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REFURBISHMENT OF THE PUBLIC BUILDING STOCK TOWARDS NZEB

ACRONYM OF THE PROJECT: REPUBLIC_ZEB

D4.1 REPORT ON THE COUNTRY ASSUMPTIONS FOR THE APPLICATION OF THE ENERGY USE (FOSSIL AND RENEWABLE) EVALUATION METHODOLOGY TO THE CASE STUDIES (REFERENCE BUILDINGS AND DEFINED EFFICIENCY MEASURES)

4 November 2015

RePublic_ZEB Project

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Website: www.republiczeb.org

Project consortium

BME	WP3 Leader
BRE	WP6 Leader
BSERC	WP2 Leader
CRES	Partner
CTI	WP1-WP7 Leader Coordination
EIHP	Partner
URBAN-INCERC	Partner
IREC	Partner
LNEG	WP5 Leader
MACEF	Partner
POLITO	WP 4 Leader
ZRMK	Partner

Project overview

The RePublic_ZEB project is focused on the energy and CO_2 emissions associated with existing public buildings and their refurbishment towards nZEB.

The **core objective** of the project is to:

- Define costs-benefit optimized "packages of measures" based on efficient and quality-guaranteed technologies for the refurbishment of the public building stock towards nZEB that are standardized and adopted by builders and building owners.

From this stems three **basic objectives:**

(i) State-of-the-art assessment of the public building stock through a country-specific evaluation of the energy consumption and CO_2 emissions;

(ii) Define reference buildings; and;

(iii) Develop a common framework and a harmonized methodology for the definition of a nZEB concept for public buildings.

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Authors of this report:

Vincenzo Corrado	Politecnico di Torino (POLITO)
Simona Paduos	Politecnico di Torino (POLITO)

With the contribution of the following partners in the national sections:

Lulin Radulov	Black See Energy Research Centre (BSERC)
Toni Borković	Energetski institut Hrvoje Požar (EIHP)
Elpida Polychroni	Centre for Renewable Energy Sources and Saving (CRES)
Katerina Sfakianaki	Centre for Renewable Energy Sources and Saving (CRES)
Sashe Panevski	Macedonian Center for Energy Efficiency (MACEF)
Laura Aelenei	National Laboratory of Energy and Geology, I.P. (LNEG)
Susana Camelo	National Laboratory of Energy and Geology, I.P. (LNEG)
Ana Rute Ferreira	National Laboratory of Energy and Geology, I.P. (LNEG)
Horia Petran	NIRD URBAN-INCERC
Gasper Stegnar	Gradbeni inštitut ZRMK (ZRMK)
Marjana Šijanec Zavrl	Gradbeni inštitut ZRMK (ZRMK)
Joana Tarres	Institut de Recerca en Energia de Catalunya (IREC)
Joana Ortiz	Institut de Recerca en Energia de Catalunya (IREC)
Ma. Leandra González	Institut de Recerca en Energia de Catalunya (IREC)
Richard Hartless	BRE
Zoltan Magyar	Budapest University of Technology and Economics (BME)
Gabor Nemeth	Budapest University of Technology and Economics (BME)
Jeno Kontra	Budapest University of Technology and Economics (BME)
Giovani Riva	Comitato Termotecnico Italiano (CTI)

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Acronyms and Abbreviations

AC	Air conditioning
DHW	Domestic Hot Water
EP	Energy Performance
gl	global
HVAC	Heating, Ventilating and Air Conditioning
nren	non-renewable
ren	renewable
RER	Renewable Energy Ratio
tot	total

1. EXECUTIVE SUMMARY

This document was developed within Task 4.1 "*Definition of a methodology and the relevant tools for determining the energy use (fossil and renewable) and the cost optimal levels of the reference buildings*" of the RePublic_ZEB project.

According to the RePublic_ZEB Description of the Action:

> "*the calculation of building energy consumption and RES contribution requires the evaluation of a specific common methodology that will be implemented through tools developed by partners with a contribution from CTI. This methodology will comply with EPBD requirements and CEN standards and will consider the following services: space heating, space cooling and dehumidification, ventilation and humidification, hot water and lighting. Energy use will be calculated according to relevant CEN standards, specifically: CEN/TR 15615 Explanation of the general relationship between various European standards and the Energy Performance of Buildings Directive (EPBD) - Umbrella Document; EN ISO 13790 for building net energy demand; EN 15316 for energy demand of heating systems and DHW; EN 15241 for energy demand of ventilation systems; EN 15243 for energy demand of conditioning systems; EN 15193 for delivered energy demand of lighting systems*."

This document explains the common methodology to calculate the total global primary energy used according to the definition in prEN ISO/DIS 52000-1:2015 (which substituted prEN 15603:2015), and summarises the country/project partner assumptions for the application of the energy use evaluation methodology.

2. INTRODUCTION

POLITO provided a document outlining the advantages and disadvantages of simplified and detailed tools to calculate the energy performance (EP) of buildings.

Partners were then asked to express their preference for the most suitable calculation method considering the following three alternative options:

Table 2.1. Different calculation options for the EP evaluation.

Option	Level of detail	Description	Reference
1	Simple	Common tool provided by POLITO	EN standards
2	Simple	National EP assessment tools (different for each country)	EN standards
3	Detailed	Dynamic simulation tools (chosen by each partner)	Existing SW (e.g. EnergyPlus, ESPr, TRNSYS, IDA ICE…)

NOTE: Even for option 1, national assumptions regarding climatic data, occupancy data, and default values of thermal parameters are considered.

The following table summarises the main positive and negative aspects of each option.

Table 2.2. Positive and negative aspects for different calculation options.

	Option		
	1	**2**	**3**
Input data	POSITIVE ASPECTS • Same input data list for every partner (easy comparison among partners)	POSITIVE ASPECTS • Input data list fitted to national practice	POSITIVE ASPECTS • Detailed description of the building, technical systems and occupant behaviour
	NEGATIVE ASPECTS	NEGATIVE ASPECTS • Different input data list for each partner (difficult comparison among partners) • Uncertain if it would be easy to compare among partners	NEGATIVE ASPECTS • A wide amount of input data, is often not available for the building stock considered, and could be too detailed for the project goals • Different input data detail for each simulation software (impossible comparison among partners)
Energy performance	POSITIVE ASPECTS • Common calculation base assumptions		POSITIVE ASPECTS • Correct evaluation of

assessment		the building and technical systems dynamic behaviour • Modelling of the advanced technologies fitted to nZEB
	NEGATIVE ASPECTS • The use of simplified methodologies based on quasi steady-state conditions (usually monthly) could lead to uncertainties, especially in cases where there is mis-match between heat losses and heat gains: e.g. non-residential building, highly insulated buildings, cooling season.	NEGATIVE ASPECTS • Different calculation assumptions (difficult comparison of results among partners)

Regardless of the option adopted, each partner was required to present a list of assumptions for the energy and the financial assessment, according to a common scheme provided by POLITO.

The use of the common tool provided by POLITO is recommended as to facilitate the comparison among different countries. Nevertheless, the partners are free to adopt the most suitable calculation methodology.

According to Table 2.1, the following table summarizes the approaches of each partner in the energy performance evaluation of the reference buildings. In the table, the reference tool column shows the tool the partner will use to achieve the RePublic_ZEB goals.

Table 2.3. Calculation tools adopted for the energy performance evaluation.

	OPTIONS			REFERENCE TOOL
	(1) Common tool provided by POLITO	(2) EP assessment national tool	(3) Dynamic simulation tool	
BULGARIA		X		(2)
CROATIA	X	X		(1)
FORMER YUGOSLAV REPUBLIC OF MACEDONIA	X			(1)
GREECE	X			(1)
HUNGARY	X	X		(1)
ITALY	X		X	(1)
PORTUGAL	X	X	X	(1)/(3)
ROMANIA	X		X	(1)
SLOVENIA	X	X	X	(1)
SPAIN	X			(1)
UK	X	X		(1)

Section 5 gives more information regarding the national assumptions under-pinning the calculation tool adopted for the energy performance evaluation. For the assumptions, Appendix A gives a comparison of the national reference values.

3. ENERGY USE EVALUATION METHODOLOGY

The aim of the calculation procedure is to evaluate the total annual primary energy use, which includes the energy demand for heating, cooling, ventilation, hot water and lighting (for non-residential buildings).

The prEN ISO/DIS 52000-1:2015 Standard provides a general scheme for the energy performance calculation; the procedure includes the following steps:

1. define, for the building category or, if differentiated, for each space category, the internal conditions of use (temperature, humidity, occupancy, internal heat gains, time schedule thereof);
2. define the external conditions (climatic data);
3. partition the building in zones, if needed. The zoning may be different for the thermal energy need calculation and for technical building systems;
4. for each calculation interval calculate the energy needs for heating, cooling and (de)humidification and domestic hot water.
5. for each of the technical building systems related to the EPB services, calculate the energy use, including auxiliary energy, the contribution of renewable energy sources and the recoverable thermal losses;
6. calculate PV, wind, CHP and other electricity on-site production;
7. calculate delivered and exported energy components for each calculation interval;
8. for each calculation interval, weight delivered energy as primary energy;
9. sum individual step results and get the energy performance for the calculation period.

The calculation direction goes from the needs to the source (e.g. from the building energy needs to the primary energy). In order to assess the energy performance according to the above calculation steps, the following EU standards – and referred national implementation - are used.

Table 3.1. List of EU standards for the energy performance calculation assessment.

REFERRED STANDARD	
EN ISO 6946	Building components and building elements - Thermal resistance and thermal transmittance - Calculation method
EN 13947	Thermal performance of curtain walling - Calculation of thermal transmittance
EN ISO 13370	Thermal performance of buildings - Heat transfer via the ground - Calculation methods
EN ISO 10077-1	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General
EN ISO 10211	Thermal bridges in building construction - Heat flows and surface temperatures - Detailed calculations
EN ISO 14683	Thermal bridges in building construction - Linear thermal transmittance - Simplified methods and default values
EN ISO 13789	Thermal performance of buildings - Transmission and ventilation heat transfer coefficients - Calculation method
EN ISO 13790	Thermal performance of buildings – Transmission and ventilation heat transfer coefficients – Calculation method
EN 15241	Ventilation for buildings. Calculation methods for energy losses due to

	ventilation and infiltration in buildings
EN ISO 15927-1	Hygrothermal performance of buildings - Calculation and presentation of climatic data - Part 1: Monthly means of single meteorological elements
EN 15232	Energy performance of buildings – Impact of Building Automation, Controls and Building Management
EN 15316-1	Heating systems and water based cooling systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 1: General and Energy performance expression
EN 15316-2-1	Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 2-1: Space heating emission systems
EN 15316-2-3	Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 2-3: Space heating distribution systems
EN 15316-3	Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 3-1: Domestic hot water systems
EN 15316-4-1	Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 4-1: Space heating generation systems, combustion systems (boilers)
EN 15316-4-2	Heating systems and water based cooling systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 4-2: Space heating generation systems, heat pump systems
EN 15316-4-3	Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 4-3: Heat generation systems, thermal solar systems
EN 15316-4-4	Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 4-4: Heat generation systems, building-integrated cogeneration systems
EN 15316-4-5	Heating systems and water based cooling systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 4-5: District heating and cooling
EN 15316-4-6	Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 4-6: Heat generation systems, photovoltaic systems
EN 15316-4-7	Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 4-7: Space heating generation systems, biomass combustion systems
EN 15243	Ventilation for buildings – Calculation of room temperatures and of load and energy for buildings with room conditioning systems
EN 15193	Energy performance of buildings - Energy requirements for lighting

Electrical energy (for lighting, ventilation, auxiliary) and thermal energy (for heating, cooling, humidification, dehumidification, domestic hot water) are considered separately inside the assessment boundaries. The interactions between the different energy services (such as heating, cooling, lighting) are taken into account by the calculation of heat gains and recoverable system losses which can have a positive or negative impact on the energy performance of the building. In the simplified approach the recovered system heat losses, obtained by multiplying the recoverable thermal system losses by a recovery factor, are directly subtracted from the loss of each technical building (sub-) system considered. The calculation procedure is the following:

1. do the sub-system calculations according to the relevant EPB standards and determine the recoverable system thermal losses;
2. calculate the recovered thermal system losses by multiplying the recoverable system thermal losses by a conventional recovery factor;
3. subtract the recovered thermal system losses:
    a. from the total thermal system losses if losses are recovered for the same building service;
    b. from building needs if losses are recovered for a different building service (e.g. domestic hot water losses recovered for heating).

The contribution of building automation and control (BAC) including technical building management (TBM) to the building energy performance is considered in the calculation procedure as the impact of all installed building automation and control functions (BAC functions) on the building energy performance. It deals with three characteristics: Control Accuracy, BAC Functions and BAC Strategies. The contribution of one such BAC function is taken into account by one of the following five approaches: time approach, set-point approach, direct approach, operating mode approach and correction coefficient approach.

As specified in prEN ISO/DIS 52000-1:2015, the Energy Performance (EP) is expressed as the building global primary energy demand divided by the conditioned area. The global primary energy refers to all the EPB energy services (heating, cooling, DHW, ventilation, lighting) and is calculated according to the Standard. EP can either include only non-renewable energy (EP_{nren}), or include both non-renewable energy and renewable energy (EP_{tot}):

$EP_{tot} = EP_{nren} + EP_{ren}$

The Renewable Energy Ratio (RER) is the ratio of the renewable primary energy to the total primary energy:

$RER = EP_{ren} / EP_{tot}$

The Energy Performance is fully described by a couple of indicators:

- EP_{tot} and EP_{nren} , or alternatively
- EP_{tot} and RER.

The renewable, the non-renewable and the total primary energy factors are defined at national level.

4. THE COMMON TOOL

According to the calculation procedure and the EU standards provided in Section 3, the tool developed by POLITO allows the assessment of the following data:

- the energy need for heating/cooling/DHW;
- for each energy carrier and/or source, the energy demand for heating/cooling/DHW/ventilation and lighting;
- for each service, the non-renewable/renewable/total primary energy;
- the Renewable Energy Ratio, RER.

The tool takes into account the Italian transposition of the EU standards. At national level the need for a coordinated national landmark has resulted in the development of the package of technical specifications UNI/TS 11300 that consists of four parts.

- UNI/TS 11300-1 defines the guidelines for the national implementation of the UNI EN ISO 13790:2008 by reference to the monthly quasi-steady method for the calculation of net energy requirements for heating and cooling;
- UNI/TS 11300-2 provides data and methods for the determination of the useful energy demand for domestic hot water, losses and electricity needs of heating systems and domestic hot water, the primary energy need for space heating and domestic hot water, the seasonal efficiency of the technical systems;
- UNI/TS 11300-3 is used to determine the air conditioning system efficiency and energy need in summer , as well as the primary energy need;
- UNI/TS 11300-4 calculates the primary energy need for space heating and domestic hot water in presence of renewable sources: thermal solar; biomass; air distribution sources, heat pumps for the portion considered renewable; PV system.

The Technical Report CTI 14 complements the technical specification UNI/TS 11300 with reference to buildings classification and provides details and calculation methods to determine the primary energy demand of buildings uniquely and reproducibly.

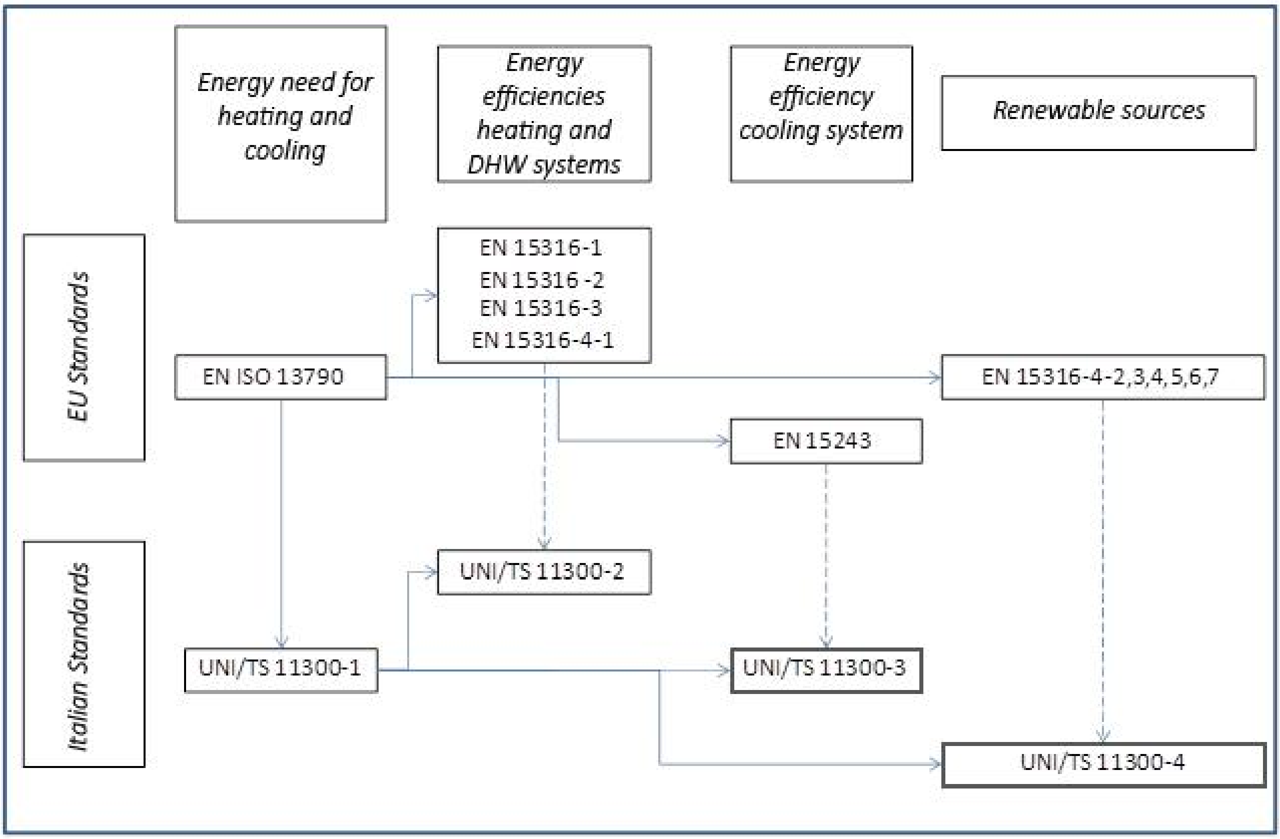

Figure 4.1. List of EU standards for the energy performance calculation assessment and the Italian transposition.

The tool's modeling assumptions and the referred default assumptions on the calculation of the parameters (if relevant) are summarized in the following tables.

Table 4.1. Space heating/cooling and (de)humidification.

ISSUE	MODELLING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Calculation method	Quasi-steady state method, based on average conditions over the month.	
	Dynamic effects are taken into account by means of suitable factors, such as: o utilization factor, for the effect of the mismatch between heat gain and heat transfer, depending on building thermal inertia (time constant) and on gain/loss ratio; o internal temperature adjustment for the effect of intermittent heating, depending on building thermal inertia (time constant), gain/loss ratio, type of intermittent heating (set-back, cut-off, reduced heating power), schedule of intermittent heating (temperature set point, time boost)	The internal heat capacity is defined through default values as a function of type of construction, according to national assumptions.
Zone/Room heat balance	Zoning: single zone. Rooms in thermal zone are not modelled	
	Uniformity of air temperature and of absolute humidity throughout the zone	
	Mixed (long-wave radiative and convective) heat transfer at each internal surface treated together, by means of a fixed surface heat transfer coefficient	
	Uniform spatial distribution of the radiative part of the heat flow due to internal sources	
	Time independent distribution of solar radiation on the internal surfaces of the room	
External surface heat transfer	Mixed (long-wave radiative and convective) heat transfer at each external surface treated together, by means of a fixed surface heat transfer coefficient	
	The effect of solar irradiation on opaque components is modelled through sol-air temperature	
Thermal transmission through the envelope	Constant thermal properties of materials (i.e. temperature independent and time independent)	
	One-dimensional heat conduction through each enclosure element and surfaces are considered isothermal	U-valued determined according to EN ISO 6946 and to EN ISO 10077
	Heat conduction through thermal bridges is modelled by an equivalent one-dimensional heat flow proportional to the length of building junctions or windows and door frames	Thermal bridges are evaluated through the linear thermal transmittance, according to EN ISO 14683
	Heat transfer to the ground is modelled by an equivalent one-dimensional heat flow according to calculation procedures given in EN ISO 13789	The opaque components heat transmission to the ground is calculated by means of transmission heat transfer coefficient according to EN ISO 13370

ISSUE	MODELLING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Solar gains through glazing components	Glazing solar behaviour is characterized through a Total Solar Energy Transmittance (TSET or g_{gl})	
	Corrections of the solar gains by means of reduction factors for taking into account the following aspects:	
	o non transparent area (frame factor);	
	o non normal incidence of solar radiation (exposition factor);	The exposition factor is determined according to national assumptions
	o permanent shading from other buildings, topography, overhangs, fins, etc. (shading factor);	Fixed obstruction shadings are considered by means of national default values according to latitude, month, component orientation and characteristic angle
	o external fixed and movable solar shadings	o Total Solar Energy Transmittance calculated according to EN 13363 o Movable solar shading are considered in use when the incident solar irradiation on the window is higher than 300 W/m^2 (according to EN ISO 13790)
Ventilation	For natural and mechanical ventilation, the supply air flow rate is fixed according to comfort and hygienic requirements, which depend on the building type and on the occupancy	The ventilation rate is set to a fixed value, according to the building use and is defined at national level
Occupancy and Internal gains	The actual duration of heating or cooling season can be either determined according to EN ISO 13790 , or defined according to legislative constraints	Heating/cooling seasons defined by law at national level
	Air temperature and relative humidity throughout the zone are scheduled	The temperature set-point for winter and summer are set to fixed national values, according to the building use Fixed relative humidity set-point of the zone
	Internal gains derive from lighting, equipment and people and are strongly dependent on the occupants' behaviour in terms of kind of activity Average values are considered Radiative and convective parts are considered together	The sensible internal heat gains (together convective and radiative) are set to a one fixed national values for lighting, occupants, internal equipment and appliances altogether, according to the building use
External conditions	Climatic data (external air temperature, intensity of the solar radiation on different orientation, sky and ground radiant temperatures)	The average climatic data of a location over the reference period (month) for a complete year are defined according to

ISSUE	MODELLING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
		national standards. When thermal solar and/or PV systems applied, the incident solar radiation for the referred tilt angle and exposure is also requested
	Temperature of adjacent zones	The opaque components heat transmission to adjacent unconditioned space and to adjacent conditioned space is calculated by means of transmission heat transfer coefficient according to EN ISO 13789

Table 4.2. Building technical systems using fossils.

ISSUE	MODELLING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
General	The technical systems for heating/cooling/DHW are divided into sub-systems: emission, control, distribution, storage (when feasible) and generation	
	The energy demand is calculated per energy carrier and per energy services. Primary energy weighting factors are then defined for each energy flow delivered or exported through the assessment boundary.	The conversion factors in primary energy (renewable, non-renewable) are defined at national level for each energy carrier
	Thermal losses, recoverable and recovered losses are determined for each sub-system	
	The thermal losses can be determined by means of the sub-systems energy efficiencies	Heating and cooling emission efficiency is a fixed value, according to the emitters technology used, the zone height and the annual mean heat load, and defined at national level
		DHW emission efficiency is a fixed value, defined at national level
		Heating and cooling control efficiency is a fixed value, according to the regulation and the emitters technology used, and defined at national level
		Heating and DHW distribution efficiency is a fixed value, according to the distribution technology used and the pipes

ISSUE	MODELLING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
		insulation, and defined at national level
		Heating and DHW generation efficiency is a fixed value, according to the generator technology used and installation, and defined at national level
DHW	The delivered energy for DHW assessment is based on volume required according to the zone use	Values at national level
	The DHW inlet temperature is determined according to the outdoor air temperature	The temperature of the inlet water is equal to the yearly average value of the monthly outdoor mean air temperature
Heat pumps	The monthly Energy Efficiency Ratio (EER) of the chiller is a function of the monthly average load factor and of the technology used	The EER at part load condition is determined according to EN 14825
	The auxiliary energy for each sub-system is duly considered	
	In case of heat pumps, the calculation period is divided in shorter periods (*bins*), that are determined according to the values of the outdoor air temperature (each bin corresponds to a temperature range of 1 K)	
	Air to water electrical heat pumps are considered as default heat pumps	The source temperature corresponds to the outside air temperature
		The (water) sink temperature is defined by standard values given at national level according to the final use (DHW or heating)
		The (air) sink temperature is the indoor air temperature
		Source and sink temperatures are considered fixed during the month
		The operation off-limit temperature is defined at $q_{W,off}$: 55 °C for DHW and at $q_{H,off}$: 20 °C for heating
		Heat pumps for heating and/or DHW are considered equipped with storage
	The heat pump auxiliary energy is considered within the COP	

ISSUE	MODELLING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Lighting	The lighting system calculation procedure implements the EN 15193 standard; the LENI indicator is determined	The lighting power density is requested as a function of the building main use for each thermal zone; the daylight dependent artificial lighting control factor and the lighting control factor are also specified as input data

Table 4.3. Building technical systems using renewables.

ISSUE	MODELLING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Solar collectors	The thermal energy produced by solar collectors is considered as a reduction of the energy demand for the heating/DHW generation sub-system	
	The thermal solar system calculation procedure implements the EN 15316-4-3 standard; the F-Chart method is applied	Default values are specified at national level
	The thermal energy produced by solar collectors is calculated according to a-dimensional factors and depends on the system technology characteristics	The solar collector energy efficiency is a fixed value, according to the technology used and defined at national level
PV panels	The PV system calculation procedure follows EN 15316-4-6	Default values are specified at national level
	The thermal energy produced by the PV system, the auxiliary energy consumption and the generation losses are not recovered	
	The electrical energy produced by PV panel is considered as a reduction of the electrical energy demand; the balance is within the month; the exported electrical energy is not considered	

5. COUNTRY ASSUMPTIONS

Section 5 reports on the discrepancies and on the national assumptions that differ from the Italian approach, as defined in Section 4.

5.1 BULGARIA

The Bulgarian legislative framework in the field of energy efficiency of buildings is established by the Energy Efficiency Act (updated in 2008, 2013, 2015) and the ordinances on:

- Building energy performance,
- Building auditing and energy certification,
- Designing of HVAC systems,
- Heat retention in buildings,
- Registering of building auditors,
- Inspection of boilers and AC

This complex defines the whole process of identification of building's energy performance.

The methodology for calculation of the annual energy consumption of buildings is based on the monthly energy balance method described in BDS EN ISO 13790 and the corresponding standards.

A national calculation tool EAB 1.0 for building energy modelling and simulation has been developed and it is used by all authorized energy auditors in the country.

Table 5.1. BG: Space heating/cooling and (de)humidification.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Calculation method	Dynamic effects are taken into account by means of suitable factors, such as: o utilization factor, for the effect of the mismatch between heat gain and heat transfer, depending on building thermal inertia (time constant) and on gain/loss ratio; o internal temperature adjustment for the effect of intermittent heating, depending on building thermal inertia (time constant), gain/loss ratio, type of intermittent heating (set-back, cut-off, reduced heating power), schedule of intermittent heating (temperature set point, time boost)	As described in EN ISO 13790, the method is based on monthly energy balance and involves utilisation factor. According to the Bulgarian national method we use two categories of room temperature - during the occupation period: design temperature and during non-occupation period: decreased temperature
External surface heat transfer	Mixed (long-wave radiative and convective) heat transfer at each external surface treated together, by means of a fixed surface heat transfer coefficient	NO. The convective heat transfer and the long-wave radiation are calculated separately
	The effect of solar irradiation on opaque components is modelled through sol-air temperature	NO - the heat flow due to the solar irradiation is modelled by the absorption coefficient and the emissivity coefficient of the external surfaces
Solar gains through glazing components	Corrections of the solar gains by means of reduction factors for taking into account the following aspects:	
	o non transparent area (frame factor);	
	o non normal incidence of solar radiation (exposition factor);	The exposition factor is determined according to national assumptions

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
	o permanent shading from other buildings, topography, overhangs, fins, etc. (shading factor);	Fixed obstruction shadings are considered by means of national default values according to latitude, month, component orientation and characteristic angle
	o external fixed and movable solar shadings	Movable solar shading are not modelled dynamically
Occupancy and Internal gains	Internal gains derive from lighting, equipment and people and are strongly dependent on the occupants' behaviour in terms of kind of activity Average values are not considered	For each building the gains are calculated as simultaneous power multiplied by the operation period
External conditions	Climatic data (external air temperature, intensity of the solar radiation on different orientation, sky and ground radiant temperatures)	There is national climatic database for 9 climatic zones containing monthly average temperatures, solar irradiation as well as hourly data for an average day of the month.

Table 5.2. BG: Building technical systems using fossils.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
General	The thermal losses can be determined by means of the sub-systems energy efficiencies	Heating and DHW distribution efficiency is a fixed value, according to the distribution technology used and the pipes insulation, and determined for each building as a result of the energy audit
Heat pumps	In case of heat pumps, the calculation period is divided in shorter periods (*bins*), that are determined according to the values of the outdoor air temperature (each bin corresponds to a temperature range of 1 K)	NO
	Air to water electrical heat pumps are considered as default heat pumps	The source temperature corresponds to the outside air temperature The (water) sink temperature is defined by standard values given at national level according to the final use (DHW or heating) Source and sink temperatures are not calculated

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
		The operation off-limit temperature is defined at $q_{W,off}$: 55 °C for DHW and at $q_{H,off}$: 20 °C for heating
		Heat pumps for DHW are considered equipped with storage
Lighting	The lighting system calculation procedure implements the EN 15193 standard; the LENI indicator is determined	Control factors are not determined as input data

Table 5.3. BG: Building technical systems using renewables.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Solar collectors	The thermal energy produced by solar collectors is considered as a reduction of the energy demand for the heating/DHW generation sub-system	
	The thermal solar system calculation procedure implements the EN 15316-4-3 standard; the F-Chart method is applied	F-Chart method is applied
	The thermal energy produced by solar collectors is calculated according to a-dimensional factors and depends on the system technology characteristics	The solar collector energy efficiency is a fixed value, according to the technology used and defined at national level
PV panels	The PV system calculation procedure follows EN 15316-4-6	PV system is not envisaged in the EC packages

5.2 CROATIA

National calculation algorithm implements holistic calculation of building energy balance, with monthly calculation of heating energy need, and hourly calculation of cooling energy need, followed by monthly calculation of final energy balance. This hybrid method gives reasonable precision of heating and cooling energy calculation, and inclusion of recovered auxiliary energy in building energy balance. Subsystems efficiency are given as a result of converging holistic calculation as well as interaction of heating, cooling, ventilation and DHW systems within building. Building zoning is based on internal design temperature, building use, and technical system used.

EPBD supporting standards are strictly followed in national calculation algorithm, amended by some lacking information derived from DIN-V 18599.

Table 5.4. HR: Space heating/cooling and (de)humidification.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Calculation method	Quasi-steady state method, based on average conditions over the month.	Heating - quasy steady state method. Cooling - hybrid simple hourly calculation method and quasi-steady state for systems
External surface heat transfer	The effect of solar irradiation on opaque components is modelled through sol-air temperature	Effect of solar radiation on opaque surfaces is not included in calculation due to small effect on insulated surfaces, radiation losses from opaque surfaces are not accounted for to compensate for former
Solar gains through glazing components	Corrections of the solar gains by means of reduction factors for taking into account the following aspects:	
	o non transparent area (frame factor);	None – calculated accordingly to building geometry
	o non normal incidence of solar radiation (exposition factor);	national regulation
	o permanent shading from other buildings, topography, overhangs, fins, etc. (shading factor);	national regulation
	o external fixed and movable solar shadings	irradiation >300 W/m²
Occupancy and Internal gains	Internal gains derive from lighting, equipment and people and are strongly dependent on the occupants' behaviour in terms of kind of activity	5W/m² for residential 6 W/m² for non-residential buildings
	Average values are not considered	
External conditions	Climatic data (external air temperature, intensity of the solar radiation on different orientation, sky and ground radiant temperatures)	National climatic database for 2 climatic zones containing hourly temperatures, solar irradiation wind speed, humidity, 30 monthly sets of data for monthly calculation

Table 5.5. HR: Building technical systems using fossils.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
General	Thermal losses are determined by holistic system calculation	Emission, and regulation system efficiencies are depending on system characteristic; distribution system efficiency is calculated after building energy balance calculation

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Heat pumps	In case of heat pumps, the calculation period is divided in shorter periods (*bins*), that are determined according to the values of the outdoor air temperature (each bin corresponds to a temperature range of 1 K)	Bin method is implemented for heat pumps, hourly data for two climatic zones is used
	Air to water electrical heat pumps are considered as default heat pumps	Storage tanks are calculated as separate subsystem, with losses affecting total heating, cooling or DHW system efficiency accordingly.

5.3 FORMER YUGOSLAV REPUBLIC OF MACEDONIA

The national methodology for the energy performance of buildings assessment is based on the Energy Law and its secondary legislation: Rulebook for Energy Audits and Rulebook for Energy Performance of Buildings. The Rulebook for Energy Audits additionally defines the Top-Down and Bottom-Up Methodologies.

In the Rulebook for Energy Audits there is a developed and adopted bottom-up methodology. It consist of 20 different methods that can be used in order to assess the effects of implementing the EEMs in different sectors of the final energy consumption. These methods are the following:

1) New residential buildings,
2) Improvement of the envelope of the residential buildings,
3) Boilers on biomass
4) Installation of condensing boilers for water heating in closed system in residential buildings,
5) Energy efficient cooling machines and washing machines,
6) Sanitary hot water in households - Solar water heaters,
7) Sanitary hot water in households - Heat pumps,
8) Improvement of the heating system in water cycle in non-residential buildings (tertiary sector),
9) Improvement of lighting systems (in tertiary sector),
10) Improvement of central acclimatization (in tertiary sector),
11) Office equipment,
12) Energy efficient motors,
13) Variable speed drives,
14) Energy efficient vehicles,
15) Changing the transport mode of passengers,
16) Eco-driving,
17) Intelligent meters in households,
18) Energy audits,
19) Replacement and installation of new lamps in residential buildings,
20) Replacement and installation of new systems for public lighting.

As regards the EP assessment for RePublic_ZEB proposals, the Former Yugoslav Republic of Macedonia adopts the same assumptions as in the reference tool provided by POLITO.

5.4 GREECE

The energy performance calculation procedure is based on the monthly methodology of EN ISO 13790 and a set of national parameters defined where necessary. The assumptions and basic parameter calculations are described in a number of Technical Guides (TOTEE 20701-(1-4)/2010), published by the Technical Chamber of Greece (TEE) in July 2010. These Guides also include the climate files to be used in the calculation, as well as the thermal properties of building materials.

The energy performance assessment takes into account the following aspects, covering the most common uses in a building:

- Space heating
- Space cooling
- Ventilation (only for the tertiary sector)
- Domestic hot water (for specific building categories)
- Electricity for lighting (only for the tertiary sector)

A software tool (TEE-KENAK) for the calculation of the energy performance was developed by TEE. It provides results on the energy demand, energy consumption per end use, primary energy consumption and CO_2 emissions for the building, but also for energy saving measures/scenarios that may be proposed for the building envelope and/or the electromechanical installations. In the case of retrofit interventions, the investment cost is also calculated along with the resulting simple payback period and the annual energy savings, the CO_2 emissions and the operating cost.

Table 5.6. GR: Space heating/cooling and (de)humidification.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Occupancy and Internal gains	Internal gains derive from lighting, equipment and people and are strongly dependent on the occupants' behaviour in terms of kind of activity	The sensible internal heat gains (together convective and radiative) are defined separately, as follows: a) lighting, b) occupants, and c) internal equipment and appliances
	Average values are considered	
	Radiative and convective parts are considered together	
Thermal transmission through the envelope	Heat conduction through thermal bridges is modelled by an equivalent one-dimensional heat flow proportional to the length of building junctions or windows and door frames	Thermal bridges are evaluated through the linear thermal transmittance, according to EN ISO 14683 and EN ISO 10211
Solar gains through glazing components	External fixed and movable solar shadings are taken into account for the correction of the solar gains by means of reduction factors.	Movable shadings are not considered
External conditions	Climatic data (external air temperature, intensity of the solar radiation on different orientation, sky and ground radiant temperatures)	The average climatic data of a location over the reference period (month) for a complete year are defined according to national standards. When thermal solar and/or PV systems applied, the exploitation factor for the referred tilt angle is requested

Table 5.7. GR: Building technical systems using fossils.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
General	The thermal losses can be determined by means of the sub-systems energy efficiencies	Heating and cooling emission efficiency is a fixed value, according to the emitters technology used, their position
		Heating and cooling emission efficiency is a fixed value, according to the pipe length and diameter, the fluid temperature, the type of zone transit (unheated, external air, etc) and the age of the pipeline network
		Heating and DHW generation efficiency is a fixed value, according to the generator technology used, the fuel used, and defined at national level
DHW	The DHW inlet temperature is determined according to the outdoor air temperature	The temperature of the inlet water is equal to the yearly average value of the monthly mean water supply temperature
Heat pumps	The monthly Energy Efficient Ratio (EER) of the chiller is a function of the monthly average load factor and of the technology used	The SEER is determined according to EN 15243
	In case of heat pumps, the calculation period is divided in shorter periods (*bins*), that are determined according to the values of the outdoor air temperature (each bin corresponds to a temperature range of 1 K)	N.A.
	Air to water electrical heat pumps are considered as default heat pumps	No operation off-limit temperature is defined
		Heat pumps for DHW are considered equipped with storage

5.5 HUNGARY

The national legislation (7/2006 (V.24.) TNM statue) describes the whole calculation method which should be used for the calculation of the energy consumptions of the buildings in Hungary. The statue defines four types of buildings:

- Residential;
- School;
- Office;
- Other.

The first three types have exact requirements which have to be fulfilled, meanwhile the type “other” has a methodology, with which the requirements can be calculated.

The calculation method contains several simplifications, where pre-calculated values can be chosen from the tables, provided in the statue. With this method you can calculate the heat transmission factors of the different structures, the heat losses and the primary energy consumptions.

Table 5.8. HU: Space heating/cooling and (de)humidification.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Calculation method	Dynamic effects are taken into account by means of suitable factors, such as: o utilization factor, for the effect of the mismatch between heat gain and heat transfer, depending on building thermal inertia (time constant) and on gain/loss ratio; o internal temperature adjustment for the effect of intermittent heating, depending on building thermal inertia (time constant), gain/loss ratio, type of intermittent heating (set-back, cut-off, reduced heating power), schedule of intermittent heating (temperature set point, time boost)	The internal heat capacity is defined in two levels
Occupancy and Internal gains	The actual duration of heating or cooling season can be either determined according to EN ISO 13790 , or defined according to legislative constraints	Calculation is based on the heating degree day

Table 5.9. HU: Building technical systems using fossils.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
General	The technical systems for heating/cooling/DHW are divided into sub-systems: emission, control, distribution, storage (when feasible) and generation	National low defines only generation, distribution, storage and control
	The thermal losses can be determined by means of the sub-systems energy efficiencies	No emission system defined separately, both for heating and DHW

Table 5.10. HU: Building technical systems using renewables.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
PV panels	The electrical energy produced by PV panel is considered as a reduction of the electrical energy demand; the balance is within the month; the exported electrical energy is not considered	Balance within the year

5.6 PORTUGAL

With the publication of the Directive nº 2010/31/EU by the European Parliament and Council, on May 19th of 2010 on the energy performance of buildings, Portugal used the opportunity to improve the national legislation and transpose to the national law the new requirements established.

The Portuguese Decree-Law 118/2013 of August 20th of 2013 represents the transposition of the directive requirements but also a revision of the national legislation concerning to building energy performance.

Table 5.11. PT: EU Directive 2010/31 transposition in Portugal.

Decree-Law 118/2013	**SCE**	Law 58/2013
		Administrative rule 349-A/2013 – SCE management
		Administrative rule 349-C/2013 – Licensing
		Dispatch 15793-C/2013 – Energetic certificate
		Dispatch 15793-J/2013 – Energetic Class
	REH	Administrative rule 349-B/2013 – Requirements
		Dispatch 15973-I/2013 – Energy Needs
		Dispatch 15973-K/2013 – Thermal parameters
	RECS	Administrative rule 349-D/2013 – Requirements
		Administrative rule 353-A/2013 – Indoor air quality requirements
		Dispatch 15973-G/2013 – Equipment
		Dispatch 15973-L/2013 – Economic Viability
	Dispatch 15793-H/2013 Contribution of renewable energy Dispatch 15793-F/2013 Climatic zoning Dispatch 15793-D/2013 Conversion factors Dispatch 15793-E/2013 Existing Simplifications	

Table 5.12. PT: Space heating/cooling and (de)humidification.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Calculation method	Quasi-steady state method, based on average conditions over the month.	Residential buildings based on quasi-steady state seasonal method with hourly base (describe in Portuguese legislation 118/2013) Office buildings through the use of EnergyPlus (dynamic tool)
Solar gains through glazing components	Corrections of the solar gains by means of reduction factors for taking into account the following aspects:	
	o non transparent area (frame factor);	The frame is considered by means of the solar factor g_{Tvc}
	o non normal incidence of solar radiation (exposition factor);	The exposition factor is determined according to national assumptions

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
	o permanent shading from other buildings, topography, overhangs, fins, etc. (shading factor);	Fixed obstruction shadings are considered by means of national default values according to latitude, month, component orientation and characteristic angle
	o external fixed and movable solar shadings	o Total Solar Energy Transmittance calculated according to EN 13363 o Movable solar shading are considered in use when the incident solar irradiation on the window is higher than 300 W/m^2 (according to EN ISO 13790)
Ventilation	For natural and mechanical ventilation, the supply air flow rate is fixed according to comfort and hygienic requirements, which depend on the building type and on the occupancy	yes (Administrative rule n.º 349-B/2013, Administrative rule n.º 349-D/2013 and Administrative rule 353-A/2013)

Table 5.13. Building technical systems using fossils.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
General	The technical systems for heating/cooling/DHW are divided into sub-systems: emission, control, distribution, storage (when feasible) and generation	The systems are calculated separately and introduced as a whole in the calculation by means of global efficiency for both the models

Table 5.14. PT: Building technical systems using renewables.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Solar collectors	The thermal energy produced by solar collectors is considered as a reduction of the energy demand for the heating/DHW generation sub-system	Not considered
	The thermal solar system calculation procedure implements the EN 15316-4-3 standard; the F-Chart method is applied	Not considered
	The thermal energy produced by solar collectors is calculated according to a-dimensional factors and depends on the system technology characteristics	Not considered
PV panels	The PV system calculation procedure follows EN 15316-4-6	PV system calculated for Office Buildings with SolTerm 6.0.0 - The SolTerm is a

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
		performance analysis program of solar systems through numerical simulation of energy balances over a reference year, specially designed to climatic and technical conditions for Portugal

5.7 ROMANIA

The building energy performance is computed and displayed (in the energy performance certificate – EPC) based on the calculation methodology (Ministry Order 1057/2007) for the energy performance of buildings (Mc 001/1, 2, 3 - 2006), taking into account the EPBD standards, especially the EN ISO 13790 for heating and cooling, which was available in draft when the methodology was issued. The methodology includes also alternative calculation methods for heating and hot water consumption, based on previous Romanian research activity. The methodology was amended and supplemented with a calculation summary of the energy performance of buildings and EPC template for apartments (2009), by publishing climatic data for EPB calculation methodology application (2012, revised monthly data for 40 cities and reference year for 9 cities), approving procedure for EPC control (2013, State Inspectorate in Constructions), and providing guidelines for inspection of HVAC and heating systems (2013). The methodology is available both for new and existing buildings, as well as for residential and non-residential buildings. Software tools, created according to the Mc 001-2006, are available on the market (only software for EPC issued for apartments in collective buildings are subject of compliance verification).

The energy performance assessment takes into account the following aspects, covering the most common uses in a building:

- Space heating,
- Space cooling (only for buildings equipped with relevant systems),
- Mechanical ventilation (only for buildings equipped with relevant systems)
- Domestic hot water,
- Electricity for lighting.

Table 5.15. RO: Space heating/cooling and (de)humidification.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Calculation method	Dynamic effects are taken into account by means of suitable factors, such as: o utilization factor, for the effect of the mismatch between heat gain and heat transfer, depending on building thermal inertia (time constant) and on gain/loss ratio; o internal temperature adjustment for the effect of intermittent heating, depending on building thermal inertia (time constant), gain/loss ratio, type of intermittent heating (set-back, cut-off, reduced heating power), schedule of intermittent heating (temperature set point, time boost)	Yes. Utilisation factors according to EN13790 are not fully suitable for Romanian climatic conditions (in particular for summer/cooling), but no specific values have been defined yet at national level
External surface heat transfer	The effect of solar irradiation on opaque components is modelled through sol-air temperature	Yes, for each surface (depending on orientation, inclination and radiation properties). Equivalent temperatures are calculated, similar to sol-air temperatures
Thermal transmission through the envelope	Heat conduction through thermal bridges is modelled by an equivalent one-dimensional heat flow proportional to the length of building junctions or windows and door frames	Yes. Linear transmittances of thermal bridges are calculated with heat transfer areas based on total internal dimensions (convention)
	Heat transfer to the ground is modelled by an equivalent one-dimensional heat flow according to calculation procedures given in EN ISO 13789	Yes. An alternative calculation method is provided at national level
Solar gains through glazing components	Corrections of the solar gains by means of reduction factors for taking into account the following aspects:	
	o non transparent area (frame factor);	
	o non normal incidence of solar radiation (exposition factor);	The exposition factor is determined according to national assumptions
	o permanent shading from other buildings, topography, overhangs, fins, etc. (shading factor);	Yes, but no national default values are defined so far. Calculated values for latitudes different than those in Italian example are needed (or calculation procedure)
Ventilation	For natural and mechanical ventilation, the supply air flow rate is fixed according to comfort and hygienic requirements, which depend on the building type and on the occupancy	Yes. Flow rates are set for different building uses, but the ventilation rate must be calculated for the whole building (based on room/zones values). Usually these are time-dependent (operation schedule)
Occupancy and Internal gains	The actual duration of heating or cooling season can be either determined according to EN ISO 13790 , or defined according to legislative constraints	The duration of H/C season is not fixed, but results based on building characteristics and climatic data (monthly

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
		calculation). Model calculation is needed in the simulation tool
	Internal gains derive from lighting, equipment and people and are strongly dependent on the occupants' behaviour in terms of kind of activity	Yes, but distinction should be made for different occupation/use schedules
	Average values are considered	Yes, but no global/average default values are defined
	Radiative and convective parts are considered together	Yes
External conditions	Climatic data (external air temperature, intensity of the solar radiation on different orientation, sky and ground radiant temperatures)	Yes. A set of representative cities can be defined (for all 5 climatic zones - winter)
	Temperature of adjacent zones	Yes. However, calculation of temperatures of adjacent rooms with heat gains from pipes/equipment and with ground boundaries should be included in the model

Table 5.16. RO: Building technical systems using fossils.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
General	The thermal losses can be determined by means of the sub-systems energy efficiencies	Heating and cooling emission efficiency is a fixed value, according to the emitters technology used, the zone height and the annual mean heat load, and defined at national level
		DHW emission efficiency is a fixed value, defined at national level. Different methods are provided as alternative (based on data availability)
		Heating and cooling control efficiency is a fixed value, according to the regulation and the emitters technology used, and defined at national level
		Heating and DHW distribution efficiency is a fixed value, according to the distribution technology used and the pipes insulation, and defined at

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
		national level
		Heating and DHW generation efficiency is a fixed value, according to the generator technology used and installation, and defined at national level

Table 5.17. RO: Building technical systems using renewables.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Solar collectors	The thermal solar system calculation procedure implements the EN 15316-4-3 standard; the F-Chart method is applied	Yes, but no default values are set at national level
	The thermal energy produced by solar collectors is calculated according to a-dimensional factors and depends on the system technology characteristics	Yes, the collector's efficiency curve if data is available (e.g. Solar Keymark)
PV panels	The PV system calculation procedure follows EN 15316-4-6	Yes, but no default values are set at national level

5.8 SLOVENIA

The Slovenian Regulation specifies requirements on national calculation approach through Rules on efficient use of energy in buildings with a technical guideline (Technical Guideline TSG-1-004:2010 - Efficient energy use), where it follows all EPBD requirements. The later defines monthly method for calculations of energy performance of residential and non-residential buildings. The calculation refers to all main EN standards:

- SIST EN ISO 13790 – Energy need for heating and cooling;
- SIST EN ISO 15316 and SIST EN ISO 15234 – Heating and cooling systems;
- SIST EN ISO 15603 – Energy performance of buildings;

Table 5.18. SI: Space heating/cooling and (de)humidification.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Calculation method	Quasi-steady state method, based on average conditions over the month.	Monthly method will be used with DEMO tool and additional Slovenian commercial tool

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
	Dynamic effects are taken into account by means of suitable factors, such as: o utilization factor, for the effect of the mismatch between heat gain and heat transfer, depending on building thermal inertia (time constant) and on gain/loss ratio; o internal temperature adjustment for the effect of intermittent heating, depending on building thermal inertia (time constant), gain/loss ratio, type of intermittent heating (set-back, cut-off, reduced heating power), schedule of intermittent heating (temperature set point, time boost)	IDA ICE is going to be used for dynamic simulations
Zone/Room heat balance	Zoning: single zone. Rooms in thermal zone are not modelled	Yes for tools using monthly method. For dynamic simulations - several thermal zones are going to be used.
	Uniformity of air temperature and of absolute humidity throughout the zone	Yes for tools using monthly method. For dynamic simulations - Time-dependent air temperature and absolute humidity of each zone
	Mixed (long-wave radiative and convective) heat transfer at each internal surface treated together, by means of a fixed surface heat transfer coefficient	Yes for tools using monthly method. For dynamic simulations - Long-wave radiative and convective heat transfer at each internal surface treated separately
	Uniform spatial distribution of the radiative part of the heat flow due to internal sources	yes
	Time independent distribution of solar radiation on the internal surfaces of the room	Yes for tools using monthly method. For dynamic simulations - Time dependent distribution of solar radiation on the internal surfaces of the room
External surface heat transfer	Mixed (long-wave radiative and convective) heat transfer at each external surface treated together, by means of a fixed surface heat transfer coefficient	Yes for tools using monthly method. For dynamic simulations - Long-wave radiative and convective heat transfer at each external surface treated separately
	The effect of solar irradiation on opaque components is modelled through sol-air temperature	The effect of solar irradiation on opaque components is modelled through sol-air temperature
Thermal transmission through the envelope	Heat conduction through thermal bridges is modelled by an equivalent one-dimensional heat flow proportional to the length of building junctions or windows and door frames	Heat conduction through thermal bridges is modelled by an equivalent three-dimensional heat flow with SOLIDO software

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Ventilation	For natural and mechanical ventilation, the supply air flow rate is fixed according to comfort and hygienic requirements, which depend on the building type and on the occupancy	The ventilation rate is set to a fixed value, according to the building use and is defined at national level
External conditions	Climatic data (external air temperature, intensity of the solar radiation on different orientation, sky and ground radiant temperatures)	The average climatic data of a location over the reference period (month) for a complete year are defined according to national standards. The hourly climatic data of a location over the reference period (hour) for a complete year are defined according to national standards and reference test year. When thermal solar and/or PV systems applied, the incident solar radiation for the referred tilt angle and exposure is also requested

5.9 SPAIN (Catalonia Region)

The Spanish Legislation has included the EPBD requirements through the update of the Technical Building Code (CTE, 13th March 2014) and the Regulation on Building Heating Installations (RITE, 5th April 2013). Both regulations define the methods and hypothesis to calculate the energy performance of the buildings and achieve the EPBD requirements. The technical specifications of the regulations are described following:

- DA-DB-HE-1 (CTE) provides data and methods to calculate the heating and cooling demand of the building.
- DA-DB-HE-3 (CTE) defines the methodology to define the energy efficiency of lighting systems in tertiary buildings.
- DA-DB-HE-4 (CTE) establishes the methodology to calculate the domestic hot water demand and the minimum solar thermal contribution.
- DA-DB-HE-5 (CTE) defines the minimum requirement of solar photovoltaic contribution.
- IT 1 (RITE) defines the method to design and size the energy systems: heating, cooling, domestic hot water, ventilation and renewable systems.

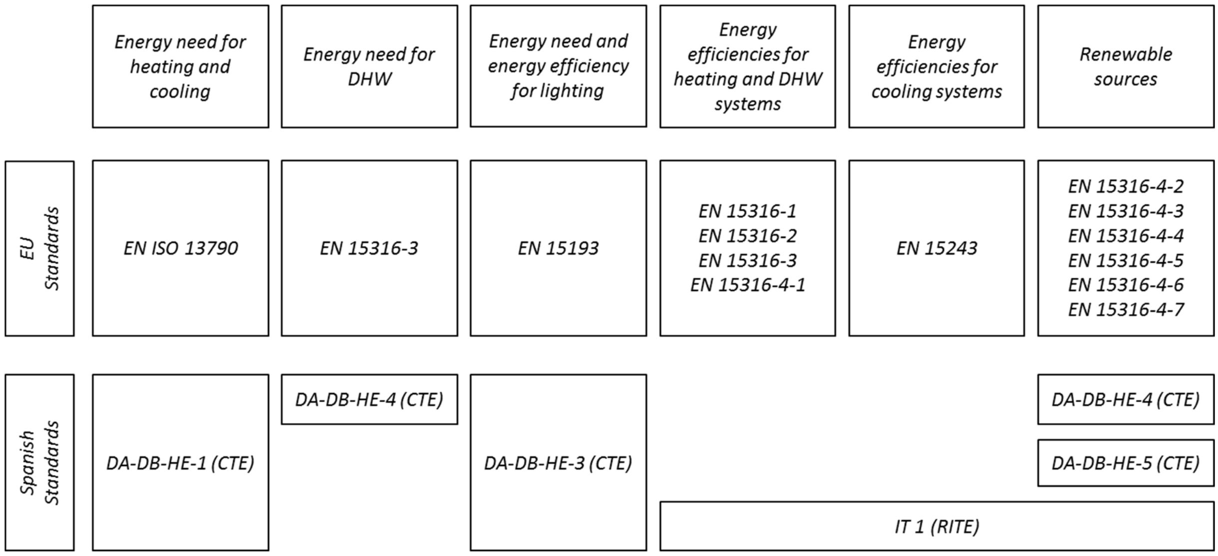

Figure 5.1. List of EU standards for the energy performance calculation assessment.

Table 5.19. ES: Space heating/cooling and (de)humidification.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Thermal transmission through the envelope	One-dimensional heat conduction through each enclosure element and surfaces are considered isothermal	The U-value calculation by steady state method using TRNbuild (it works with TRNSYS and develops dynamic simulation)
	Heat conduction through thermal bridges is modelled by an equivalent one-dimensional heat flow proportional to the length of building junctions or windows and door frames	National values
Occupancy and Internal gains	The actual duration of heating or cooling season can be either determined according to EN ISO 13790 , or defined according to legislative constraints	Heating/cooling seasons defined by law at national level. For tertiary building there are not defined heating and cooling periods
External conditions	Climatic data (external air temperature, intensity of the solar radiation on different orientation, sky and ground radiant temperatures)	METEONORM database

Table 5.20. ES: Building technical systems using fossils.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
DHW	The delivered energy for DHW assessment is based on volume required according to the zone use	According to EN 94002:2005
	The DHW inlet temperature is determined according	According to EN 94002:2005

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
	to the outdoor air temperature	

Table 5.21. ES: Building technical systems using fossils.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
DHW	The delivered energy for DHW assessment is based on volume required according to the zone use	According to EN 94002:2005
	The DHW inlet temperature is determined according to the outdoor air temperature	According to EN 94002:2005

5.10 United Kingdom

The UK's National Calculation Method (NCM) for EP assessment to meet the requirements of the EPBD is defined by the Department for Communities and Local Government (DCLG). The procedure to demonstrate compliance with the Building Regulations for buildings other than dwellings is by calculating the annual energy use for a proposed building and comparing it with the energy use of a comparable 'notional' building. Both calculations make use of standard sets of data for different activity areas and call on common databases of construction and service elements. A similar process is used to produce an 'asset rating' in accordance with the EPBD. The NCM therefore comprises the underlying method plus the standard data sets.

The NCM allows the actual calculation to be carried out either by an approved simulation software or by a new simplified tool based on a set of CEN standards. That tool is called SBEM - Simplified Building Energy Model – and is accompanied by a basic user interface - iSBEM.

SBEM provides an analysis of a building's energy consumption. It calculates monthly energy use and carbon dioxide emissions of a building given a description of the building geometry, construction, use and HVAC and lighting equipment. It was originally based on the Dutch methodology NEN 2916:1998 (Energy Performance of Non-Residential Buildings) and has since been modified to comply with the recent CEN Standards. Details of the calculation method, the algorithms used and the assumptions made are provided in the SBEM Technical Manual.

The CEN Standards used by SBEM are:

- PG-N37 Standards supporting the Energy Performance of Buildings Directive
- EN 15193-1 Energy requirements for lighting – Part 1: Lighting energy estimation
- EN 15217 Methods of expressing energy performance and for energy certification of buildings
- EN 15243 Ventilation for buildings – Calculation of room temperatures and of load and energy for buildings with room conditioning systems
- EN ISO 13786:2005 Review of standards dealing with calculation of heat transmission in buildings – Thermal performance of building components – Dynamic thermal characteristics – Calculation methods

- EN ISO 13789 Review of standards dealing with calculation of heat transmission in buildings – Thermal performance of buildings –Transmission and ventilation heat transfer coefficients – Calculation methods
- EN ISO 13790 Energy performance of buildings – Calculation of energy use for space heating and cooling
- EN 15316-3 Heating systems in buildings – Method for calculation of system energy requirements and system efficiencies – Part 3: Domestic hot water systems.

Table 5.22. UK: Space heating/cooling and (de)humidification.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Calculation method	Dynamic effects are taken into account by means of suitable factors, such as: o utilization factor, for the effect of the mismatch between heat gain and heat transfer, depending on building thermal inertia (time constant) and on gain/loss ratio; o internal temperature adjustment for the effect of intermittent heating, depending on building thermal inertia (time constant), gain/loss ratio, type of intermittent heating (set-back, cut-off, reduced heating power), schedule of intermittent heating (temperature set point, time boost)	"Determine utilisation factors for internal and solar heat sources using equations 31&32 (EN ISO 13790), to allow non-utilised heat which leads to an undesired increase in temperature above set-points to be ignored. This depends on the thermal capacity of the structure. Adjust set-point temperature as described in EN ISO 13790 (i.e., thermal capacity-dependent) using information in databases"
Zone/Room heat balance	Zoning: single zone. Rooms in thermal zone are not modelled	Building is partitioned into several zones, taking no account of thermal coupling between zones. Calculation procedure for multi-zone: Regard as a series of single zone calculations, but with boundary conditions and input data coupled when zones share same heat/cooling system. Zones are aggregated when served by the same heating/cooling system.
External surface heat transfer	The effect of solar irradiation on opaque components is modelled through sol-air temperature	NO - modelled through the radiation weather data and component properties
Thermal transmission through the envelope	Heat conduction through thermal bridges is modelled by an equivalent one-dimensional heat flow proportional to the length of building junctions or windows and door frames	Calculate transmission heat loss according to EN ISO 13789:2005
Solar gains through glazing components	Corrections of the solar gains by means of reduction factors for taking into account the following aspects:	
	o non transparent area (frame factor);	
	o non normal incidence of solar radiation	Solar radiation used is for the

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
	(exposition factor);	specific location, orientation and pitch of the glazing element
	o permanent shading from other buildings, topography, overhangs, fins, etc. (shading factor);	Fixed obstruction shadings are considered by means of national default values according to latitude, month, component orientation and characteristic angle
	o external fixed and movable solar shadings	o Total Solar Energy Transmittance calculated according to EN 13363 o Movable solar shading are considered in use when the incident solar irradiation on the window is higher than 300 W/m^2 (according to EN ISO 13790)
Ventilation	For natural and mechanical ventilation, the supply air flow rate is fixed according to comfort and hygienic requirements, which depend on the building type and on the occupancy	Natural ventilation is determined according to the activity in the zone. Mechanical ventilation allows user input of SFP and exhaust air flow rate
Occupancy and Internal gains	The actual duration of heating or cooling season can be either determined according to EN ISO 13790 , or defined according to legislative constraints	Not calculated in SBEM – heat/cooling is available whenever monthly calculation demands it
	Air temperature and relative humidity throughout the zone are scheduled	The heating and cooling set-points define the conditions which the selected HVAC system will be assumed to maintain for the period defined by the heating and cooling schedules. For the unoccupied period, the system will be assumed to maintain the space at the setback temperature defined in the database
		Fixed relative humidity set-point of the zone. Max and min for each zone determined by activity database
	Internal gains derive from lighting, equipment and people and are strongly dependent on the occupants' behaviour in terms of kind of activity	The sensible internal heat gains (together convective and radiative) are set to a one fixed national values for lighting, occupants, internal equipment and appliances altogether, according to the
	Average values are considered	
	Radiative and convective parts are considered together	

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
		building use. Hourly schedules
External conditions	Climatic data (external air temperature, intensity of the solar radiation on different orientation, sky and ground radiant temperatures)	The average climatic data of a location over the reference period (month) for a complete year are defined according to national standards. When thermal solar and/or PV systems applied, the incident solar radiation for the referred tilt angle and exposure is also requested. 14 climate regions in the UK
	Temperature of adjacent zones	The boundary of the building is the elements between the conditioned and unconditioned spaces, including exterior. Heat transfer between conditioned spaces is ignored

Table 5.23. UK: Building technical systems using fossils.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
General	Thermal losses, recoverable and recovered losses are determined for each sub-system	Accounted for through System Seasonal Efficiencies but not separately reported
DHW	The delivered energy for DHW assessment is based on volume required according to the zone use	YES - activity database
	The DHW inlet temperature is determined according to the outdoor air temperature	The temperature of the inlet water is fixed at 10 °C
Heat pumps	The monthly Energy Efficiency Ratio (EER) of the chiller is a function of the monthly average load factor and of the technology used	User input or default determined by inclusion on Energy technology list of ECA
	In case of heat pumps, the calculation period is divided in shorter periods (*bins*), that are determined according to the values of the outdoor air temperature (each bin corresponds to a temperature range of 1 K)	CEN monthly heat balance method. Accounted for in the system efficiency
	Air to water electrical heat pumps are considered as default heat pumps	The (water) sink temperature is defined by standard values according to the final use (DHW or heating)
		Heat pumps for heating and/or DHW are considered equipped with storage. DHW storage can be associated to any type of system

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
	The heat pump auxiliary energy is considered within the COP	Auxiliary energy calculated separately as for other systems

Table 5.24. UK: Building technical systems using renewables.

ISSUE	MODELING ASSUMPTIONS	DEFAULT ASSUMPTIONS ON PARAMETERS CALCULATION
Solar collectors	The thermal energy produced by solar collectors is calculated according to a-dimensional factors and depends on the system technology characteristics	Solar thermal calculated using the area, orientation, inclination and collector parameters
PV panels	The thermal energy produced by the PV system, the auxiliary energy consumption and the generation losses are not recovered	Balance is within the year and CO_2 emissions can be reduced to a negative value as a result of CO_2 saved by PV through energy generation

6. CONCLUSIONS

This document was developed within Task 4.1 "*Definition of a methodology and the relevant tools for determining the energy use (fossil and renewable) and the cost optimal levels of the reference buildings*" of RePublic_ZEB project. It explains the common methodology to calculate the total global primary energy use according to the definition in prEN ISO/DIS 52000-1:2015 (which substituted prEN 15603:2015), and to collect the country/project partner assumptions for the application of the energy use evaluation methodology.

Three different calculation options have been considered:

- common tool provided by POLITO;
- national tools, assessed at country level;
- dynamic simulation tool.

As shown in Table 2.3, most of the partners will use the common tool provided by POLITO.

The use of the common tool as a reference tool is recommended so as to make it easier to compare results among different countries. Nevertheless, partners are free to adopt the most suitable calculation methodology. For that reason, Bulgaria, Croatia, Hungary, Portugal, Slovenia and the UK will also perform calculation by means of national tools; in addition, Italy, Romania, Portugal and Slovenia will use dynamic simulation tools. That is highlighted in Section 5, where partners have been requested to report on discrepancies between the common tool and their national EP tool. For the assumptions, Appendix A gives a comparison of the national reference values.

The main calculation assumptions of the common tool are listed below:

- continuous heating and cooling;
- the time step is the month;
- the convective and radiative parts of sensible internal heat gains are considered together;

- the infiltration and the ventilation rate are considered together;
- the heating and cooling seasons can be either fixed at national level, or based on building characteristics and climatic data;
- the emission sub-system in the technical systems is considered separately from the control sub-system;
- the sub-system of the technical systems are modelled by means of fixed efficiencies, according to the technical characteristics; the tool does not perform an holistic calculation (e.g. efficiency expressed after the energy balance has been calculated).

A comparison of the country values of the main thermal parameter referred to the occupancy is reported in Appendix A: set-point and set-back temperatures for heating and cooling, sensible internal heat gains and total air flow rate monthly mean values. Moreover, the heating and cooling seasons are compared.

Finally, Table A.7 shows the differences between the partners concerning the primary energy factors – ren and nren – for the different energy sources. It points out that in some countries no values for non-renewable sources are provided.

APPENDIX A

This Appendix provides a comparison of the values of the building assumptions that will be adopted in the reference tool by each partner.

As regards the UK, some values in the following tables are missing because there is no single answer. The UK's calculation tool (SBEM) models zones based on activity, and each activity has its own specific set of parameters, temperature set-point and set-back included. Similarly, air flow rates and internal gains vary with each zone.

Table A.1. Heating set-point (and set-back) temperatures for the different reference buildings categories.

	BULGARIA	CROATIA	FORMER YUGOSLAV REPUBLIC OF MACEDONIA	GREECE	HUNGARY	ITALY	PORTUGAL	ROMANIA	SLOVENIA	SPAIN	UK
Set-point temperature [°C]											
Residential	21	20	20	n/a	20	20	20	n/a	n/a	n/a	n/a**
Offices	20	20	20	20	20	20	20	20	20	21	n/a**
Education buildings	20	20	20	20	20	20	n/a	20	20	n/a	n/a**
Hospitals	21	n/a	22	n/a	n/a	n/a	n/a	n/a	20	20/25*	n/a**
Nursing home	n/a	n/a	22	n/a	n/a	n/a	n/a	n/a	20	n/a	n/a**
Set-back temperature [°C]											
Residential	21	15	16	n/a	20	20	20	n/a	n/a	n/a	n/a**
Offices	15	15	16	20	20	20	20	12	20	21	n/a**
Education buildings	15	15	16	20	20	20	n/a	12	20	n/a	n/a**
Hospitals	21	n/a	n/a	n/a	n/a	n/a	n/a	n/a	20	20/25*	n/a**
Nursing home	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	20	n/a	n/a**

(*) Values for surgery rooms and patients rooms, respectively.

(**) Values vary between activity zones.

Table A.2. Cooling set-point temperatures for the different reference buildings categories.

	BULGARIA	CROATIA	FORMER YUGOSLAV REPUBLIC OF MACEDONIA	GREECE	HUNGARY	ITALY	PORTUGAL	ROMANIA	SLOVENIA	SPAIN	UK
Set-point temperature [°C]											
Residential	n/a	22	26	n/a	26	26	25	n/a	n/a	25	n/a**
Offices	25	22	26	26	26	26	25	26	26	n/a	n/a**
Education buildings	n/a	22	26	26	26	26	n/a	26	26	20/25*	n/a**
Hospitals	n/a	n/a	26	n/a	n/a	n/a	n/a	n/a	26	n/a	n/a**
Nursing home	n/a	n/a	26	n/a	n/a	n/a	n/a	n/a	26	n/a	n/a**

(*) Values for surgery rooms and patients rooms, respectively.

(**) Values vary between activity zones.

Table A.3. Heating and cooling season for the specific reference buildings.

	BULGARIA	CROATIA	FORMER YUGOSLAV REPUBLIC OF MACEDONIA	GREECE	HUNGARY	ITALY	PORTUGAL (**)	ROMANIA	SLOVENIA	SPAIN	UK
Heating season	1 Nov 30 Apr	Not fixed	15 Oct 15 Apr	1 Nov 15 Apr	15 Oct 15 Apr	15 Oct 15 Apr	18 Nov 10 April	Not fixed	Not fixed (*)	Not fixed	Not fixed
Cooling season	1 June 30 Sept	Not fixed	Not fixed	15 May 16 Sept	Not fixed	Not fixed	1 June 30 Sept	Not fixed	Not fixed (*)	Not fixed	Not fixed

(*) The duration of the heating season is constructed on the basis of the air temperature. The first day of the heating season is defined as the day after the air temperature was lower than or equal to +12°C at 9 pm three consecutive days before. The last day of the heating season is defined as the day after the days, when the air temperature was higher than +12°C at 9 pm for three consecutive days.

(**) The heating season is defined according to National Law that states: "*The conventional heating season is the period of the year with beginning in the first ten days consecutive after the 1st of October, for each city, with the daily average temperature below 15 °C and ending on the previous ten-day period on 31st* *of May in which the temperature stills bellow 15 °C*". The data presented in Table A.3 refers to Lisbon. For cooling season it is the data presented in Table A.3 which is fixed for all the country, according to the National Law.

Table A.4. Overall internal sensible heat gains: monthly time-averaged value.

	BULGARIA	CROATIA	FORMER YUGOSLAV REPUBLIC OF MACEDONIA	GREECE	HUNGARY	ITALY	PORTUGAL	ROMANIA	SLOVENIA	SPAIN	UK
Sensible heat gains [W/m²]											
Residential	7.14	5.00	3.75	n/a	5.0	5.0	4.0	n/a	n/a	n/a	n/a**
Offices	8.80	6.00	3.75	2.4	7.0	6.0	25.0	7.2	6.0	7.71*	n/a**
Education buildings	6.90	6.00	7.50	7.2	9.0	4.0	n/a	21.5	6.0	n/a	n/a**
Hospitals	5.40	n/a	7.50	n/a	n/a	n/a	n/a	n/a	6.0	15.50*	n/a**
Nursing home	n/a	n/a	3.75	n/a	n/a	n/a	n/a	n/a	4.0	n/a	n/a**

(*) Values from CTE (Technical Building Code) for non-residential buildings for occupation profile (W/m²): 12 and 24 hours; respectively for mean level of density internal gains (Sensible heat gains: Occupants: 6.00+ Lighting: 8.85 Office, 10.00 Hospital + Appliances: 4.50).

(**) Values vary between activity zones.

Table A.5. Air flow rate (infiltration + ventilation): monthly time-averaged value.

	BULGARIA	CROATIA	FORMER YUGOSLAV REPUBLIC OF MACEDONIA	GREECE	HUNGARY	ITALY	PORTUGAL	ROMANIA	SLOVENIA	SPAIN	UK
Infiltration rate [h⁻¹]											
Residential	0.63	0.50	0.4	n/a	0.50	0.50	0.40	n/a	n/a	n/a	n/a***
Offices	0.70	0.50	1.2	0.80	0.80	1.06	0.82	0.38	0.58	0.11* 0.59**	n/a***
Education buildings	0.70	0.50 5.00	1.8	3.14	0.90	1.20 1.70	n/a	2.90	0.94 1.00	n/a	n/a***

Hospitals	0.70	n/a	2.0	n/a	n/a	n/a	n/a	n/a	1.05	0.21* 6.0**	n/a***
Nursing home	n/a	n/a	1.0	n/a	n/a	n/a	n/a	n/a	1.95	n/a	n/a***

(*) Infiltration rate.

(**) Total ventilation rate.

(**) Values vary between activity zones.

Table A.6. DHW energy service.

	BULGARIA	CROATIA	FORMER YUGOSLAV REPUBLIC OF MACEDONIA	GREECE	HUNGARY	ITALY	PORTUGAL	ROMANIA	SLOVENIA	SPAIN	UK
DHW (yes/no)											
Residential	yes	yes	yes	n/a	yes	yes	yes	n/a	n/a	n/a	n/a
Offices	yes	no	no	no	yes	yes	no	yes	yes	no	yes
Education buildings	yes	yes	no	no	yes	yes	n/a	yes	yes	n/a	yes
Hospitals	yes	n/a	yes	n/a	n/a	n/a	n/a	n/a	yes	yes	yes
Nursing home	n/a	n/a	yes	n/a	n/a	n/a	n/a	n/a	yes	n/a	yes

Table A.7. Primary energy factors for different energy carriers/sources

Energy carrier/Sources		BULGARIA	CROATIA	FORMER YUGOSLAV REPUBLIC OF MACEDONIA	GREECE	HUNGARY	ITALY	PORTUGAL	ROMANIA	SLOVENIA (**)	SPAIN	UK
Natural gas	nren	1.10	1.095	n/a	n/a	1.00	1.05	1.00	1.17	1.10	1.190*	n/a
	ren	0.00	0.001	n/a	n/a	0.00	0.00	0.00	0.00	0.00	0.005*	n/a
	tot	1.00	1.097	1.10	1.05	1.00	1.05	1.00	1.17	1.10	1.195*	1.22
Gas oil	nren	1.10	1.138	n/a	n/a	1.00	1.05	1.00	1.10	1.10	1.179*	n/a
	ren	0.00	0.001	n/a	n/a	0.00	0.00	0.00	0.00	0.00	0.003*	n/a
	tot	1.10	1.140	1.20	1.10	1.00	1.05	1.00	1.10	1.10	1.182*	1.10
LPG	nren	1.10	1.160	n/a	n/a	1.00	1.07	1.00	n/a	1.10	1.201*	n/a
	ren	0.00	0.001	n/a	n/a	0.00	0.00	0.00	n/a	0.00	0.003*	n/a
	tot	1.10	1.162	1.10	n/a	1.00	1.07	1.00	n/a	1.10	1.204*	1.09
Solid biomass	nren	0.00	0.1230	n/a	n/a	0.60	0.20	1.00	1.08	0.10	0.085*	n/a
	ren	1.05	1.0364	n/a	n/a	0.00	0.80	0.00	0.00	0.00	1.028*	n/a
	tot	1.05	1.1910	1.05	1.00	0.60	1.00	1.00	1.08	0.10	1.113*	1.01
Liquid or gaseous biomass	nren	1.10	n/a	n/a	n/a	0.60	0.40	1.00	n/a	n/a	0.034*	n/a
	ren	0.30	n/a	n/a	n/a	0.00	0.60	0.00	n/a	n/a	1.003*	n/a
	tot	1.40	n/a	1.05	n/a	0.60	1.00	1.00	n/a	n/a	1.037*	n/a
Electricity	nren	2.55 (***)	0.798	n/a	n/a	2.50	1.95	n/a	2.62	2.50	2.461*	n/a
	ren	0.18	0.433	n/a	n/a	0.00	0.47	n/a	0.00	0.00	0.000*	n/a
	tot	2.73 (***)	1.614	2.7	2.90	2.50	2.42	2.50	2.62	2.50	2.461*	3.07
District heating	nren	1.30	1.494	n/a	0.70	1.26	1.50	n/a	0.92	1.00	n/a	n/a
	ren	0.00	0.022	n/a	0.50	0.00	0.00	n/a	0.00	0.00	n/a	n/a
	tot	1.30	1.523	1.20	1.20	1.26	1.50	n/a	0.92	1.00	n/a	n/a
Thermal	nren	0.00	0.024	1.00	n/a	0.00	0.00	0.00	0.00	0.00	0.00	n/a

Energy carrier/Sources		BULGARIA	CROATIA	FORMER YUGOSLAV REPUBLIC OF MACEDONIA	GREECE	HUNGARY	ITALY	PORTUGAL	ROMANIA	SLOVENIA (**)	SPAIN	UK
energy from solar collectors	ren	1.00	1.013	1.00	n/a	1.00	1.00	1.00	1.00	1.00	1.00	n/a
	tot	1.00	1.048	1.00	n/a	1.00	1.00	1.00	1.00	1.00	1.00	n/a
Electricity from PV	nren	0.00	n/a	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0.00	n/a
	ren	1.00	n/a	1.00	n/a	1.00	1.00	2.50	2.62	1.00	1.00	n/a
	tot	1.00	n/a	1.00	n/a	1.00	1.00	2.50	2.62	1.00	1.00	n/a
Thermal energy from outdoors (free cooling)	nren	0.00	n/a	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0.00	n/a
	ren	1.00	n/a	1.00	n/a	1.00	1.00	1.00	1.00	1.00	1.00	n/a
	tot	1.00	n/a	1.00	n/a	1.00	1.00	1.00	1.00	1.00	1.00	n/a
Thermal energy from outdoors (heat pumps)	nren	0.00	n/a	0.00	n/a	0.00	0.00	0.00	0.00	0.00	0.00	n/a
	ren	1.00	n/a	1.00	n/a	1.00	1.00	1.00	1.00	1.00	1.00	n/a
	tot	1.00	n/a	1.00	n/a	1.00	1.00	1.00	1.00	1.00	1.00	n/a

(*) Primary energy conversion factors extracted from: *PROPUESTA DE DOCUMENTO RECONOCIDO: FACTORES DE EMISIÓN DE CO2 Y COEFICIENTES DE PASO A ENERGÍA PRIMARIADE DIFERENTES FUENTES DE ENERGÍA FINAL CONSUMIDAS EN EL SECTOR EDIFICIOS EN ESPAÑA, VERSIÓN 03/03/2014 (pg. 29).* Available at:

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(**) Calculation of total primary energy consists of “nren” energy only, since “ren” primary energy conversion factors have not been defined yet in Slovenia on Regulation level.

(***) These values are not valid until the corresponding Regulation No.7 will be updated. The actual regulation prescribes *nren = 3*.