zero Energy Buildings (ZEB)
New buildings to be zero emission buildings-2020

Existence of national registry database for EPC in your country: No data

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Prescriptive requirements in building energy codes

No data

U-Value (W/m²K):
Energy Requirements:

Insulation

U-Values (W/m2.K)	Roof	Walls	Floor
All climate zones	0.25	0.45	0.45

Windows

U-Values (W/m2.K)	Windows	Door
All climate zones	1.6	1.6

Air Leakage: Not regulated

Requirements for primary energy demand are related to the ratio area / volume: 110.0 - 230.0 kWh/m2/year

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: No data

Energy performance monitoring requirements: No data

Lithuania

The majority of the Lithuanian population (66%), live in multi-apartment buildings constructed in the period from 1960-1990. Currently, 97% of the housing stock is privately owned and only 3 per cent of apartments belong to local municipalities. Institutions responsible for housing are the Ministry of Environment and the Housing and Urban Development Agency, which administrates housing refurbishment programmes. The principal documents for housing sector and refurbishment of the multi-family buildings are Lithuanian Housing Strategy (2004). The Strategy foresees to renovate 70 per cent of the multi-apartment dwelling houses by 2020, and reduce the cost of heat energy up to 30 per cent; “Programme for the Modernisation of Multi-family Buildings”, which started in 2005 [26]

Main regulatory documents related to building energy codes

Technical Regulation of Construction STR 2.01.09:2005 Building Technical Regulation STR 2.01.09:2005

- 2005

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Passive cooling
- Heat recovery
- Thermal bridges

Software: No data

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Existence of national registry database for EPC in your country: Yes

Energy Performance Certificate support BC
Positive labeling for building beyond the minimum BC level

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Residential buildings:
  - One family;
  - Multiple family buildings
- Commercial buildings:
  - Offices; Retail and wholesale; Hotels; Hospitals; Educational buildings
- Public buildings:
  - Offices; Hospitals; Educational buildings
- All urban buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Boiler/AC system
- Specified thermal comfort levels for summer and winter
- Solar gains (G-values)

Values for New Buildings
Residential Buildings
U-values (W/(m2·K): Roof – 0.16; Wall – 0.2; Floor-0.25; Window – 1.6
Energy Performance: 80kwh

Thermal bridge demands
Overall Thermal bridge max value: ΨN 0.18
Ventilation:
Depends on the type and size of system.
Domestic Hot Water COP - Heat Pump:
Depends on the type and size of system.
Value for airtightness:
For naturally ventilated buildings, maximum n50=3 h-1, for mechanically ventilated buildings, maximum n50=1.5 h-1.
Heat Recovery
Technical HVAC systems
Efficient Lighting

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes, Inspection of boilers, Inspection of HVAC systems

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: None

Energy performance monitoring requirements: During construction

Poland

The residential sector in Poland is dominated by individual property (~ 60%), followed by Cooperative property (~20%). In addition to relevant government agencies, energy agencies, such as the National energy efficiency Agency, play an important role in promoting energy efficiency in the country's housing stock. In Poland, as early as 1994, a law was adopted that establishes requirements for buildings in terms of minimum requirements for energy efficiency, thermal insulation and other requirements relating to energy saving. In the development of the use of renewable energy in 2012 adopted a Resolution that prescribes to analyze the possibility of the use of decentralized systems of energy supply based on renewable energy sources [27, 28].

Main regulatory documents related to building energy codes

Technical regulations: Energy Savings and Thermal insulation (2002)
The Act of 7 July 1994. Constructive Law.
The Act of 29 August 2014. The Energy Performance of Buildings Law
Regulation of the Minister of Transport, Construction and Maritime Economy of 25 April 2012 concerning the detailed scope and form of construction

- 2002-2014
- Climate zones

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Passive cooling
- Heat recovery
- Thermal bridges

Software: No data

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

EPBD Energy Performance Certificate (2009)
Passive House (1990), Maximum cooling demand (kWh/m².year): cooling-15; space heating-15; total primary energy-120. Voluntary **Methodology** for calculating the energy performance of buildings

Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Family residential building
  Single-family residential building
  Multi-family residential building
- Collective residential building (Apartment blocks)
- Commercial buildings (Health-care building, Warehouse and production buildings)
- Public buildings (Health-care building, Warehouse and production buildings)

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

End-uses energy: Space heating, Ventilation, Lighting interior, Water heating, Appliances, Auxiliary devices, Space cooling, Water heating, Lighting interior, Humidification

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Specified thermal comfort levels for summer and winter
- Solar gains (G-values)
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewable

Insulation (2017):
U-values (W/(m2·K): Roof, f(tºC) – 0.18-0,70; External Wall, f(tºC) – 0.23-0.9; Internal Wall-1.0; Floor on the ground, f(tºC) -0.30-1.5; Window, f(tºC) – 1.1-1.6; Door – 1.5; Skylights, f(tºC) – 1.3-1.6;
Space Heating System (2017):
EP_{H+W} Values (kWh/m^2*year) for heating, ventilation and hot utility water: Single-family residential building-95; Multi-family residential building-85; Collective residential building-85; Health-care building -290; Public buildings-60; Warehouse and production buildings-90.
Space Cooling System (2017):
ΔEP_C Values (kWh/m^2*year): Single-family residential building and Multi-family residential building-10; Collective residential building, Health-care building and Public buildings-25.
Water Heating System: EP_{H+W} Values, mean partial EP maximum value ratio for heating, ventilation and hot utility water
Lighting (2017): EP_L Values (kWh/m^2*year): Single-family residential building and Multi-family residential building-0; Collective residential building, Health-care building, Public buildings and Warehouse and production buildings - for $t_0 < 2500$ $EP_L = 50$; for $t_0 \geq 2500$ $EP_L = 100$.

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: bonuses, grants

Energy performance monitoring requirements: No data

Slovakia

The housing sector of Slovakia took third place in the overall balance of energy consumption of the country. The need to develop a strategy for the reconstruction of residential and non-residential buildings in Slovakia follows from Directive 2012/27/EC of the European Parliament and of the Council of 25 October 2012 on energy efficiency. A systematic approach to the reconstruction of buildings was made in the late 1990s, when it was found that many facilities built between 1960 and 1992 had insufficient thermal protection of structures and technical facilities of buildings had a high degree of wear and tear. For such buildings, there was a need to replace structures with quality components to create the necessary security and well-being in these buildings [29].

Main regulatory documents related to building energy codes

MTC SR: 555/2005 Coll. Act on the Energy Performance of Buildings and on Amendments to Certain Acts.- 300/2012 Coll.
Act amending Act no. 555/2005 Coll. on the Energy Performance of Buildings and on Amendments to some Acts as amended and amending. ISO, European and Slovak Technical norms, Plan for the restoration of relevant (public) buildings, Update of the Energy Performance of Building Concept f 2010 with a view to 2020.

- The first law act to energy performance of buildings was adopted by 2005

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge, mandatory requirement to assess post-construction requirement of the thermal bridge: Yes

Non-renewable primary energy use

The existing standards for determining the energy characteristics of the buildings in operation are sufficiently accurate: Yes

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new non-residential
- new residential

Stringency: Mandatory

Existence of national registry database for EPC: Yes
Type of energy that the EPC refer to: Total primary energy, Non-renewable primary energy.

Existence of national registry database for EPC: Yes

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: European Union standards used for CE Marking

Requirements to test building materials and products by certified test laboratories: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

The buildings covered by the energy codes: They are separated by residential and nonresidential for the means of certification. For the needs of energy audits, there is more detailed breakdown.

Stringency: Mandatory

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Solar gains (G-values)
- External solar protections
- Ventilation or air quality
- Periodic transmittance and time lag of walls and roof
- Ventilation for summer comfort
- Solar absorbance of external surfaces (e.g. cool paintings for roofs and streets)
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewables
- Thermal bridges

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for both heating and A/C systems

Your country have specific incentives that complement or motivate compliance with building energy codes: Yes,
Financial support,
Fines for non-compliance,
Also possible: Refusal for occupancy or construction permit

Energy performance monitoring requirements: Yes

Armenia

Armenia introduced in 2016 a mandatory building energy code with the adoption of a new regulation “Thermal Protection of Buildings”, which was developed based on Russian Building Energy Code from 2003 (updated in 2012) and European codes and methodologies. It links building envelope construction and heat loses with established energy limits, taking into account differences in climatic conditions. It also includes a requirement for a building energy passport and an energy efficiency label with energy efficiency classes [30].

Main regulatory documents related to building energy codes

Law on Standardization, AL-21 (08.02.2012)
Law on Technical Regulation, AL-19 (08.02.2012)
Law on Licensing, the AL-193 (30.05.2001)
Law on Energy Saving and Renewable Energy, AL-122 (2004)
National Program on Energy Saving and Renewable Energy (2007)
National Energy Efficiency Action Plan (2010)
Amendment to RA Energy Saving and Renewable Energy Law (2016).

- 2013-2017
- Climate zones, Sub-regions

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Air-conditioning system(s)
- Space heating system and hot water supply units
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

The subset of ISO EPB standards: Full set of CEN EPB standards, a Subset of ISO EPB standards

Software used for compliance verification: Yes

The gap between predicted and actual performance levels: 40- 60%
There is mandatory requirement to assess post-construction requirement of the thermal bridge: Yes
There is mandatory requirement for air tightness testing: Yes

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- existing residential
- existing non-residential

Type of energy that the EPC refer to: Total primary energy,

Stringency: Mixed (both voluntary and mandatory)

Existence of national registry database for EPC: No

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: European Union standards used for CE Marking

Requirements to test building materials and products by certified test laboratories: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

Stringency: Mixed (both voluntary and mandatory)

The construction objects in the Republic of Armenia are divided into five categories depending on their scale, significance, significance and complexity, as well as the safety of citizens and the environment. 1) low-risk objects: Category I; 2) objects of medium risk category II; 3) objects of medium risk category III category; 4) high-risk objects - category IV; 5) objects with the highest degree of risk - category V.
Mandatory measures to ensure the energy efficiency of buildings are established by the Decree of the Government of the Republic of Armenia. Indicators for assessing energy efficiency and energy consumption in building codes have not yet established

(Residential and public buildings: walls - 0,29-0,56 floors - 022-0,37 roofs -0,23-0,42 windows - 2.04-3.33)

Energy use for: heating, cooling, hot water, lighting, ventilation, Total primary energy use.

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Solar gains (G-values)
- Ventilation or air quality
- Ventilation for summer comfort
- Daylighting requirements
- Periodic transmittance and time lag of walls and roof
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewables

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for heating systems only

Penalties, incentives and other mechanisms for improving compliance: Yes

Energy performance monitoring requirements: No

Azerbaijan

The existing housing stock in Azerbaijan consists of houses built before the 1920s and located mainly in the historical part of the cities, and, as a rule, these houses need reconstruction and repair, and in rural areas the houses built during the 1920-1940 period prevail. The basis of the old housing stock (more than 80%) consists of houses built before 1990. The quality level of these mainly large-panel houses is below modern standards. The construction of the new residential sector is mainly carried out in the form of private cottage settlements and multi-apartment complexes in major cities of the country. The country is provided with oil and natural gas, and problems of energy saving in housing sector first of all are planned to be solved at the expense of development of alternative energy sources and strengthening of control of consumption of energy [31].

Main regulatory documents related to building energy codes

It is processed the draft law “Efficient Use of Energy Resources and Energy Efficiency” with the support of Energy Charter and it is planned to draft a law “Energy Efficiency in Buildings” afterwards. There is currently applied regulative document named as “Urban Planning and Building codes”
Decree of the Cabinet of Ministries “The rules of increasing energy efficiency of construction facilities and economized use of energy resources” has been remaining in force since 2014.

- climate zones and sub-regions

Performance-based requirements in building energy codes

- New buildings
- Existing buildings

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

There is not an officially confirmed document to: Energy levels are considered in building codes; The subset of ISO EPB standards; The International Performance Measurement & Verification Protocol.

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- existing residential
- existing non-residential

Stringency: Mandatory

Existence of national registry database for EPC: No

Building Materials and Products

Rating/certification of building materials: The compliance of construction materials to requirements of the legal acts is checking

Harmonization with other technical standards: No answer

Requirements to test building materials and products by certified test laboratories: It is checked in the accredited laboratories

Building Energy Codes Stringency and Coverage

Coverage:

- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- existing residential
- existing non-residential

Stringency: Voluntary

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewables

These all are included in the technical normative documents

Values for the prescriptive requirements: No answer

Individual energy metering and control units: It is not applied in existing buildings, but it is planned to be implemented in new buildings

Mandatory requirement: No, there is not.

Requirements for enforcement and compliance

Specific policy packages and incentives that complement or motivate compliance with building codes: There are not specific policy packages and incentives.

Requirements for regular inspection of heating and A/C systems: No

Penalties, incentives and other mechanisms for improving compliance: Fines and fees for non-compliance, Refusal for occupancy or construction permit
There is no any penalty for non-compliance but it will be considered in the further planned project named as “Energy efficiency in buildings”

Energy performance monitoring requirements: Yes, there is.
The government according to the law of the utilizing of energy resources controls it

Belarus

In Belarus, the urban population is three-quarters of the total population. Despite the high level of home ownership and the dominant position of home ownership in new housing construction, the housing Finance structure in Belarus remains largely public sector-oriented and the role of private investment and market-based housing Finance remains insignificant. Housing Finance, maintenance, modernization and management systems are dominated by state-owned enterprises, that is, state-owned companies and banks. The housing sector, including housing construction, maintenance, financing and infrastructure development, is covered by the State Housing Policy, by the National Housing Program, the Housing Code of Belarus and a number of other normative acts. [32].

Main regulatory documents related to building energy codes

The draft technical regulation of the Republic of Belarus "Energy efficiency of buildings", harmonized with the Directive 2010/31 / EU, is expected to be approved in mid-2018

- 2000 - 2017

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge
- Mechanical and natural ventilation
- Air-conditioning system(s)
- Built-in lighting system (mainly in the non-residential sector)

Partial set of CEN EPB standards, A subset of ISO standards EPB

Software for compliance checking: No

The existence of a mandatory requirement for post-construction requirement for thermal bridge: Yes, the regulatory requirements for the resistance to heat transfer of buildings require the consideration of thermal bridges

Mandatory requirement for air-tightness: Yes, the draft Technical Regulations provide for the mandatory measurement. Voluntary level of requirements and corresponding methods are available in the current standards.

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Main regulatory documents for the EPC:

In the country, there is no system of power certification of buildings. There is a system of classification of buildings by an indicator of specific consumption of thermal energy on heating and ventilation.

Coverage: No answer

Existence of national registry database for EPC: No

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: Requirements of national standards

Requirements to test building materials and products by certified test laboratories: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

There is a power classification of buildings by consumption of thermal energy on heating and ventilation, classes G - A+. An indicator for reference to a certain class - specific annual consumption of thermal energy on heating and ventilation

It is not allowed to design new buildings if the requirements for buildings do not correspond to classes A +, A or B.

Types of energy considered in building codes and regulations: Use of energy for heating

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Air-tightness
- Ventilation or air quality
- The requirements for daylight
- Artificial lighting system, lighting density
- Thermal bridges
- Solar gains (G-values)

Buildings equipped with individual energy metering and control units - Yes

Stringency: Mandatory

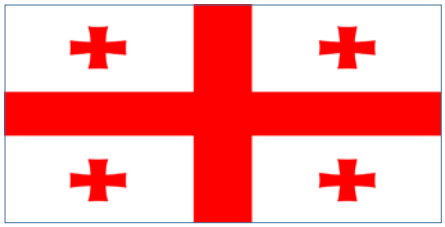
Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Да, только для систем отопления, Mandatory

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: No

Energy performance monitoring requirements: No

Georgia



Almost 93 per cent of the rural population lives in separate homes. At the same, more than half of Georgia's population live in urban areas, with 67% of households living in Apartment blocks apartments in urban areas. Typically, for a large part of the housing stock in Georgia-regardless of its ownership-will require reconstruction as part of the old housing stock to be demolished due to natural wear and tear of structures and lack of timely maintenance. Since 2017, unified building design standards have been introduced in Georgia [33].

Main regulatory documents related to building energy codes

"Law of the Energy Performance of Buildings" was elaborated, but not entered into force yet.

- This year

Performance-based requirements in building energy codes

- Elements, which must be taken into account for the calculation of the energy performance of a building: Not set yet

The subset of ISO EPB standards: Directive 2010/31/EU on Energy Performance of Buildings (EPBD).

The International Performance Measurement & Verification Protocol (IPMVP): No

Software used for compliance verification: No

The existing standards for determining the energy characteristics of the buildings in operation are sufficiently accurate: No

There is mandatory requirement to assess post-construction requirement of the thermal bridge: No

There is mandatory requirement for air tightness testing: No

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

Not yet defined

Stringency: Mandatory

Who is entitled to issue EPC: Accredited body

Existence of national registry database for EPC: No

Type of the EPC energy:
Total primary energy, Non-renewable primary energy

Building Materials and Products

Rating/certification of building materials: No

Harmonization with other technical standards: No answer

Requirements to test building materials and products by certified test laboratories: No answer

Building Energy Codes Stringency and Coverage

Coverage:

- new residential

This law shall apply to new and existing buildings, except for the following buildings:
Buildings which have a status of cultural heritage monuments, buildings used as places of worship and for religious activities, temporary buildings with a time of use of two (2) years or less, industrial sites, workshops and non-residential agricultural buildings with low energy demand, stand-alone buildings with a total useful floor area of less than 50 m2.

Stringency: Mandatory

Performance-based requirements in building energy codes: New buildings

Energy levels are considered in building codes:
Energy use for: heating, cooling, hot water, lighting, ventilation.
Non-renewable primary energy use

Prescriptive requirements in building energy codes

Prescriptive requirements coverage: When the law enters into force, the relevant regulations will be adopted and detailed information will be available

Requirements for regular inspection of heating and air/conditioning (A/C) systems: After the law will enter into fore establishment of rules on regular, inspection of heating and air-conditioning systems will be mandatory

Individual energy metering and control units:
Yes, this a mandatory requirement

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Please provide further comments on requirements

Penalties, incentives and other mechanisms for improving compliance: Yes, But this article (on penalties) is under processing
There is separate article on penalties in EPB Law

Energy performance monitoring requirements: Yes

Kazakhstan

The residential sector is the third largest consumer of heat and electricity in the country after the energy and manufacturing sectors. In recent years, improving the energy efficiency of the economy has become a national strategic priority of Kazakhstan. The political will of the country's leadership in strengthening energy efficiency is expressed through the adoption of a number of strategic documents, namely the strategy of transition of the Republic of Kazakhstan to a “green” economy, strategy-2050,” Nurly Zhol "program, 100 steps of the nation, energy Saving2020 and others. The main document on energy efficiency is the Law of the Republic of Kazakhstan № 541-IV “On energy saving and energy efficiency” dated January 13, 2012 [34].

Main regulatory documents related to building energy codes

The Law of the Republic of Kazakhstan № 541-IV “On energy saving and energy efficiency”, January 13, 2012
SN 2.04-21-2004 " Thermal protection and energy consumption of civil buildings"
SN RK-2.04-04-2011 " Thermal protection of buildings"

- 2006 and 2012
- National standards take into account different climatic conditions of the Republic

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Design position and orientation of buildings
- Indoor and outdoor climatic conditions
- Thermal bridge

Software: No

The average energy performance gap between the projected and actual levels of energy efficiency and energy consumption: 20-30% in new buildings

Mandatory requirement to assess post-construction requirement of the thermal bridge: No

Mandatory requirement for air tightness testing: No

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Main regulatory documents for the EPC: No

EPC Coverage: currently EPC is not used

Policy requirement level for EPC: mandatory

Existence of national registry database: No

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: International technical standards (ISO)

Requirements to test building materials and products by certified test laboratories: Yes, Committee for Technical Regulation and Metrology

Building Energy Codes Stringency and Coverage

Coverage:

- Apartment blocks
- Commercial buildings
- Public buildings

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

National classification of buildings in the building code of 2012: A++; A+; A; B+; B; C+; C; C-; D; E.

Stringency: Mandatory

Requirements for the assessment of energy efficiency and energy consumption:

Existing buildings (for example, after major repairs)
There are requirements, but they are not really implemented.

Energy use for: heating, ventilation.

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Air-tightness
- Ventilation or air quality
- The requirements for daylight
- Thermal bridges

District heating and other external heating system, buildings are equipped with individual energy metering and control units: Yes

Stringency: Mandatory

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Нет

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Нет

Energy performance monitoring requirements: Нет,

Kyrgyzstan

In Kyrgyzstan, the population has grown faster than the housing stock in recent years. About 85% of the existing housing stock was built before 1990. Since then, a large part of the housing stock is in multi-apartment buildings, but as a rule, technical systems in multi-apartment houses need repair. Some new expensive residential complexes meet modern energy efficiency standards, including thermal insulation and triple glazing. Technical maintenance of housing is identified as one of the key priorities of the national housing programme in Kyrgyzstan. The Ministry of energy and industry of the Republic has prepared a draft program of energy saving and energy efficiency planning until 2017 and in the future until 2025 [35].

Main regulatory documents related to building energy codes

Law of the Kyrgyz Republic (KR) "On Energy Efficiency of Buildings" of 26.07.2011, No. 137, as amended by Law No. 194 of 18 October 2013

- 2011

Performance-based requirements in building energy codes

- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Passive solar systems and solar protection
- Passive cooling

Software: None

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Stringency: Mandatory

EPC: Yes

Existence of national registry database for EPC in your country: None

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

Coverage:
Buildings: residential, public, administrative and multifunctional

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

The minimum energy efficiency requirements for buildings do not apply to:
• Individual residential buildings, the total area of which does not exceed 150 square meters;
• buildings designed for religious rites, rituals and ceremonies;
• buildings that, in accordance with legislation, are assigned to cultural heritage sites
• Temporary objects of non-capital construction;
• holiday homes;
• Buildings and structures of auxiliary use.

Prescriptive requirements in building energy codes

- Thermal insulation
- Ventilation or air quality
- Daylighting requirements
- Boiler/AC system
- Specified thermal comfort levels for summer and winter
- Solar gains (G-values)
- Artificial lighting system, lighting density

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: periodic monitoring of energy efficiency of boilers, heating systems and hot water supply

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: No data

Energy performance monitoring requirements: carried out at least once a year

Republic of Moldova

The energy efficiency of the housing Fund of the Republic of Moldova is highly dependent on foreign energy, importing 95% of its energy needs. The housing sector is the highest consumer of about 30 per cent of total energy consumption. Therefore, improving energy efficiency is crucial. This will contribute to energy security, economic competitiveness and will have a positive impact on the environment. Improving energy efficiency will improve housing conditions and reduce energy costs in the future, thus reducing energy costs for households. The Government's goal is to reduce energy consumption in buildings by 10% by 2020. The government may consider actively participating in the work of the UNECE task force on energy efficiency standards [36].

Main regulatory documents related to building energy codes

Law on Energy Performance of Buildings (2014),
Law on energy efficiency nr 140 from 2012; transpose Directive 32/2010 on energy performance of the buildings.

- In year 2012
- Moldova is on the way to transpose EU standards. Some current standards are old GOST and SNIP norms and need revision.

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

The full set of CEN EPB standards

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential

Type of energy that the EPC refer to: Total primary energy,

Entitled to issue EPC: Qualified experts

Stringency:

Mixed (both mandatory and voluntary)

Existence of national registry database for EPC: No answer

Building Materials and Products

Rating/certification of building materials: No

Harmonization with other technical standards: European Union standards used for CE Marking

Requirements to test building materials and products by certified test laboratories: No

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Public buildings

- new non-residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

LAW OF THE REPUBLIC OF MOLDOVA of July 11, 2014 No. 128 on energy performance of buildings transposes the Directive 2010/31/EC . Energy class – system of measurement from "A" to "G" for specifying of energy efficiency of the building. In case of classification of buildings with very outstanding energy performance, the class "A" can be subdivided into sub-classes.

Stringency: Mixed (both voluntary and mandatory)

Performance-based requirements in building energy codes: Energy efficient development systems

Details/values of the performance-based requirements: After year 2021, all new buildings must be NZEB

Class A = 50 kWh/m2/year; B=99 kWh/m2/year

Energy use for: heating, cooling, hot water, lighting, ventilation.

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Ventilation or air quality
- Boiler/AC system
- Renewables

Individual energy metering and control units: Partially (approximate share of equipped buildings in the country)

The main legislative documents relating to EPC: Law Nr. 128 of 11.07.2014 on Energy performance of the buildings

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for both heating and A/C systems

Penalties, incentives and other mechanisms for improving compliance: No

Energy performance monitoring requirements: Yes

Russian Federation

In Russia about 80% of apartment buildings were built before 1999 according to outdated building codes. New legislation in the field of energy efficiency sets standards for energy consumption regulation to stimulate energy saving and amends the current legislation to ensure compliance with energy saving regulations. The government program recognizes that Russia's energy intensity is 2.5 times higher than the world average and up to 3.5 times higher than in developed countries, and it is expected that 44 percent of the projected energy savings will be in buildings and district heating. These changes imply that regional and municipal authorities should develop programmes at the local level to increase the use of energy-efficient technologies and the use of renewable energy to achieve energy saving goals [37].

Main regulatory documents related to building energy codes

Federal law No. 261-FZ “On energy saving and energy efficiency improvement” – 23.11.2009
GOST R 56828.18-2017 GOST R 51388-99 energy Saving
Government resolution No. 18 of 25 January 2011
Government resolution No. 452 of 16 may 2014

- Climatic zone
- Subregions

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Indoor and outdoor climatic conditions
- Thermal bridge

Use of the International Performance Measurement & Verification Protocol (IPMVP): Yes

Software used for compliance verification: Yes

Mandatory requirement to assess post-construction requirement of the thermal bridge: Yes

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Main regulatory documents for the EPC: The EPC contract can be concluded between the customer and the contractor to perform a full cycle of work and responsibility for the risks.

Coverage:

- Apartment blocks
- Commercial buildings
- Public buildings

- new residential

Energy EPC refer to: total primary energy

Stringency: Mandatory

National registry database for the EPC: Yes

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards:.European Union standards used for CE Marking and International technical specifications, such as those prepared by ISO for other countries

Requirements to test building materials and products by certified test laboratories: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family
- Apartment blocks
- Commercial buildings
- Public buildings

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

National classification of buildings covered in building energy code:
A++, A+, A, B+, B, C+, C, C-, D, E.

Stringency: Mixed (both voluntary and mandatory)

Energy use for: heating, cooling, hot water, lighting, ventilation. Total primary energy use

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Specified thermal comfort levels for summer
- Solar gains (G-values)
- Thermal bridge

Individual energy metering and control units: yes

Stringency: Mandatory

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes, for heating only

Mandatory

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Yes, Refusal for occupancy or construction permit

Energy performance monitoring requirements: Yes, Mandatory

Tajikistan

Reserves of energy efficiency in residential buildings. About 90% of the housing stock in Tajikistan is built according to old standards, and the main consumption of energy resources (3.6 billion kWh) is carried out by these houses. Therefore, it is important for the Republic not only to build energy-efficient houses, but also to bring the old housing stock to the characteristics of modern buildings by warming and thermal modernization of the Complex of measures to minimize heat and electricity losses in buildings. The Government should develop building codes for newly constructed buildings as well as ensure its proper enforcement - In rural areas The Government should stimulate the systematic use of efficient techniques based on local expertise [38].

Main regulatory documents related to building energy codes

Law of the Republic of Tajikistan No. 1018 of September 19, 2013 "On Energy Saving and Energy Efficiency"

- 2013

Performance-based requirements in building energy codes

No data

Software: No data

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

No data

Stringency: No data

Existence of national registry database for EPC in your country: No data

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

No data

Stringency: No data

Prescriptive requirements in building energy codes

No data

Values for New Buildings
Residential Buildings
U-values (W/(m2·K): No data

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: No data

Energy performance monitoring requirements: No data

Turkmenistan

In Turkmenistan, the existing apartment buildings were built in 1960-1991. Thermal insulation of roofs and external walls in such buildings is practically not used. The government is promoting a number of strategies to stimulate housing growth and could easily organize a gradual change in energy efficiency by creating incentives for energy inclusion efficiency technologies in construction. It is encouraging that the government of Turkmenistan is currently working with the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) on a project that seeks to introduce efficient designs and technologies in the residential sector of Turkmenistan [39].

Main regulatory documents related to building energy codes

SNT 2.08.01.-15 "Residential buildings"
SNT 2.01.03-16 "Construction heat engineering"
SNT 2.03.10-01 * Roofs and roofs
A Handbook on the Design of Energy-Efficient Residential Buildings for SNT 2.08.01-15 "Residential Buildings".

- 2015-2017

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Space heating system
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Design position and orientation of buildings
- Indoor and outdoor climatic conditions
- Thermal bridge

Energy use for: heating, cooling, hot water, ventilation. Total primary energy use.

Note: The primary indicator for estimating the energy consumption of buildings is the primary energy consumption for heating, cooling and ventilation.

Software used for compliance verification: No
The gap between predicted and actual performance levels: around 10%

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

The main document related to certification (EPC) is the Regulation on the rules and procedure for conducting energy audits in residential buildings in Turkmenistan.
Coverage:

- Single family houses
- Apartment blocks

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

Type of energy that the EPC refer to: total primary energy

Stringency: Mandatory

Existence of national registry database for EPC in your country: No

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: No information
Requirements to test building materials and products by certified test laboratories: The State Standardization Agency "Turkmenstandartlary" and the Institute of Seismology of Turkmenistan

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Energy saving is a requirement of the new SNT 2.01.03- "Building heat engineering" and can be considered mandatory

Prescriptive requirements in building energy codes

- Specified thermal comfort levels for winter and summer
  Ventilation
- Thermal bridges

Certain levels of thermal comfort for winter and summer for the cold period t = 20 ° C, for the warm period of the year t = 25 ° C. Relative humidity φB,% for the cold period of the year 55 and for the warm period of the year 50.

Ventilation - the amount of air delivered from the premises of 3 m3 / h per 1 m2 of residential premises

Thermal bridges - there is a special calculation and calculated for a specific node.

Building energy codes contain requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes, both for heating and A/C systems

Mandatory requirement: Yes

Individual energy metering and control units: No

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for both heating and A/C systems:

Requirements for regular inspection of heating and A/C systems: Yes, for both heating and A/C systems:

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Refusal for occupancy or construction permit

Ukraine

The number of households in Ukraine is about 17 million. A sample survey of household living conditions in 2013 showed that 69.3% of Ukrainian households live in urban areas and 30.7% in rural areas. The number of flats in Ukraine, per 1,000 inhabitants (425 apartments) close to the EU level. Although the data show some improvement in living conditions in Ukraine, many problems remain, such as limited space and deteriorating living conditions, deteriorating living conditions and growing inequalities in access to better housing. There is an uneven distribution of housing consumption, which means that some households have more than one housing unit, but there is no official data on housing needs. Modern housing and construction is estimated as energy efficient, with the use of modern technical solutions and technological materials [40].

Main regulatory documents related to building energy codes

DBN.2.6-31 (state building codes) -
the document concerns buildings;
DSTU B A.2.2-8 (state standards of Ukraine) -
the document concerns engineering systems
• DBN B.2.6-31 - 2006
• DSTU B A.2.2-8 - 2010
• Climatic zones

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Use of Energy Performance in Buildings (EPB) standards (2017): Yes

Software used for compliance verification: No

Energy Performance Gap: Low

Mandatory requirement to assess post-construction requirement of the thermal bridge: Yes

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage: http://zakon3.rada.gov.ua/laws/show/2118-19

EPC Coverage: currently under development

Type of energy EPC refers to: currently under development

Stringency: Mixed (both mandatory and voluntary)

Existence of national registry database for the EPC: Not clear

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: Not clear

Requirements to test building materials and products by certified test laboratories: Not clear

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Public buildings: гостиницы, предприятия торговли, здания и сооружения учебных заведений, детских дошкольных учреждений, учреждения здравоохранения

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

National classification of buildings covered in building energy codes: A, B, C, D, E, F, G.

Stringency: Mixed (both voluntary and mandatory)

Energy use for: heating, cooling, hot water, ventilation. Total primary energy use.

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Solar gains (G-values)
- Air-tightness
- Ventilation or air quality
- External solar protections
- Solar absorbance of external surfaces
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewables
- Thermal bridges

Individual energy metering and control units: Partially,

This is a mandatory requirement

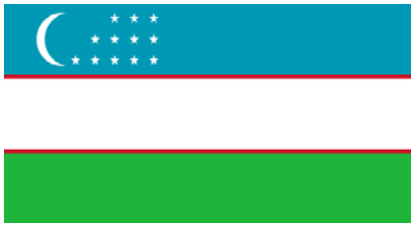
Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: No

Energy performance monitoring requirements: No

Uzbekistan



The main share of housing construction (87.0%) falls on individual housing 97.7 per cent of households in the Republic have their own home or apartment, including 99.5 per cent in rural areas. The main type of housing is a separate house (77.1%). In the housing stock, the share of multi-apartment houses built before 1991 is 83.2%. The housing stock has a relatively high level of centralized water supply (82.7 per cent), gas supply (83.5 per cent) and heat supply (45.0 per cent). Introduction of new energy-efficient building codes create conditions for practical implementation of energy-saving technologies in Uzbekistan [41].

Main regulatory documents related to building energy codes

The Uniform Building Regulations of the Republic of Uzbekistan (Part 1) (Annex No. 3 to the Decision of the Cabinet of Ministers of the Republic of Uzbekistan on August 20, 2013, No. 229)
Rules of organization of works on the improvement of settlements taking into account modern architectural and town-planning requirements (Annex to the Decision of the Cabinet of Ministers of the Republic of Uzbekistan of 09.03.2009 N 59)
KMK 2.01.12-2000 Norms of energy consumption for heating ventilation and air conditioning of buildings and structures

- 1997 – 2017
- Climatic zones

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Use of Energy Performance in Buildings (EPB) standards (2017): Yes

Software used for compliance verification: Yes

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

The main legislative documents related to the EPC: Decision on measures to ensure the rational use of energy resources. November 8, 2017, No. PP-3379

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings
- All types of buildings
-

Type of energy EPC refers to: total primary energy, electricity, heat and hot water

Policy requirement for the EPC: Mandatory
Existence of the national registry database for EPC: Yes

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: ISO

Requirements to test building materials and products by certified test laboratories: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Energy use for: heating, cooling, hot water, lighting, ventilation. Total primary energy use.

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Solar gains (G-values)
- Air-tightness
- Ventilation or air quality
- External solar protections
- Ventilation for summer comfort
- Solar absorbance of external surfaces
- The requirements for daylight
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewables

Stringency: Mandatory

Individual energy metering and control units: yes

This is a mandatory requirement

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes, for both heating and A/C systems

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Yes, differentiated tariffs for energy resources. Penalties and charges for non-compliance.

Energy performance monitoring requirements: Yes, mandatory

Canada

In Canada, as a rule, those who can afford to buy a home, doing this partly to ensure security of tenure and partly as investments. Across the country, 70% of Canadians own and 30% rent housing. Canadian housing takes many forms. More than half of canadian homes are single-family detached houses; 17% are other land-based forms, such as row houses, duplexes, semi-detached or mobile; 18% are low - sea-level and 10% are high-sea-level apartments. About 80 per cent of the houses are made of wood, the rest of the houses are built of stone, brick and reinforced concrete structures. As a rule, more than 90% of new housing is built into the property. "Canadian house", in which internal communications (water supply, Sewerage, wiring heating systems) are hidden in the walls, is the most heat-saving technology available today. In Canada there are 100,000 units of cooperative housing [42].

Main regulatory documents related to building energy codes

Canada has a model national code system for buildings, but implementation and enforcements of building codes is within Provincial jurisdiction. The federal model national code development process includes participation from the Provinces & Territories plus industry groups & NGO's to encourage adoption of the model national code by provinces. In general, the model national code is adopted as law by provinces although they may modify it. The list of documents is too extensive to include in this survey.

- Climate zones
- Sub-regions

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

All factors must be considered to determine the efficiency of a building. Our existing codes are not effective in doing so, but anticipated changes in our codes seek to do so.
Specific standards and references have not been determined for future codes.

Software used for compliance verification: No

The gap between predicted and actual performance levels: Unknown - this is gap future regulations are to eliminate.

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

Type of buildings do EPC cover in your country.
Comments: Energy labelling and benchmarking of buildings is coming, but is not yet in place. When the labelling and benchmarking program is in place, it is to apply to all buildings.

Stringency: No answer

Existence of national registry database for EPC: No answer

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: No answer

Requirements to test building materials and products by certified test laboratories: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential

Stringency:

Mixed (both voluntary and mandatory)

Energy codes are relatively recent and, until recently have been modest in their level of ambition. The new national building strategy is designed to dramatically improve building efficiency and have code requirements apply to all buildings, both new and existing.

Canada has two classes of buildings in its codes. Large buildings are dealt with by Part 3 of the code and are therefore called Part 3 buildings. Houses and small buildings are dealt with by Part 9 of the code and are called Part 9 buildings.

Energy levels are considered in building codes when defining the Energy Performance of a Building: Energy use for heating, cooling, hot water, lighting, ventilation.

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Ventilation or air quality
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system

The responses above reflect current codes. The work now underway is intended to address most or all of the gaps in current practices.

Values for the prescriptive requirements: The values vary with building type, climate zone, etc.

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: No

Penalties, incentives and other mechanisms for improving compliance: No

Energy performance monitoring requirements: No

United States

Almost all cities or territorial entities have their own rules and laws on construction, but in recent years, the requirements for thermal insulation and sound insulation of buildings under construction have become tougher. The 1990 American Standard for Heating, Refrigeration and air conditioning engineers (ASHRAE) was the first building energy code to include prescriptive requirements on solar reflection (how much light roofs should reflect) and minimal thermal emissions (how efficiently roofs shed heat) of roofs for air-conditioned buildings. Today, most warm staffs in the United States include prescriptive requirements on the use of steep roofs. The use of cold roofs can reduce the requirement for air conditioning by up to 20%. In warm climates with high requirements for cooling energy cool roofs to reduce peak electricity demand and transmit less heat to the outside environment thereby slowing the formation of urban smog due to energy production and improved human health and comfort in the open air [43].

Main regulatory documents related to building energy codes

These vary by region and are adopted and amended by each state. Most states base their energy code on the IECC code developed by the International Code Council.

- The US is currently utilizing the 2015 version of the ICC codes
- Climate zones
- Many states, such as California, require additional energy calculation compliance based on localized climate requirements.

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Built-in lighting system (mainly in the non-residential sector)

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage: No answers

Stringency: No answers

Existence of national registry database for EPC: No answers

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: No answers

Penalties, incentives and other mechanisms for improving compliance: No answers

Energy performance monitoring requirements: No answers

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

Stringency:

Mandatory

Performance-based requirements in building energy codes: This is an optional/alternate path of compliance in some states.

Details/values of the performance-based requirements in building: Varies considerably and only applicable in some states.

Energy levels are considered in building codes when defining the Energy Performance of a Building: Energy use for lighting

Prescriptive requirements in building energy codes

No answers

Building Materials and Products

Rating/certification of building materials: No answers

Harmonization with other technical standards: No answers

Requirements to test building materials and products by certified test laboratories: No answers

Albania

Albania's National Energy Efficiency Action Plan established a target of 9% energy use reduction across sectors by 2018. Energy use reduction in the residential building sector is expected to account for 22% of the broader target. Albania has taken important steps toward achieving these reductions by requiring energy efficiency standards for new building construction. Law No. 8937 defined minimal thermal efficiency standards for new construction, and Law No. 10113 mandates compliance with energy efficiency standards. Albania is working towards the development and passage of an updated Law on Energy Efficiency, which will build a framework for enforcement and implementation of national energy efficiency priorities that have previously remained unenforced [44].

Main regulatory documents related to building energy codes

Law was adopted in November 2015, which transposes many of the requirements of Directive 2012/27/EU (the "Energy Efficiency Directive"). Approval is expected of the draft Law on the Energy Performance of Buildings (EPB), which transposes Directive 2010/31/EU (the "Energy Performance of Buildings Directive")
Energy performance on building law 116/2016.

- On 11th of november 2016 the Energy Performance Law. Till have new sublaws on EPB law we have in force the regulation of DCM no 38 dt. 16.01.2003
- Climate zones: 3 different climate zones A B C. The C zone is the coldest with 2370 Hersting Degree Days, the 2nd zone B with 2000 and zone A with 1700 HDD

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

The International Performance Measurement & Verification Protocol (IPMVP): No

Software used for compliance verification: No

The gap between predicted and actual performance levels: 30-40%

There is mandatory requirement to assess post-construction requirement of the thermal bridge: No

There is mandatory requirement for air tightness testing: No

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Public buildings
- new non-residential

Type of energy that the EPC refer to: Total primary energy,

Stringency: Mandatory

Existence of national registry database for EPC: No

Building Materials and Products

Rating/certification of building materials: No

Harmonization with other technical standards: International technical specifications, such as those prepared by ISO

Requirements to test building materials and products by certified test laboratories: No

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)

Stones Building Brick Building Parafabricated Building

Stringency: Mixed (both voluntary and mandatory) (line 40) and Voluntary (line 70)

Performance-based requirements: Energy efficient development systems

Values of the performance-based requirements: New buildings: 55 kwh/m2a, Existing buildings (e.g. after substantial refurbishment): 80 kwh/m2a

Energy levels are considered in building codes:
Energy use for: heating, cooling, hot water, lighting, ventilation.

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Solar gains (G-values)
- Air-tightness
- Ventilation or air quality
- Ventilation for summer comfort
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewables

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: No

Penalties, incentives and other mechanisms for improving compliance: Fines for non-compliance

Energy performance monitoring requirements: Yes

Bosnia and Herzegovina

Nearly two thirds of the housing sector has been rehabilitated with the support of various international and local donors, and another third, mostly less damaged buildings, has been renovated with private funds from homeowners. The number of completed dwellings in Bosnia and Herzegovina increased to 989 in the fourth quarter of 2017 from 640 in the third quarter of 2017. District heating systems are available in urban areas, particularly Sarajevo, Banja Luka, Zenica and Tuzla. The district heating system in Tuzla receives heat from the Tuzla power plant, which is the only example of a co-production plant for domestic heating in Bosnia and Herzegovina [45].

Main regulatory documents related to building energy codes

The law on energy efficiency in the Federation of B&H (Federal official Gazette, 22/17)
The law on construction in Republic of Srpska
Regulation of the minimum energy efficiency of buildings in the Federation of B&H and Republika Srpska.

- The Regulation of minimum of energy performance of buildings in Republic Srpska (2015).
- The Regulation of minimum of energy performance of buildings in Federation of B&H currently is in adoption procedure.
- Two Climate zones

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Indoor and outdoor climatic conditions
- Thermal bridge

Energy use for: heating, cooling, hot water, ventilation
A subset of ISO EPB standards: currently we use EN ISO or EN standards as soon as other technical requirements are met, we will adopt EU standards such as EPB from 2017 (EN ISO 52000)
International performance measurement and verification Protocol (IPMVP): Yes, we are currently in the process of creating the same

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- New non-residential
- New residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

National classification of buildings covered by energy codes:
Residential building: Apartment building and individual family house
Nonresidential building: Administrative building: for education, social and health,
Commercial building for sports and recreation, tourism and catering (restaurant-hotel).

Stringency: Mandatory

The values are the same as for new buildings and major renovations. This is reflected in:
Maximum permissible values of annual heat energy required per m2 of useful surface of the building Q " H, nd (kWh / (m2 • years), depending on the shape factor (geometry of the building), climatic zone and the purpose of the building
The maximum transmittance for buildings on the climate zone, use of the building and the shape factor of the building (geometry of buildings)

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Type of energy that the EPC refer to: Energy for heating space and water
Entitled to issue EPC: accredited domestic energy assessors
Existence of national registry database for EPC: Yes

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Solar gains (G-values)
- Air-tightness
- Ventilation or air quality
- External solar protections
- Thermal bridge

The U values for external walls, floor, roof and windows depends of designed temperature of buildings and climatic zone: a table of U-values is provided

Solar gains (G-values): a table of U-values is provided
Air-tightness: a table of U-values is provided
External solar protections: a table of U-values is provided
Thermal bridge: The good examples of thermal bridges with project values of thermal conductivity for each example of thermal bridges
Individual energy metering and control units: Partially

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: European Union standards used for CE Marking

Requirements to test building materials and products by certified test laboratories: Yes, Institute for accreditation of B&H

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: No

Penalties, incentives and other mechanisms for improving compliance: Refusal for occupancy or construction permit

Energy performance monitoring requirements: No

Macedonia

Major problematic areas in Macedonia, as far as energy efficiency is concerned, are the wide use of electricity for domestic heating and the inefficient energy consumption in buildings. The Government has started addressing these problems, but they have not been given enough priority. The introduction of the building certificate system is planned. The Energy Law allocates the responsibilities for energy efficiency policy development and implementation in Macedonia to the Ministry of Economy, supported by the Energy Agency. Responsibility within the Ministry is with the Energy Department and its Unit [46].

Main regulatory documents related to building energy codes

Law on Energy (Energy Law (EL)) 2011
Law on Construction (Construction Law (CL)).
Law on spatial and urban planning, Rulebook on energy audits 2013.
Rulebook for energy characteristics of buildings 2013, Rulebook for Information System for monitoring and management of energy consumption at legal entities in public sector 2015.
Energy efficiency strategy for 2010-2020.

- The current set of regulations was adopted in 2015, but the legislation is going through changes at the moment
- Climate zones, Sub-regions. Now ion rulebook for energy characteristics of buildings only 4.

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Energy use for: heating, cooling, hot water

The subset of ISO EPB standards

Software used for compliance verification: No

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- all of them

Stringency: Mixed (both voluntary and mandatory)

Existence of national registry database for EPC: No, EPC is not functioning at that moment

Building Materials and Products

Rating/certification of building materials: No

Harmonization with other technical standards: European Union standards used for CE Marking

Requirements to test building materials and products by certified test laboratories: No

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

The national classification of buildings covered by the energy codes: they are separated by residential and non-residential for the means of certification. For the needs of energy audits, there is more detailed breakdown.

Stringency:

Mixed (both voluntary and mandatory)

Residential sector min "C class"100 kwh/m2 annual consumption, public sector min "C class" 150 kWh/m2 annual consumption
Mandatory for public sector min "D class" after substantial refurbishment

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Solar gains (G-values)
- Ventilation or air quality
- External solar protections
- Daylighting requirements
- Boiler/AC system
- Renewables
- Thermal bridge

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for both heating and A/C systems

Penalties, incentives and other mechanisms for improving compliance: Yes, losing the license

Energy performance monitoring requirements: Yes

Montenegro

The state - building sector is an obvious priority for solving energy-saving problems in Montenegro, as it accounts for about 30% of the energy-saving potential in the public buildings sector and up to 10% in the residential buildings sector from the total energy-saving potential in the country. The government is taking measures to modernize the housing stock in order to improve its energy efficiency. Montenegro adopted the energy policy until 2030, which defines three main priorities: sustainable energy development, security of supply and development of the energy market. In order to achieve these priorities, the main objectives are defined, where the use of energy-saving and renewable energy potential and the achievement of the goals are concepts that emphasize many of the defined goals [47].

Main regulatory documents related to building energy codes

Law on efficient use of energy (official Gazette of Montenegro, 57/14)
Set of rules on minimum requirements for energy efficiency of buildings (official Gazette of Montenegro 75/15)
Guidelines for energy efficiency certification of buildings (official Gazette of Montenegro 75/15)
Guidelines for energy audits of buildings (official Gazette of Montenegro 75/15)

- 2014-2015
- Climate zones: I Zone, II Zone and III Zone

Performance-based requirements in building energy codes

Performance-based requirements for buildings do not exist at this moment. Energy classes will be defined within the EEPPB II project

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Design position and orientation of buildings
- Thermal bridges
- Electricity for the pumps and fans and Electricity for appliances and equipment
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions

Energy use for: heating, cooling, hot water, lighting, ventilation.
Total primary energy use
The subset of ISO EPB standards: This will be decided within the EEPPB II project
Software used for compliance verification: Yes, ENSI, Knauf etc.

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory
EPC is not carried out in practice due to the lack of national software for calculating. This will be done in the project EEPPB II.
Existence of national registry database for EPC: No

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: Yes

Requirements to test building materials and products by certified test laboratories: Yes, Laboratory for testing building materials and constructions (part of Civil Engineering Faculty in Podgorica)

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial: hotels, recreational facilities, cultural facilities, warehouses, light industry,
- Public buildings: schools, kindergartens, universities, hospitals, dormitories,
- Other buildings that are heated on temperature above 12 °C, has area more than 50 m2 and are not under cultural heritage.

This typology is represented in current Rulebook on minimal energy efficiency requirements in buildings. New building typology will be defined within the EEPPB II project.

- new non-residential
- new residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- External solar protections
- Artificial lighting system, lighting density
- Boiler/AC system
- Renewables
- Thermal bridges

Tightness: at a pressure difference of 50 PA: n50 = 3,0 h - 1 in buildings without mechanical ventilation, and n50 = 1,5 h-1 in buildings with mechanical ventilation.
Ventilation or air quality: N = 0.5 h-1. In the case when people are not in the part of the building is n = 0,3 h-1.
Heat recovery: change of air is greater than 0.7 h-1, the total air flow is greater than 2500 m3 / h. If the criteria are met, the recovery efficiency should be above 50 %.
External solar protection: condition: fall-winter □ 0.4: requirements: gtot□firmware □ 0.20 (zone I), gtot□firmware □ 0.25 (zones II and III); condition: fall-winter □ 0.4: requirements: gtot ≤ 0.50 (zone I), gtot ≤ 0.60 (zones II and III).
Artificial lighting system, lighting density: more than 42 lumen / watt.
Boiler / AC system: (boiler efficiency), 3.2 (efficiency / AIR up to 12 kW) and 3.3 (efficiency / AIR over 12 kW)
Renewable energy: a commitment for new buildings in climate zone I to cover 30% of their annual energy needs for domestic hot water with renewable sources (solar thermal systems).
Thermal bridges: the conductivity shall be either equal to 0.2 W / MK

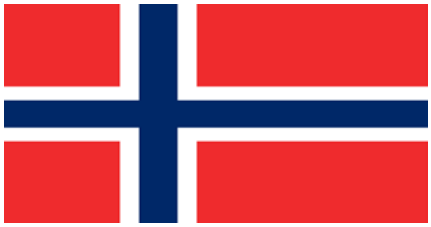
Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for both heating and A/C systems

Penalties, incentives and other mechanisms for improving compliance: Fines for non-compliance, Refusal for occupancy or construction permit

Energy performance monitoring requirements: Yes, Mandatory

Norway



Insulation to ensure adequate indoor air quality and comfort is always a part of the building code in Norway. Requirements for energy efficiency as a justification was introduced in the technical construction standards in 1969. In 1987, the requirements were tightened. Codes in 1997 placed greater emphasis on energy and the environment. Further tightening of energy requirements in the new 2010 technical code. This code is called TEK10 and is the current code. A new white paper from the Norwegian Parliament regarding future climate and building policy has notified an introduction of passive house level as a minimum requirement in the Building codes from 2015. In the new code from 2015, the passive house level might be defined as supplied energy calculated for a reference building equivalent to a passive house in accordance with NS 3700 and NS 3701 [48].

Main regulatory documents related to building energy codes

The Planning and Building Act of 27 June 2008
The Planning and Building Act (2010-2015)
The Planning and Buildings Act (2016-2017)
Norwegian standard NS 3700:2013 Criterias for passive houses and low energy houses.

- 2008-01.01.2017
- Climate zones: 1, 2, 3

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions

Software: Various software can be used if in line with national calculation methods

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses (Small houses)
- Apartment blocks (Block of flats)
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses (Small houses)
- Apartment blocks (Block of flats)
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Energy used for: Space heating, Appliances, Water heating, Lighting interior, Ventilation

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Boiler/AC system
- Specified thermal comfort levels for summer and winter
- Solar gains (G-values)
- Renewables

Prescriptive Energy Requirements: Heated usable floor area
Energy Requirements:
Insulation

U-Values (W/m2.K)	Walls	Floor	Roof
Minimum requirements	≤ 0.22	≤ 0.18	≤ 0.18
Basic/standard requirements	≤ 0.18	≤ 0.10	≤ 0.13

Windows

U-Values (W/m2.K)	Windows
Minimum requirements	≤ 1.2
Basic/standard requirements	≤ 0.8

Proportion of window and door areas ≤ 25% of heated usable floor space.
Air Leakage
The energy budget in the requirements assume an air leakage of max. 0.6 l/(s.m2) at 50 Pa.
Renewable Energy: The installation of fossil fuel heating installations is not permitted.
Small houses and leisure homes with more than 150 m2 of heated usable floor space: 120 kWh/m2/year + 1600 kWh/m2 of heated usable floor area. Block of flats: 115 kWh/m2/year

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: No data

Energy performance monitoring requirements: No data

Serbia

Studies have shown that Serbia has great potential for improving energy efficiency in the construction sector, primarily because of the fact that most of the Serbian construction Fund-a building built in the 70s and 80s, with brick walls and without thermal insulation. In addition, individual boilers for heating systems are often in poor condition. Because of the low efficiency of heating systems combined with poor performance of building dimensions leads to a significant loss of valuable energy. Serbia has adopted a number of rules aimed at improving energy efficiency, including the national energy efficiency action plan (2010), as well as the decree on energy efficiency of buildings and the decree on conditions for issuing and maintaining energy efficiency certificates for buildings (2012) [49].

Main regulatory documents related to building energy codes

The law on planning and construction ("Official Gazette of the Republic of Serbia", No. 72/2009, 81/2009)
Rulebook on energy performance of buildings ("Official Gazette of the Republic of Serbia", No. 61/2011)
Rulebook on conditions, contents and manner of issuing certificates on energy performance of buildings ("Official Gazette of the Republic of Serbia" No. 69/2012).

- Energy certification of buildings (2012), mandatory.
- Climate zones

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Design position and orientation of buildings
- Thermal bridges

- New building
- Existing building (e.g. after substantial refurbishment)

The energy class of the new building shall not be lower than class "C" or higher. The class of energy consumption of existing buildings should be upgraded to at least one class after reconstruction.

Software used for compliance verification: No
The gap between predicted and actual performance levels: 10%

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- New non-residential
- New residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

Energy type to which EPC refers: total primary energy

Stringency: Mixed (both mandatory and voluntary)

Existence of national registry database for EPC: Central registry for energy passport, but it is not mandatory.

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: The Draft Law on Construction Products is currently under way.

Requirements to test building materials and products by certified test laboratories: Yes, Accreditation Board of Serbia (ABS)

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings

- new non-residential
- new residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)

National classification of buildings covered by the energy codes: A, B, C, D, E, F, G, H
According to the Rulebook on energy efficiency in buildings, the energy performance and manners of calculating thermal properties are established for the following types of buildings: Residential single apartment buildings; Residential buildings with two or more apartments; Administrative and commercial buildings; Education and culture buildings; Health and social care buildings; Tourism and hospitality buildings; Sports and recreation buildings; Buildings in trade and service industries; Mixed purpose buildings; 10) Buildings for other purposes that use energy.

Stringency: Mixed (both voluntary and mandatory)

Energy use for: heating, total primary energy use

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Specified thermal comfort levels for winter and summer
- Solar gains (G-values)
- Air-tightness
- Ventilation or air quality
- External solar protections
- Periodic transmittance and time lag of walls and roof
- Solar absorbance of external surfaces (e.g. cool paintings for roofs and streets)
- Daylighting requirements
- Thermal bridges

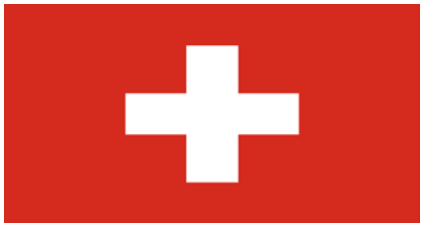
Main legislative documents relating to the EPC: the law on efficient use of energy; the law on environmental protection;
Position on the assessment of the limit values of the annual energy consumption; Rulebook on conditions, contents and procedure of issuing certificates on the energy performance of buildings
Individual energy metering and control units: No

Requirements for enforcement and compliance

Requirements for regular inspection of heating and A/C systems: Yes, for both heating and A/C systems, but it is defined in separate regulation, this is a mandatory requirement

Penalties, incentives and other mechanisms for improving compliance: Refusal for occupancy or construction permit. Construction and use permits.
Energy performance monitoring requirements: Yes, Mandatory

Switzerland



In Switzerland for achieving the targets of the EU 20/20/201 developed appropriate rules. Standards demand for heat and power under development 2014 and 2020: a reassessment of the basic agreement of the cantons on the performance of buildings, changes of various energy laws of the cantons; coordinated building codes of the Swiss cantons shall be strengthened by 2014. The prohibition of electric heating also for existing buildings by 2015. The requirement of almost zero energy buildings for new buildings should be incorporated into the building regulations of Swiss cantons by 2014 to almost zero energy buildings to become mandatory by 2018. Recently launched MINERGIE-a-standard, considered as a way to identify a nearly ZERO-energy building [50].

Main regulatory documents related to building energy codes

SIA (Swiss Society of Engineers and Architects) norms: regulations related to every aspect of the construction and operation of the building, especially the SIA 2031:2009: Norm for the Energy certification of buildings, which regulates the energy performance classification. At the same time, each of the 26 cantons of Switzerland sets its own requirements. Local building and insulation codes, vary by canton, sub-regions, varies date.

- EnDK (Conference of Cantonal Energy Directors) prescriptions: the MoPEC 2014: cantonal energy regulations if a model or template for cantonal energy regulations, created with the objective of reducing energy needs in the buildings sector, especially in existing buildings. https://www.endk.ch/fr/politique-energetique/mopec
- CECB: the cantonal label for energy use in buildings https://www.cecb.ch/StartPage.asp
- MINERGIE: the private label for energy use in buildings

Performance-based requirements in building energy codes

- Thermal characteristics and geometry of the building (envelope and internal partitions, etc.)
- Air-tightness
- Space heating system and hot water supply units
- Air-conditioning system(s)
- Mechanical and natural ventilation
- Built-in lighting system (mainly in the non-residential sector)
- Design position and orientation of buildings
- Passive solar systems and solar protection
- Indoor and outdoor climatic conditions
- Thermal bridge

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new non-residential
- existing residential (e.g. after substantial refurbishment)

Stringency: Mandatory and Mixed (both mandatory and voluntary)

Existence of national registry database for EPC: No and Yes

Building Materials and Products

Rating/certification of building materials: Yes

Harmonization with other technical standards: Swiss codes, European Union standards used for CE Marking, International technical specifications, such as those prepared by ISO

Requirements to test building materials and products by certified test laboratories: Yes

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial
- Public buildings
- Multifamily house, Hotel, Office, School, Shop, Restaurant, multi-purpose halls, Hospital, Industry, Sport halls, Warehouse

- New non-residential
- New residential
- Existing residential (e.g. after substantial refurbishment)
- Existing non-residential (e.g. after substantial refurbishment)
- Subsidies provided by cantons to upgrade buildings built before 2000

Stringency: Mandatory and Mixed (both voluntary and mandatory)

- Local / canton codes prevalence
- Variable depending on canton

Prescriptive requirements in building energy codes

- Thermal insulation (including U-values for walls, floor, roof and windows)
- Air-tightness
- Ventilation or air quality
- Daylighting requirements
- Artificial lighting system, lighting density
- Boiler/AC system
- Thermal bridges
- Specified thermal comfort levels for winter and summer
- External solar protections
- Solar gains (G-values)
- Periodic transmittance and time lag of walls and roof
- Renewables

District heating and other external heating systems, the buildings equipped with individual energy metering and control units: Yes

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: Yes, for heating systems only

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Yes,

- subsidies
- refusal for occupancy or construction permit
- Financial incentives are given to improve the thermal efficiency of the envelope and heating systems
- The Swiss Buildings Program supports measures to improve the energy efficiency of real estate assets, such as roof and facade insulation, heat recovery, optimization of technical facilities and the use of renewable energy.

Energy performance monitoring requirements: No

Turkey

Turkey's building energy regulation focuses on thermal resistance. The National Standard of Thermal Insulation Requirements for Buildings TS 825 was first issued in 1999 and became mandatory in June 2000. More recently, Turkey has begun to align with the European legislation on buildings, including the Energy Performance of Buildings Directive (EPBD). A part of this process is adoption of Building Energy Performance (BEP) Regulation, which envisages the use of district heating and/or renewable energy for the buildings above a certain threshold. BEP is mandatory for all new buildings except for industrial buildings, temporary buildings used less than 2 years, buildings with a total useful floor area of less than 50m², greenhouses, workshops as well as buildings without heating or cooling requirements [51].

Main regulatory documents related to building energy codes

Bep-TR (Regulation of energy performance of buildings) 2010
National (thermal regulation only): TS 825 (revised in 2013)

- Climate zones-4

Performance-based requirements in building energy codes

No data

Stringency: Mandatory

Software: BEP-TR and BEP-HY programs

Energy use for: Space cooling, Space heating, Water heating

Energy Performance Certification (EPC)/Energy Labelling/Energy Passport of the building

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential
- existing non-residential

Stringency: Mandatory

Bep-TR (2011), Classifications are under review, Voluntary
The building performance certificates have been recently introduced. The BEP regulation stipulates that all new buildings must have an energy identity certificate (valid for 10 years) energy performance of which is class C or higher, whereas existing buildings will be required to have that certificate by May 2017.

Existence of national registry database for EPC in your country: Yes

Building Materials and Products

Rating/certification of building materials: No data

Harmonization with other technical standards: No data

Requirements to test building materials and products by certified test laboratories: No data

Building Energy Codes Stringency and Coverage

Coverage:

- Single family houses
- Apartment blocks
- Commercial buildings
- Public buildings

- new residential
- new non-residential
- existing residential (e.g. after substantial refurbishment)
- existing non-residential (e.g. after substantial refurbishment)

Stringency: Mandatory

Prescriptive requirements in building energy codes

No data

U-Value:
TS 825 (similar to EN 13790),

Insulation (W/m2K): Climate zone	Wall	Roof	Floor	Windows
1	0.7	0.45	0.7	2.4
2	0.6	0.4	0.6	2.4
3	0.5	0.3	0.45	2.4
4	0.4	0.25	0.4	2.4

Air Leakage: TS EN 12207, TS EN 13465
Water Heating System: EN 15316
Lighting: EN 15251, EN 12464, EN 12665, EN 13032

Source: http://www.ecofys.com/files/files/ecofys-2016-u-value-maps-turkey.pdf

Requirements for enforcement and compliance

Requirements for regular inspection of heating and air/conditioning (A/C) systems: No data

Penalties, incentives and other mechanisms for improving compliance with building energy codes in your country: Refusal of permission to occupy

Energy performance monitoring requirements: No data

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