CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

Implementation of the EPBD Croatia

Status in 2020

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1. Introduction

Croatia's first steps towards transposing the EPBD started in 2005; however, the Ministry of Construction and Physical Planning (MCPP) officially started implementing the EPBD in 2008, and the Ministry of Economy became responsible for transposing certain other areas of the Directive in that same year. The Building Act in 2013 (OG 153/2013), set the legislative basis for implementing all articles of the EPBD and, with that, the MCPP became the sole ministry in charge of transposing and implementing the EPBD.

New amendments of the Building Act entered into force on 28 December 2019 (OG 125/2019) and transposed most parts of the EPBD Directive (EU) 2018/844. The remaining parts of the Directive which are not yet addressed by the Building Act, will be transposed by:

- the Ordinance on energy audits and energy certification of buildings (OG 88/2017, 90/2020),
- the Ordinance on control of energy performance certificates of buildings and reports on regular inspections of heating systems and cooling or air-conditioning systems in buildings (OG 73/2015, 54/2020); and
- the Technical regulation on energy savings and thermal protection in buildings (OG 128/2015, 70/2018, 73/2018, 86/2018, 102/2020).

Values for the energy performance of buildings (NZEB) are set based on:

- maximum annual primary energy consumption per usable floor area of a building (E''_{prim});
- maximum annual energy needs for heating per usable floor area of a building ($Q''_{H,nd}$), for new buildings and for existing buildings undergoing renovation;
- share of RES in the total energy consumption.

Also prescribed within the Building Act are the need for lighting, efficiency of technical building systems, energy efficiency class of the building, as well as automation and control systems. The designer must take into account the technical, environmental and economic feasibility of available high-efficiency alternative energy supply systems, and document these in the main design for new buildings with a useful floor area of ≥ 50 m^2.

Currently, Croatia has an electronic database for the EPCs and for reports on the regular inspection of heating and cooling/AC systems, as well as a national software tool for the calculation of the EPC.

In order to enhance the energy performance of buildings, four national programmes were adopted. Since 2014, a large number of buildings, particularly single- and multi-family buildings, have been renovated using incentives provided by the Fund for Environmental Protection and Energy Efficiency (EPEEF). An ESCO model was used in renovation of public sector buildings.

2. Current Status of Implementation of the EPBD

2.I. Energy performance requirements: NEW BUILDINGS

Energy performance requirements for new (NZEB) buildings are set for residential buildings and for various types of non-residential buildings heated to a temperature of 18°C or higher. Furthermore, buildings heated to a temperature between 12 and 18°C must meet requirements on minimum thermal protection, reduction of thermal bridges, requirements to prevent overheating, etc.

2.I.i. Progress and current status of new buildings (regulation overall performance)

Based on cost-optimal analyses that were carried out in 2013 and 2014, requirements are set on individual types of buildings regarding annual energy needs for heating per usable floor area of a building ($Q''_{H,nd}$). The requirement regarding annual primary energy per usable floor area of a building (E''_{prim}) is included in the Technical Regulation on the rational use of energy and thermal protection in buildings (OG 97/2014 and 130/2014) – prior Technical Regulation on energy savings and thermal protection in buildings ceased to be valid. The remaining requirements for annual delivered energy per usable floor area of a building (E''_{del}) are specified in the new Technical Regulation on the rational use of energy and thermal protection in buildings, published in November 2015 (OG 128/15).

The new Technical Regulation on amendments to the Technical Regulations on the rational use of energy and thermal protection in buildings (OG 128/2015, 70/2018) entered into force on **9 August 2018**.

The new amendments to the technical regulation introduce several changes and new definitions related to:

- the surface of the useful area of the heated part of the building, A_K (m^2);
- delivered energy;
- NZEB;
- the maximum allowed values of the heat transfer coefficient *U* [W/(m^2K)];
- requirements for the building parts to be fulfilled when designing new buildings and designing the reconstruction of existing buildings;

- established default values for the calculation of the technical characteristics of certain construction products required by this regulation;
- the prescribed maximum permissible values of the annual heat energy required for heating per unit of useful area of the heated part of the building, $Q''_{H,nd}$ [kWh/(m^2 year)];
- the maximum permissible values of the annual primary energy per unit of useful area of the heated part of the building E_{prim} [kWh/(m^2 year)];
- for new buildings heated and/or cooled at a temperature of 18°C or more, for existing buildings with reconstruction being performed in a way prescribed by Article 45, Paragraph 7 of technical regulation and NZEB.

The technical requirement for the rational use of energy and thermal protection of the building is further determined by the maximum allowed annual heating energy requirement per unit of useful area of the heated part of the building $Q''_{H,nd}$ [kWh/(m^2·year)] and the maximum allowed annual primary energy per unit of useful surface area of the heated part of the building E_{prim}[kWh/(m^2·year)] based on cost-optimal levels.

A new residential building (multi-residential building or family house) and a non-residential NZEB, depending on the type, must be designed and constructed in such a way that the annual heat energy required per unit of useful area of the heated part of the building, $Q''_{H,nd}$ [kWh/(m^2 year)] is not greater than the allowed values set out in Table 8 of Annex B to the new amendments on the Technical Regulation.

The annual primary energy per unit of useful surface area of the heated part of the building E_{prim} [kWh/(m^2 year)] includes the energy listed in Table 8a and should not be higher than the values set out in Table 8 of Annex B to the new amendments on the technical regulation for new buildings.

The main design of buildings other than buildings owned and used by public authorities, which are subject to issuing a building permit, shall be made in accordance with the provisions for NZEB if the request for the building permit has been submitted after 31 December 2019.

The main design of buildings owned and used by public authorities, which are subject to issuing a building permit, shall be made in accordance with the provisions for NZEB if the request for the building permit has been submitted after 31 December 2017[1].

Depending on the building type, the requirements are prescribed for the maximum E''_{prim}, E''_{del}, $Q''_{H,nd}$, the annual energy need for cooling per usable floor area of a building ($Q''_{C,nd}$), the maximum permitted thermal transmittance for individual building components of the building envelope (U-value), the reduction of the effects of thermal bridges (for this purpose, a catalogue of good solutions[2] as integral part of the Technical Regulation on rational energy use and thermal protection in buildings has been developed), the efficiency of technical building systems, the efficiency class of the building automation and control systems, the airtightness, and the share of RES (See the Key Indicators and Decisions, KIDs). Provisions for indoor environmental quality (including air quality, thermal comfort, lighting and acoustics) are also provided.

2.I.ii. Format of national transposition and implementation of existing regulations

The EPBD is transposed within the Building Act (OG 153/2013, 20/2017, 39/2019, 125/2019 – which entered into force on 28 December 2019), which also lays down penalties to ensure that all the requirements of the EPBD are fulfilled. The Building Act further sets some secondary regulations, including:

- the Technical Regulation on the rational use of energy and thermal protection in buildings (OG 128/2015, 70/2018, 73/2018, 86/2018, 102/2020);
- the Ordinance on persons authorised to issue energy performance certifications of buildings, energy audits of buildings and regular controls of heating and cooling or AC systems of buildings (OG 73/2015,133/2015, 60/2020 – 30 May 2020);
- the Ordinance on the control of buildings EPCs and of reports on energy audits of heating and cooling or AC systems (OG 73/2015, 54/2020 – 14 May 2020)
- a new set of meteorological data – applied as of 1 January 2016
- the Ordinance on buildings energy audits and energy certification (OG 88/2017, 90/20[3]) which entered into force on 30 September 2017, implements information systems for the development of an energy certificate (IEC), managed by the ministry;
- the methodology for carrying out building energy audits, which entered into force on 30 September 2017.

2.I.iii. Action plan for progression to NZEB for new buildings

The primary energy requirements for NZEB were established in 2014 as the lowest primary energy values among the analysed systems, providing they do not correspond to high overall costs. The lowest-cost measures have been determined using the cost-optimal analysis, thus setting the optimal level of energy consumption for new and refurbished buildings. In contrast, when determining the requirements for NZEB, the range of options with the lowest primary energy consumption have been chosen in order to set requirements within the cost-effective range (primary energy below cost-optimal level, and the global cost below the existing building global cost reference).

At least 30% of the annual primary energy must be covered using RES generated on-site (i.e., on the building or in its immediate vicinity); requirements for $Q_{H,nd}$ and U-values for building elements are also applied as for new buildings.

NZEB definitions were set in 2014 for all types of buildings and have recently been updated in the technical regulation of 2015. Values for maximum allowed $E"_{prim}$ for some types of buildings (according to the regulations from 2014) have slightly increased due to the variety of the reference geometry input when analysing cost-optimality and NZEB. In situations where energy use values in kWh/m² for NZEB were higher than the values obtained in the cost-optimal analysis, the values for NZEB were corrected according to the results of the geometry for the cost-optimal analysis. The number of new low-energy and passive buildings increases in Croatia on a yearly basis, particularly for single-family houses, multi-residential buildings and recently constructed office buildings. As of 31 December 2019, all new buildings must be designed as NZEB.

2.I.iv. Requirements for building components for new buildings

Requirements are set:

- for buildings as a whole;
- for the U-values of the building envelope elements;

- for the reduction of the effects of thermal bridges and water vapour condensation inside building elements and on the surface of building elements;
- on the efficiency of technical building systems.

Since 2015, in addition to the previously determined U-values for building envelope elements, U-values are also prescribed for cupolas, light bars and windshields.

The designed and installed heating systems in new buildings must compensate for heat losses in order to maintain indoor thermal comfort. Among other requirements, heating systems must have thermally insulated pipework.

For buildings equipped with heating systems with air-to-air heat pumps, the seasonal coefficient of the performance of individual heat pumps (SCOP) should be ≥ 4.0. SCOP includes the heat pump, regulation, auxiliary heating unit and other parts of the system, such as pumps and ventilators on the side of the heat storage tank.

For heating systems with air-to-water, water-to-water and soil-to-water heat pumps, the seasonal performance factor (SPF H3) of individual heat pumps should be ≥ 3.0. SPF H3 is the factor which influences the calculated limit that includes the heat pump, regulation, auxiliary heater, and all parts of the system, including pumps and fans on the side of the tank's thermal sources (air, water, soil). Air-to-air systems do not contain the listed parts (they contain freon) and have no impact on the factor.

2.I.v. Enforcement systems new buildings

The construction of new buildings may commence only based on a building permit. The application for building permit shall be submitted by the investor to the competent office for construction and physical planning in the place where construction or some reconstruction of a buildings is planned. Since April 2014, the request can be submitted in electronic form. As of 31 December 2019, all new buildings must be designed as NZEB according to the **Technical regulation on energy savings and thermal protection in buildings** (OG 128/2015, 70/2018, 73/2018, 86/2018, 102/2020).

A completed or reconstructed building may be used or put into operation, and a decision may be issued for performing activities in that construction work pursuant to a special act only after a use permit has been issued for the construction work.

In case of suspicion that a building was built in breach of the legal provisions, that is, without a valid building permit or having no main design certificate, having more than the permitted number of stores, etc., this can be reported to the building inspection of the State Inspectorate. If inspection discovers procedural violations of laws and/or regulations, administrative proceedings shall be instituted and taking of necessary measures ordered, including any penal provisions set in relevant regulations.

2.II. ENERGY PERFORMANCE Requirements EXISTING BUILDINGS

Energy performance requirements for existing buildings, heated to a temperature of 18^{o}C or higher and undergoing reconstruction are set depending on building type and size of the reconstruction. Buildings heated to a temperature between 12 and 18^{o}C shall meet requirements on minimum thermal protection, reduction of thermal bridges, requirements to avoid overheating, etc.

2.II.i. Progress and current status of existing buildings (regulation overall performance)

For all types of buildings, in the case where only certain building envelope elements of a heated part of the building covering an area over 25% are renovated, the U-value of the entire building element shall fulfil the prescribed requirements.

In the case where reconstruction covers an area over 75% of the surface of the heated building envelope, requirements are set as U-values for the building elements, $Q''_{H,nd}$, E''_{prim} (including energy for heating, cooling, ventilation, hot water, and lighting for non-residential buildings).

Existing buildings undergoing major reconstruction meet the requirements for the use of RES if at least 10% of the energy needs are covered by RES, which may include remote or block heating, which is fully or partially based on energy from RES, unless the achievement of these conditions is not economically, technically and functionally feasible. The application of highly efficient alternative systems should also be considered and taken into account in so far as they are technically, economically and functionally feasible.

2.II.ii. Regulation on individual parts, distinct from whole building performance

Requirements are set for individual elements of buildings and for technical building systems in case of building renovation. When renovating parts of the building envelope, the U-value of the relevant parts shall meet the requirements as prescribed for a new building. The prevention of overheating caused by solar radiation and air permeability of the windows, doors and skylights shall comply with the requirements specified for new buildings. When replacing, modernising or upgrading technical building systems, the same requirements apply as for the installation of these technical building systems in new buildings.

2.II.iii. Initiatives/plans to improve the existing building stock

Case Study

The office building in Žminj (AGM PROJEKT d.o.o.) is a reinforced concrete building with a total floor area of 802 m^2. The building elements include:

- external walls and walls touching the garage and attics insulated with mineral wool (20 cm);
- flat and sloping roofs above heated spaces and ceilings towards attics insulated with mineral wool (40 cm);
- ceilings above outdoor air and ceilings above garage isolated with mineral wool (25 cm);
- windows with three-layered glazing – tinted glass, double low coating, U-value = 0.9 – 1.1 W/(m^2 K).

RES in the building: PV power plant 10 kW with total energy production of 13,000 kWh/year; solar water heating systems for low temperature underfloor heating and domestic hot water; heat pump with a coefficient of performance of 4.13. The air inside the building is mechanically ventilated with heat recovery.
LED lighting is combined with lighting sensors. Building automation and control of the HVAC systems, lighting and shading operates the systems depending on daylighting throughout the year, with the task to prioritise parts of the technical building systems in order to optimise consumption of operating energy. $Q''_{H,nd} < 15$ kWh/m^2year. Electrical energy consumption is 882.65 kWh/year.

Figure 1. Office building in Žminj

The national definition of NZEB is the same for both new and renovated buildings. As a result, achieving NZEB standards in existing buildings can be difficult in many cases, specifically when fulfilling the share of RES and the requirement for mechanical resistance and stability of the construction related to intense seismic activity according to Eurocode regulations. The main obstacles for the renovation of the national building stock into NZEB are due to financial constraints, with long periods of return on investment, different priorities by stakeholders, lengthy and complex public tenders for funding, but also the lack of information and motivation for investors, the public and stakeholders.

According to the Long-Term Strategy for Mobilising Investment in the Renovation of the National Building Stock of the Republic of Croatia[4], in order to achieve targets and indicators for the period up to 2050, various measures are envisaged. These include developing renovation techniques (e.g., in relation to the type of material from which a building is built, or specifically for the renovation of historic buildings and buildings of cultural significance), training workers and certifying contracting companies.

2.II.iv. Long Term Renovation Strategies, status

After the public announcement and after collecting comments from other ministries, a new Long Term Renovation Strategy (LTRS)[5] was sent to the Government of the Republic of Croatia for adoption.

The LTRS contributes to the overall national energy efficiency target set in the Integrated National Energy and Climate Plan, according to which the contribution of buildings to final energy consumption is reduced to 48% in 2030 and 46% in 2050. These projections are based on the goals and measures envisaged in the Integrated National Energy and Climate Plan and this LTRS, assuming the continuous annual increase of the rate of energy renovation of buildings from 1% in 2021 to 3% in 2030, and the renewal of the national building stock at a rate of 3% by 2050. The absence of these measures would result in significantly higher energy consumption in buildings in the future and failure to meet the set of national targets.

The LTRS provides clear guidelines, defines measurable targeted measures and equal access to financing for the worst performing segments of the national building stock, for consumers affected by energy poverty and, in case of split incentives, between landlords and tenants. The LTRS also includes references to health, safety and air quality fire protection and risks associated with increased seismic activity, initiatives to promote smart technologies, as well as skills and education. The LTRS sets out a clear level of ambition for the energy renovation of existing buildings to achieve the European Union's goals of developing a sustainable, competitive, secure and decarbonised future by 2050.

It is expected that this strong Long Term Renovation Strategy will accelerate the cost-effective renovation of existing buildings that currently have a low renovation rate.

2.II.v. Financial instruments and incentives for existing buildings

Until now, the role of the government has been crucial in the success of building energy renovation. In 2013, 2014 and 2015, the government adopted four building renovation programmes for single-family houses, multi-family houses, commercial buildings and public sector buildings, for the implementation period of 2014 to 2020.

The programmes for the energy renovation of both single-family and multi-family houses that were implemented by the end of 2016 provided financial incentives for integral renovations as well as for implementing individual measures to improve energy-efficiency.

In 2015, 9,574 projects for implementing energy efficiency and installing RES in single-family houses have been completed and about 476 million kuna (64.9 million €) has been disbursed from the national Environmental Protection and Energy Efficiency Fund (EPEEF).

Over 2,300 projects or requests from building managers have been approved and contracted under the programme for the energy renovation of multi-family houses and a total funding of more than 279 million kuna (37.5 million €) was approved.

From 2015 to 2020, the Ministry of Construction and Physical Planning published five public calls for project proposals: four calls for the energy renovation of public sector buildings and one call for the energy renovation of multi-apartment buildings in the frame of which 1,455 grant agreements were signed. The total value of the projects amounts to 4.17 billion kuna (549.1 million €), of which more than 2.09 billion kuna (275.6 million €) is provided in the form of grants.

The financial instrument 'ESIF Loans for Energy Efficiency in Public Sector Buildings' was also established with a total amount of 402.8 million kuna (53 million €) implemented through the Croatian Bank for Reconstruction and Development (HBOR). Eligible beneficiaries are public sector entities to which, before applying for a loan, the Ministry of Construction and Physical Planning issued a Decision on Financing the project with grants under the call 'Energy renovation and use of RES in public sector buildings'.

Also, 170 requests for the energy renovation of commercial buildings have been received, of which 80 have been approved, and for which 46 million kuna (6.2 million €) has been secured. Of those approved projects, 43 projects have been completed, for which about 20 million kuna (2.7 million €) has been paid.

Regarding the implementation of the Programme for the energy renovation of public sector buildings, 57 public procurement procedures have been published for the provision of energy services and 20 agreements on the energy performance of buildings have been signed. The estimated value (excluding VAT) is about 364 million kuna (48.9 million €).

During 2016, a further seven (7) contracts for building energy performance were signed for an estimated value (excluding VAT) of 219 million kuna (29.4 million €).

Regarding the implementation of the Programme for the energy renovation of public sector buildings through energy service contracting (ESCO), 12 contracts for building energy performance were signed for a value (excluding VAT) of 621 million kuna (83 million €).

Croatia successfully implemented the national energy management information system (EMIS), a web application for gathering and monitoring energy and water consumption, as well as for measuring energy savings for all public sector buildings.

Existing programmes for the energy renovation of buildings are currently being adapted for the new financing period of 2021 – 2026 according to the conditions of co-financing from EU funds, as described below.

- The Programme for energy refurbishment of public sector buildings 2016-2020 (OG 22/2017).
- The Programme to encourage the construction of new and the renovation of existing buildings to NZEB - published on the official website MCPP (December 2018).
- The draft Programme for Combating Energy Poverty, which includes the use of RES in residential buildings in assisted areas and areas of special state concern for the period of 2019-2021. The draft programme was completed in September 2019 and submitted for further reference procedure and adoption by the Government of the Republic of Croatia.

2.II.vi. Information campaigns / complementary policies

Information campaigns for energy efficiency are a continuous activity, adjusted to the needs of the professional and the general audience, and directed to support strategic goals of energy efficiency policies. To achieve the set goals, different tools were employed – from continuous stakeholder dialogue, a charter on cooperation in decarbonisation of building stock, conferences, presentations, and development of different guidelines for both professionals and building owners.

The open stakeholder dialogues

With the goal of creating a wide network of experts who are ready for a joint dialogue and contribution to the decarbonisation of the existing building stock until 2050, MCPP has initiated the open stakeholder dialogue and prepared the charter on co-operation towards a decarbonised building stock by 2050, by the signing of which symbolically makes signatories stakeholders.

So far, five open dialogues have been held with the following topics:

1. the energy efficiency in buildings (09/2018);
2. energy poverty (02/2019);
3. the application of modern solutions and rules of fire protection and risk of increased seismic activity during energy renovation of buildings (04/2019);
4. amendments to the Construction Act related to the transposition of Directive 2018/844 (10/2019);
5. the energy renovation of buildings and the long-term strategy for the energy renovation of buildings (02/2020).

Charter on co-operation

The contents of the charter on co-operation towards a decarbonised building stock by 2050 refers to the achievement of energy and climate goals at national and EU level through the decarbonisation of the building stock, the renovation of buildings and the construction of NZEB. It raises awareness on the importance of additional greenhouse gas emission reductions, increasing the share of RES, improving energy security, and introducing innovation and smart technologies that enable buildings to contribute to the overall decarbonisation of the economy. By signing the charter, continuous cooperation is enhanced to develop a long-term renovation strategy to support the renovation of the national building stock and the transition to the construction standard of NZEB.

By the end of March 2020, the charter had been signed by more than 60 stakeholders from the business and public sectors.

CEI expert conference 'Energy Efficiency in buildings - for a better tomorrow'

The Ministry of Construction and Physical Planning organised in September 2018 the expert conference on energy efficiency in buildings for a better tomorrow[6]

Guidelines for NZEB - PART ONE

(intended for the interested public) – December 2019[7]

Guidelines for NZEB - PART TWO

(intended for the experts) – December 2019[8]

2.III. Energy performance certificate requirements

An EPC shall be issued for buildings or independent building units when it is necessary to use energy to maintain the indoor design temperature in accordance with their purpose. EPCs are issued prior to the issuing of a building use permit, or when selling, renting out or leasing a building. The validity of the EPC shall not exceed ten years from the date of its issue.

In the Ordinance on energy audit of buildings and energy certification (OG 88/2017), the EPC template for residential as well as non-residential buildings contains four (4) pages and the energy class is expressed in two ways: as the annual energy need for heating per usable floor area of a building {$Q''_{H,nd}$ [kWh/(m^2.year)]} and as the annual primary energy per usable floor area of a building {E_{prim} [kWh/(m^2.year)]}.

ENERGETSKI CERTIFIKAT ZGRADE

prema *Pravilniku o energetskom pregledu zgrade i energetskom certificiranju (NN .....)*

Naziv zgrade

Naziv samostalne uporabne cjeline zgrade

Ulica i kućni broj | *Poštanski broj* | *Mjesto*

PODACI O ZGRADI	☐ nova ☐ postojeća ☐ rekonstrukcija		
Vrsta zgrade (prema *Pravilniku*)	odaberi vrstu zgrade prema Pravilniku iz padajućeg izbornika		
Vrsta zgrade prema složenosti tehničkih sustava	odaberi iz padajućeg izbornika		
Vlasnik / investitor			
k.č.br.		k.o.	
Ploština korisne površine grijanog dijela zgrade A_K		Godina izgradnje / rekonstrukcije	
Građevinska (bruto) površina zgrade [m^2]		Mjerodavna meteorološka postaja	
Faktor oblika f_0 [m^{-1}]		Referentna klima	

ENERGETSKI RAZRED ZGRADE	Specifična godišnja potrebna toplinska energija za grijanje $Q''_{H,nd}$ [kWh/(m^{2}a)]	Specifična godišnja primarna energija E_{prim} [kWh/(m^{2}a)]
A+ / A / B / C / D / E / F / G	C	B
Specifična godišnja isporučena energija E_{del} [kWh/(m^{2}a)]		
Specifična godišnja emisija CO_2 [kg/(m^{2}a)]		
Upisati „nZEB" ako energetsko svojstvo zgrade (E_{prim}) zadovoljava zahtjeve za zgrade gotovo nulte energije propisane važećim TPRUETZZ	nZEB	

ROK VAŽENJA CERTIFIKATA / PODACI O OSOBI KOJA JE IZDALA ENERGETSKI CERTIFIKAT					
Oznaka energetskog certifikata		Datum izdavanja		Datum važenja	
Naziv ovlaštene pravne osobe				Registarski broj	
Ime i prezime imenovane osobe u ovlaštenoj pravnoj osobi ili ime i prezime ovlaštene fizičke osobe / vlastoručni potpis					

PODACI O OSOBAMA KOJE SU SUDJELOVALE U IZRADI ENERGETSKOG CERTIFIKATA				
Dio zgrade	Ime i prezime ovlaštene osobe	Naziv pravne osobe	Registarski broj	Vlastoručni potpis
Građevinski				
Strojarski				
Elektrotehnički				

ENERGETSKI CERTIFIKAT ZGRADE str. 1/4

Figure 2. EPC of residential and non-residential buildings according to the new ordinance.

2.III.i. Progress and current status on EPCs at sale or rental of buildings

As of January 2014, sale advertisements published in the media must indicate the building energy class. This obligation is commonly followed.

The law imposes penalties for owners who fail to provide an EPC at the time of selling, renting, or leasing a building. Penalties are also imposed if the owner fails to deliver the EPC to the buyer, or if they fail to indicate the energy class in the sale advertisement published in the media.

2.III.ii. Quality Assurance of EPCs

All issued EPCs undergo administrative control during their entry into the database. Detailed quality control is carried out on EPCs that are randomly selected and/or based on complaints.

So far, 510 out of about 228,902 EPCs in total were checked in detail, 236 of which were declared invalid. Detailed control includes checks of the content of the report on the energy audit of the building, the validity and completeness of the input data, the accuracy of the EPC and the calculated and proposed measures to improve the energy performance of the building.

An EPC is declared invalid only if it contains calculation results, input data or proposed measures with significant (more than 30%) deviation and if the result causes a change of one or more energy classes.

Authorised persons shall be sanctioned by means of a fine or by annulment of authorisation in the case of three (3) or more invalid EPCs.

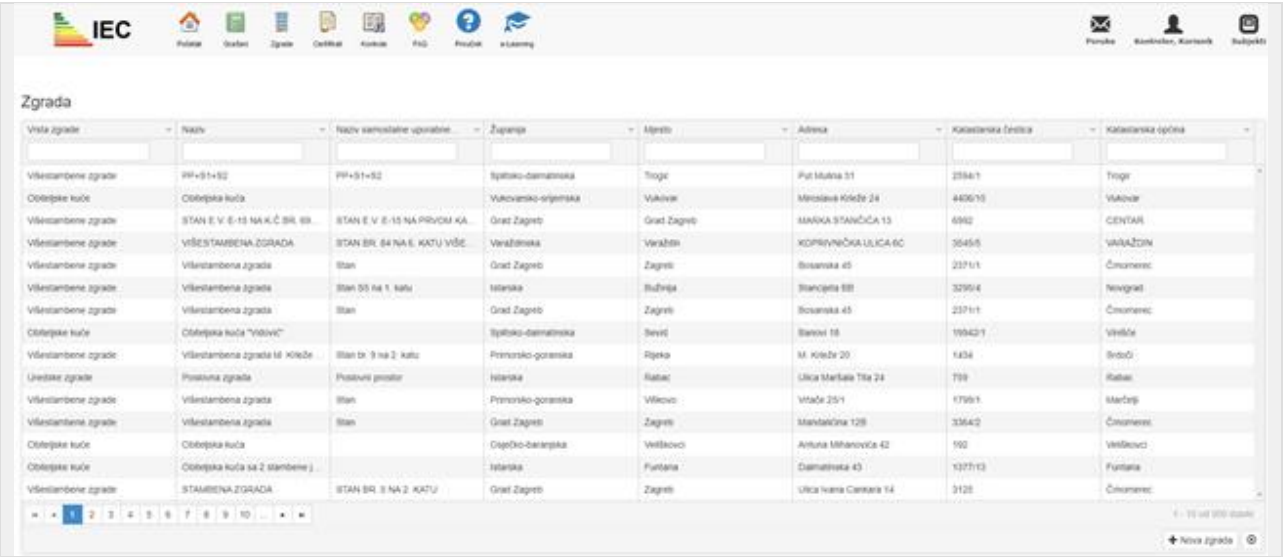

Figure 3. Screenshot of the electronic data base.

2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public

Public buildings with a total useful floor area of over 250 m^2 must display the EPC. This includes public buildings used by public authorities for performing their activities, and buildings used to house specific population groups (e.g., elderly persons, children, etc.) as well as non-residential buildings in which a high number of people are present or are provided with a service.

Municipal service officers control whether these EPCs are adequately displayed by visiting the buildings and making a report. In the case of non-compliance with the regulation, they shall ask the owner to display the EPC.

EPCs for public buildings are in the same format as those of non-residential buildings and follow the same procedures (audit followed by issue of EPC).

Fines for public building owners who fail to display the EPC are established by law and amount from 15,000 to 30,000 kuna (approximately 2,000 – 4,000 €) for legal entities, and from 5,000 to 10,000 kuna (approximately 700 – 1,300 €) for natural persons. The obligation for public display of the EPC is commonly followed and no fines have yet been issued.

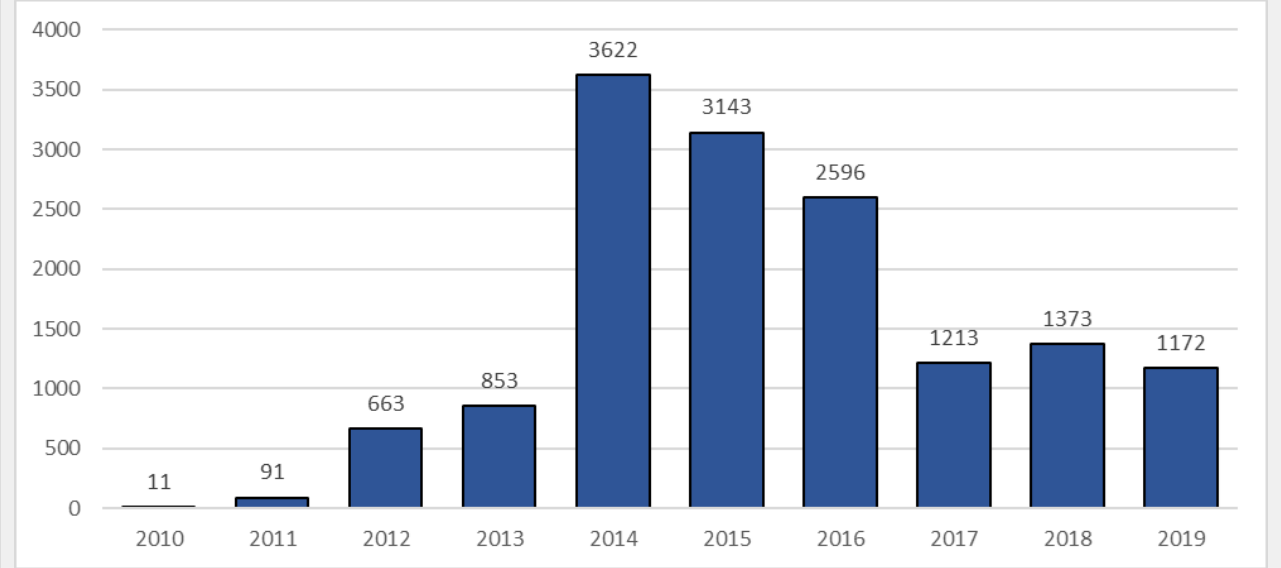

Figure 4. Display of the EPC in public buildings for the period of 2010 – 2019.

2.III.iv. Implementation of mandatory advertising requirement - status

As of January 2014, there is an obligation to indicate the energy class in the sales advertisements published in the media. Penalties are imposed by law both for owners and for authorised real estate brokers. Supervision is under the competence of the Ministry of Economy, Market Inspectorate. This obligation is commonly followed and no fines have been issued so far.

2.IV. Smart buildings and building systems

2.IV.i. Status and plans on smart buildings

Currently there is no national definition of smart buildings.

2.IV.ii. Regulation of system performance

Current policies on technical buildings systems are reflected in the building code **Technical regulation on rational energy use and thermal protection in buildings** (OG 128/2015, 70/2018, 73/2018, 86/2018, 102/2020), indirectly through the requirements on primary energy use in buildings. Further technical requirements are set in the building codes Technical regulation for ventilation and air conditioning (OG 03/07), Technical regulation for flues in building (OG 03/07) and Technical regulation for heating and cooling systems (OG 110/08).

2.IV.iii. Building Automation and Controls (BACs)

Requirements on Building Automation and Controls are implemented in the **building act** (Official Gazette 153/2013, 20/2017, 39/19, 125/2019) and **Technical Regulation on energy savings and thermal protection in buildings** (OG 128/2015, 70/2018, 73/2018, 86/2018, 102/2020) according to Directive (EU) 2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.

2.IV.iv. Status and encouragement of intelligent metering

Promotion and encouragement to include intelligent metering is prescribed by the building act. Each building, depending on the type and purpose, must be designed and constructed so that it is possible, without significant costs, to ensure individual metering of energy and water consumption, with the possibility to have remote readings for individual and separate parts of the building.

The Energy Management Information System – EMIS - is a web application for monitoring and analysing energy and water consumption in public sector buildings. EMIS provides a transparent oversight and control of energy consumption, making itself an inevitable tool for systematic energy management.

2.IV.v. Progress and current status on heating systems (Inspection / Equivalence)

Regular inspection of the heating system in a building must be carried out alongside the energy audit of the building for the purpose of issuing an EPC. When not concurrent with EPC issuance, heating systems with a boiler of an effective rated output of more than 70 kW are regularly inspected every 10 years. A regular inspection includes a visual and functional inspection of the heating system and of heated areas, the necessary measurements, an assessment of the size of the system relative to the building's needs, and a proposal of measures to improve the energy efficiency of the system and/or to apply alternative solutions.

2.IV.vi. Progress and current status on AC systems (Inspection / Equivalence)

The inspection of cooling/AC systems is obligatory and must be carried out alongside the energy audit of the building for the purpose of issuing an EPC. If not established in parallel with the issued EPC, cooling systems with an effective rated output of 70 kW or more shall be regularly inspected, at least once every 10 years.

Regular inspections of cooling/AC systems in buildings include a visual and functional check of the cooling/AC system, cooled and air-conditioned space, the necessary measurements, a proposal of measures for improving the energy efficiency and/or applying alternative solutions as well as drafting a final report.

2.IV.vii. Enforcement and impact assessment of inspections

Enforcement and penalties

Regular inspections of heating and cooling/AC systems of a building must be performed by authorised personnel. Authorisation is granted by the Ministry for an indefinite period but with the obligation of professional training at least once every two years.

Enforcement and penalties for the owner of a building are the same as for the EPC. No fine has yet been issued.

Quality control of inspection reports

The quality control of inspection reports is performed by the legal personnel authorised to carry out control checks. Quality control shall be carried out on reports that are randomly selected and based on complaints. The authorised personnel check the completeness of the report and the proposed measures to improve energy efficiency.

The report on the regular inspection of heating and cooling/AC systems of a building is declared invalid if the control determines that the report contains less than 30% of the required data and there is no justification for this in the report. Authorised personnel who issue invalid reports shall be sanctioned by means of fines and annulment of authorisation in the case of three (3) or more reports being invalid.

So far, 94 reports on regular inspections of heating systems in buildings were issued and two (2) for cooling/AC systems, all as part of the report on building audits that were performed for the purpose of issuing EPCs. Up until now no inspection reports have been controlled.

Impact assessment, costs and benefits

Since regular inspections of heating and cooling/AC systems started recently and due to the small number of issued reports, no control has yet been performed and no assessments of impacts have been carried out.

3. A success story in EPBD implementation

The best example of the promotion of energy efficiency and sustainable construction is when the idea is materialised and visible, and when the results confirm assumptions. Such a best-practice example is the multi-family ECO-SANDWICH house. The first out of twelve planned typical multi-family houses with three apartments, as a new type of housing within the programme of subsidised housing construction (POS), was completed on 7 September 2016, with an energy class of A+.

The first ECO-SANDWICH house is the first realisation of the prefabricated ventilated facade system ECO-SANDWICH, which is the result of the cooperation between Croatian scientific institutions (Construction and Architecture, University of Zagreb) and Construction industry (Beton Lucko Ltd., Knauf Insulation Ltd., Eurco dd), and was approved to be funded under the EU programme CIP-EIP-Eco-Innovation 2011. As an innovative product, ECO-SANDWICH was also recognised by the Environment Protection and Energy Efficiency Fund (EPEEF) which co-financed the project.

The project objectives go beyond energy efficiency alone; it also encourages the recycling of construction waste, increasing the efficient use of existing resources and increasing the possibility of using construction and demolition waste. The promotion of the use of thermal insulation materials is based on the ECOSE[9] technology, which does not contain harmful substances such as formaldehyde, phenols, pentane, butane and acrylics, and the production requires 70% less energy than in the case of conventional mineral wool using a binder in base oil.

The ECO-SANDWICH wall panels were cast out of concrete containing 50% recycled aggregates, and thus they contribute to resource efficiency goals, together with the energy efficiency goals. Additionally, the project ECO-SANDWICH promotes the application of prefabricated panels that reduce embedded energy in the product, as well as greenhouse gas emissions and harmful by-products from the production. Environmental Product Declaration (EPD) was produced for the ECO-SANDWICH wall panels in cooperation with consultants from The Netherlands, according to the EN 15804 standard. During the construction of the residential building in Koprivnica, green public procurement was performed for the design as well as construction phase.

The technical details for the multi-family house in Koprivnica, Lenišće are as follows:

- useful floor area of the heated part of the building = 267.82 m^2;
- $Q''_{H,nd}$ = 14.95 kWh/m^2.year;
- $Q''_{C,nd}$ = 10.86 kWh/m^2.year;
- E''_{prim} (for heating, cooling and domestic hot water) = 39.50 kWh/m^2.year;
- natural gas is used for domestic hot water;
- space heating is by air-to-air heat pump.

Figure 5. Multi-family house in Koprivnica, Lenišće.

4. Conclusions, future plans

The combination of requirements set for new buildings, renovated buildings and NZEB, and subsidies that were assigned to the improvement of the energy efficiency of existing buildings will bring significant energy savings over the coming years. The recommendations in the EPCs serve as good guidelines to help owners to decide on implementing some of the possible energy improvements. The number of qualified experts necessary for issuing EPCs and for regular inspections of technical systems is sufficient to cover all the market needs.

The national calculation tool has been developed. Due to complex calculation procedures, it will only cover the most commonly encountered combinations of RES and combined heat and power systems, so there is a need for a more comprehensive calculation tool to complement this tool.

The future plans are:

- To strengthen the existing quality assessment scheme and increase the number of EPCs to be controlled, which currently stands at 0.22% of issued EPCs.
- To continue ongoing information campaigns and develop a new campaign to raise awareness on the benefits of building energy renovations and the purpose of energy certification and regular inspection of heating and cooling/AC systems.
- To continue improving the electronic platform that supports the issuing of the EPCs and collecting reports on the regular control of heating and cooling/ AC system.
- To improve and simplify the calculation methodology and software tool for the calculation of the energy performance of buildings.
- To perform a new cost-optimal analysis.
- To create new programmes for energy renovation of buildings for the period of 2021-2027 and improve schemes for building energy renovation with measures for healthy indoor climate conditions, fire safety and reduced risks related to intense seismic activity according to Directive (EU) 2018/844.

Endnotes

1. https://mgipu.gov.hr/UserDocsImages/dokumenti/Propisi/1a_Technical%20regulation70-18.pdf
2. https://narodne-novine.nn.hr/clanci/sluzbeni/dodatni/438515.pdf
3. https://narodne-novine.nn.hr/clanci/sluzbeni/2020_08_90_1747.html
4. Proposal of the Long-Term Strategy for Mobilising Investment in the Renovation of the National Building Stock of the Republic of Croatia
5. https://mgipu.gov.hr/news/cei-expert-conference-energy-efficiency-in-buildings-for-a-better-tomorrow/8138
6. https://mgipu.gov.hr/UserDocsImages/dokumenti/EnergetskaUcinkovitost/Smjernice_1_dio_nZEB_mgipu.pdf
7. https://mgipu.gov.hr/UserDocsImages/dokumenti/EnergetskaUcinkovitost/Smjernice_2_dio_nZEB_mgipu.pdf
8. ECOSE technology means production of mineral wool in which natural resins (sugars) are used as the binder which polymerises and bounds the mineral wool fibres at a temperature of approximately 200-250 °C.

Annexes -Key Indicators & Decisions

Key Indicators & Decisions – General Background

<table>
<tr><th>no</th><th>Key Implementation Decisions – General Background</th><th>Description / value / response</th><th>Comments</th></tr>
<tr><td>01.01</td><td>Definition of public buildings (according to article 9 b)</td><td>Public sector buildings are buildings that are owned and used by public authorities.
Public sector includes budgetary and extra-budgetary users of the state budget and budget users of local and regional (regional) governments authorities</td><td>Energy Efficiency Act (OG 127/2014), Article 4</td></tr>
<tr><td>01.02</td><td>Definition of public buildings used by the public (according to article 13)</td><td>Public building means a building, or a part thereof used by public authorities for performing their activities, a building or a part thereof used for housing of specific population groups, and a non-residential building or part thereof in which a number of people are present, or a larger number of people are provided a service.</td><td>Building Act (OG 153/2013, 20/2017, 39/19, 125/19), Article 3.
Housing of specific population groups includes housing for elderly persons, children, etc.</td></tr>
<tr><td>01.03</td><td>Number of residential buildings</td><td><table><tr><th></th><th>Number</th><th>Area m^2</th></tr><tr><td>Multi-family houses</td><td>290,689</td><td>55,438,063</td></tr><tr><td>Family houses</td><td>471,708</td><td>86,738,615</td></tr><tr><td>Total residential</td><td>762,397</td><td>142,176,678</td></tr></table></td><td>Long Term Strategy for Mobilising Investment in the Renovation of the National Building Stock of the Republic of Croatia
Total number includes buildings constructed by the end of 2011</td></tr>
<tr><td>01.04</td><td>Number of non-residential buildings</td><td><table><tr><th></th><th>Number</th><th>Area m^2</th></tr><tr><td>Public buildings</td><td>80,196</td><td>13,801,902</td></tr><tr><td>Commercial buildings</td><td>44,728</td><td>36,540,459</td></tr><tr><td>Total non-residential</td><td>124,924</td><td>50,342,361</td></tr></table></td><td>Long Term Strategy for Mobilising Investment in the Renovation of the National Building Stock of the Republic of Croatia
Total number includes buildings constructed by the end of 2011</td></tr>
<tr><td>01.05</td><td>If possible, share of public buildings included in the number given in 01.04</td><td>64%</td><td>Long Term Strategy for Mobilising Investment in the Renovation of the National Building Stock of the Republic of Croatia</td></tr>
<tr><td>01.06</td><td>If possible, share of commercial buildings included in the number given in 01.04</td><td>36%</td><td>Long Term Strategy for Mobilising Investment in the Renovation of the National Building Stock of the Republic of Croatia</td></tr>
<tr><td>01.07</td><td>Number of buildings constructed per year (estimate)</td><td>Number of finished buildings<table><tr><th>Year</th><th>Total</th><th>Residential</th><th>Non-residential</th></tr><tr><td>2016</td><td>4,824</td><td>3,811</td><td>1,013</td></tr><tr><td>2017</td><td>4,940</td><td>3,699</td><td>1,241</td></tr><tr><td>2018</td><td>4,933</td><td>3,824</td><td>1,109</td></tr><tr><td>2019</td><td>5,521</td><td>4,316</td><td>1,205</td></tr></table></td><td>Croatian Bureau of Statistics</td></tr>
<tr><td>01.08</td><td>If possible, share of residential buildings constructed per year (estimate, included in the number given in 01.07)</td><td>79% in 2016
74% in 2017
77% in 2018
78% in 2019</td><td>Croatian Bureau of Statistics</td></tr>
</table>

<table>
<tr><th>no</th><th>Key Implementation Decisions – General Background</th><th>Description / value / response</th><th>Comments</th></tr>
<tr><td>01.09</td><td>If possible, share of non-residential buildings constructed per year (estimate, included in the number given in 01.07)</td><td>21% in 2016
26% in 2017
23% in 2018
78% in 2019</td><td>Croatian Bureau of Statistics</td></tr>
<tr><td>01.10</td><td>Useful floor area of buildings constructed per year in million square meters (estimate)</td><td>Useful floor area m^2
<table><tr><th>Year</th><th>Total</th><th>Residential</th><th>Non-residential</th></tr><tr><td>2016</td><td>1,832,144</td><td>1,012,270</td><td>819,874</td></tr><tr><td>2017</td><td>2,029,111</td><td>1,041,123</td><td>987,988</td></tr><tr><td>2018</td><td>2,206,821</td><td>1,301,523</td><td>905,298</td></tr><tr><td>2019</td><td>2,567,133</td><td>1,429,644</td><td>1,137,489</td></tr></table></td><td>Croatian Bureau of Statistics</td></tr>
</table>

Key Indicators & Decisions – New Buildings

no	Key Implementation Decision – New Buildings	Description / value / response	Comments
02.01	Are building codes set as overall value, primary energy, environment (CO_2), reference building or other	Building codes are set as overall primary energy value.	
02.02	Requirements for energy performance of residential buildings in current building code	Requirements are established for residential buildings heated and/or cooled at indoor temperature of 18ºC or higher: • Maximum permitted annual energy needs for heating per unit of the usable floor area of a building (Q''_{Hnd}) • Maximum permitted U-value • Maximum permitted annual primary energy consumption per unit of the usable floor area of a building (E''_{prim}) • Maximum permitted annual energy needs for cooling per unit of the usable floor area of a building ($Q''_{C,nd}$) • Share of RES Primary energy includes the heating and cooling energy needs, energy for ventilation and domestic hot water E''_{prim} [kWh/(m^2·year)] **Multi-family houses** continental 120 littoral 90 **Family houses** continental 115 littoral 70	
02.03	Requirements for energy performance of non-residential commercial buildings in current building code	Requirements are established for non-residential buildings heated and/or cooled at indoor temperature of 18ºC or higher: • Maximum permitted Q''_{Hnd} • Maximum permitted U-value • Maximum permitted E''_{prim} • Maximum permitted Q'' • Share of RES Primary energy includes the heating and cooling energy needs, energy for ventilation, domestic hot water and lighting for non-residential buildings.	

no	Key Implementation Decision – New Buildings	Description / value / response	Comments
		E''_{prim} / [kWh/(m^2·year)] **Offices** continental 70 littoral 70 **Educational** continental 65 littoral 60 **Hospitals** continental 300 littoral 300 **Wholesale and retail trade services** continental 450 littoral 280	
02.04	Requirements for energy performance of non-residential public buildings in current building code	**Educational** continental 65 littoral 60 **Hospitals** continental 300 littoral 300 **Sports facilities** continental 400 littoral 170 **Other types** continental 150 littoral 100	
02.05	Is the performance level of nearly zero energy (NZEB) for new buildings defined in national legislation?	Yes	Technical Regulation on rational use of energy and thermal protection in buildings (OG 128/2015, 70/2018, 73/2018, 86/2018, 102/2020)
02.06	Nearly zero energy (NZEB) level for residential buildings (level for building code)	E''_{prim} [kWh/(m^2·year)] **Multi-family houses** continental 80 littoral 50 **Family houses** continental 45 littoral 35	Technical Regulation on rational use of energy and thermal protection in buildings (OG 128/201570/2018, 73/2018, 86/2018, 102/2020)
02.07	Year / date for nearly zero energy (NZEB) as level for residential buildings (as indicated in 02.04)	31 December 2020	All new buildings (residential and non-residential) that are under construction must comply with the NZEB standard by 31 December 2020. The main design of the building should be prepared according to the requirements for NZEB, if application for building permit is submitted after 31 December 2019.

no	Key Implementation Decision – New Buildings	Description / value / response	Comments
02.08	Nearly zero energy (NZEB) level for all non-residential buildings (level for building code)	E''_{prim} [kWh/(m^2·year)] **Offices** continental 35 littoral 25 **Educational** continental 55 littoral 55 **Hospitals** continental 250 littoral 250 **Hotels and restaurants** continental 90 littoral 70 **Sports facilities** continental 210 littoral 150 **Wholesale and retail trade services** continental 170 littoral 150	Set in values, formula for calculation or text, for instance based on model building.
02.09	Year / date for nearly zero energy (NZEB) as level for non-residential buildings (as indicated in 02.06)	31 December 2020	All new buildings (residential and non-residential) that are under construction must comply with the NZEB standard by 31 December 2020. The main design of the building should be prepared according to the requirements for NZEBs if application for building permit is submitted after 31 December 2019. All new buildings owned or occupied by public authorities must have NZEB performance after 31 December 2018. For buildings occupied and owned by public authorities the main design of the building should be prepared according to the requirements for NZEBs if application for building permit is submitted after 31 December 2017
02.10	Are nearly zero energy buildings (NZEB) defined using a carbon or environment indicator?	No	
02.11	Is renewable energy a part of the overall or an additional requirement?	Overall	NZEB fulfils criteria for RES if at least 30% of the annual primary energy is covered from RES.
02.12	If renewable energy is an additional requirement to NZEB, please indicate level		

no	Key Implementation Decision – New Buildings	Description / value / response	Comments
02.13	Specific comfort criteria for new buildings, provide specific parameters for instance for airtightness, minimum ventilation rates	yes	The air change rate of indoor air in buildings where persons stay or work shall be at least 0.5 h-1. At the time when the building is unoccupied, an air change rate of at least 0.2 h-1 should be provided. The lowest air change rate shall be higher in individual parts of the building if necessary for the purpose of avoiding threats to hygiene and health conditions, and/or due to the use of open-flame heating and/or cooking devices. If it is not possible to ensure natural air ventilation that meets the requirements for the prescribed air quality, hybrid or mechanical ventilation should be designed. For multi-family residential buildings, airtightness requirements must be fulfilled for each apartment. For non-residential buildings, airtightness requirements must be fulfilled for the building envelope. Air permeability classification of windows, balcony doors and skylights shall comply with the requirements specified according to HRN EN 12207:2011. Indoor air comfort shall be determined by fulfilling requirements for heating, cooling, ventilation, thermal stability, indoor surface temperature, humidity, proper lighting and allowed noise. Recommended design values are determined in HRN EN 15251:2008.

Key Implementation Decision – Existing Buildings

no	Key Implementation Decision – Existing Buildings	Description / value / response	Comment
03.01	Is the level of nearly zero energy (NZEB) for existing buildings set in national legislation?	No	
03.02	Is the level of nearly zero energy (NZEB) for existing buildings similar to the level for new buildings?	Yes	The level of NZEB in set in legislation and it refers to new buildings. In order to become NZEB, an existing building undergoing renovation shall meet the same requirements set for new buildings.
03.03	Definition of nearly zero energy (NZEB) for existing residential buildings (if different from new buildings)		Definition of NZEBs for existing buildings is the same as for new buildings.
03.04	Definition of nearly zero energy (NZEB) for existing non-residential buildings (if different from new buildings)		Definition of NZEBs for existing buildings is the same as for new buildings.
03.05	Overall minimum requirements in case of major-renovation	Major renovation of a building means the renovation of a building where more than 25% of the surface of the envelope undergoes renovation. In the case of major renovation, the heat transmission coefficient of the entire building element shall fulfil the prescribed requirements. Buildings undergoing major renovation shall fulfil at least 10% of energy demand from RES which can be obtained from district or block heating based entirely or partially on energy from RES unless it is technically, functionally and economically feasible. When reconstruction covers more than 75% of the surface of the heated building envelope, requirements are set on $Q_{H,nd}$, E_{prim}, $E_{del.}$	

<table>
<tr><th>no</th><th>Key Implementation Decision – Existing Buildings</th><th>Description / value / response</th><th>Comment</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td></td><td colspan="2">E"$_{prim}$ [kWh/(m^2·year)]</td></tr>
<tr><td></td><td>cont.</td><td>litt.</td></tr>
<tr><td>Multi-family house</td><td>180</td><td>130</td></tr>
<tr><td>Family house</td><td>135</td><td>80</td></tr>
<tr><td>Offices</td><td>75</td><td>75</td></tr>
<tr><td>Educational</td><td>90</td><td>75</td></tr>
<tr><td>Hospitals</td><td>340</td><td>330</td></tr>
<tr><td>Hotels and restaurants</td><td>145</td><td>115</td></tr>
<tr><td>Sport facilities</td><td>420</td><td>215</td></tr>
<tr><td>Whole sale and retail trade services</td><td>475</td><td>300</td></tr>
<tr><td>Other types</td><td>180</td><td>130</td></tr>
</table>
</td><td></td></tr>
<tr><td>03.06</td><td>Minimum requirements for individual building parts in case of renovation</td><td>For individual parts of buildings, a maximum allowed U-value for elements of new buildings and after reconstruction of existing buildings heated to a temperature of 18˚C or more and heated between 12˚C and 18˚C in continental and littoral climate are prescribed.
<table>
<tr><td rowspan="3">Building element</td><td colspan="4">Maximum U-values</td></tr>
<tr><td colspan="4">Indoor temperature</td></tr>
<tr><td colspan="2">≥18°C</td><td><12°C</td><td><18°C</td></tr>
<tr><td></td><td>cont.</td><td>litt.</td><td>cont.</td><td>litt.</td></tr>
<tr><td>External walls</td><td>0.30</td><td>0.45</td><td>0.50</td><td>0.60</td></tr>
<tr><td>Transparent façade elements (frame)</td><td>1.60</td><td>1.80</td><td>2.50</td><td>2.80</td></tr>
<tr><td>Glazing only</td><td>1.10</td><td>1.40</td><td>1.40</td><td>1.40</td></tr>
<tr><td>Roofs</td><td>0.25</td><td>0.30</td><td>0.40</td><td>0.50</td></tr>
<tr><td>Ceilings above external air</td><td>0.25</td><td>0.30</td><td>0.40</td><td>0.50</td></tr>
<tr><td>Walls and ceilings of non-heated rooms</td><td>0.40</td><td>0.60</td><td>0.90</td><td>1.20</td></tr>
<tr><td>Floor</td><td>0.40</td><td>0.50</td><td>0.65</td><td>0.80</td></tr>
<tr><td>External doors</td><td>2.00</td><td>2.40</td><td>2.90</td><td>2.90</td></tr>
<tr><td>Wall shutter boxes</td><td>0.60</td><td>0.80</td><td>0.80</td><td>0.80</td></tr>
<tr><td>Ceilings and floors between apartments</td><td>0.60</td><td>0.80</td><td>1.20</td><td>1.20</td></tr>
<tr><td>Cupolas, light bars</td><td>2.50</td><td>2.50</td><td>2.50</td><td>2.50</td></tr>
<tr><td>Windshields</td><td>3.00</td><td>3.00</td><td>3.00</td><td>3.00</td></tr>
</table>
</td><td>Maximum U-Value</td></tr>
</table>

<table>
<tr><th>no</th><th>Key Implementation Decision – Existing Buildings</th><th>Description / value / response</th><th>Comment</th></tr>
<tr><td>03.07</td><td>National targets for renovation in connection to Long Term Renovation Strategy (number or percentage of buildings)</td><td>
<table>
<tr><th></th><th>2030</th><th>2040</th><th>2050</th></tr>
<tr><td>total renovated buildings</td><td>30,838,830</td><td>41,063,535</td><td>32,099,102</td></tr>
<tr><td>renovated residential</td><td>20,171,751</td><td>26,966,267</td><td>21,117,537</td></tr>
<tr><td>average annual renovation rate residential</td><td>2 %</td><td>3.5%</td><td>4%</td></tr>
<tr><td>renovated non-residential</td><td>10,667,079</td><td>14,097,268</td><td>10,981,565</td></tr>
<tr><td>average annual renovation rate non-residential</td><td>2%</td><td>3.5%</td><td>4%</td></tr>
</table>
</td><td></td></tr>
<tr><td>03.08</td><td>National targets for renovation in connection to Long Term Renovation Strategy (expected reductions and relevant years)</td><td>
<table>
<tr><th>energy consumption [PJ]</th><th>2017</th><th>2020</th><th>2030</th><th>2040</th><th>2050</th></tr>
<tr><td>services</td><td>33.5</td><td>34.6</td><td>39.2</td><td>39.5</td><td>36.8</td></tr>
<tr><td>households</td><td>99.5</td><td>98.5</td><td>96.9</td><td>83.6</td><td>68.4</td></tr>
</table>
</td><td></td></tr>
</table>

Key Implementation Decision – Energy Performance Certificates

<table>
<tr><th>no</th><th>Key Implementation Decision – Energy Performance Certificates</th><th>Description / value / response</th><th>Comment</th></tr>
<tr><td>04.01</td><td>Number of energy performance certificates per year (for instance average or values for of 3-5 years)</td><td>Number of issued EPCs in 2015/2016
<table>
<tr><th>Number/type of building</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th></tr>
<tr><td>Total</td><td>47,428</td><td>41,895</td><td>21,738</td><td>20,683</td><td>19,596</td></tr>
<tr><td>Family houses</td><td>15,202</td><td>14,427</td><td>7,151</td><td>6,333</td><td>6,221</td></tr>
<tr><td>Multi-family houses</td><td>23,940</td><td>17,418</td><td>10,712</td><td>10,553</td><td>10,299</td></tr>
<tr><td>Offices</td><td>2,568</td><td>3,489</td><td>1,505</td><td>1,115</td><td>718</td></tr>
<tr><td>Educational buildings</td><td>641</td><td>530</td><td>266</td><td>327</td><td>308</td></tr>
<tr><td>Hospitals</td><td>239</td><td>210</td><td>101</td><td>94</td><td>73</td></tr>
<tr><td>Hotels and restaurants</td><td>2,368</td><td>2,162</td><td>522</td><td>570</td><td>334</td></tr>
<tr><td>Sports facilities</td><td>159</td><td>157</td><td>90</td><td>74</td><td>67</td></tr>
<tr><td>Wholesale and retail trade service buildings</td><td>1,260</td><td>2,252</td><td>774</td><td>878</td><td>724</td></tr>
<tr><td>Non-residential buildings in which energy is used to create certain conditions of conditioning</td><td>483</td><td>928</td><td>432</td><td>531</td><td>596</td></tr>
<tr><td>Other non-residential buildings that are heated at a temperature of +18°C or higher (for example: a building for transport and communications, terminals, stations, traffic buildings, post offices, telecommunications buildings, buildings for cultural and art activities and entertainment, museums and libraries, etc.).</td><td>568</td><td>331</td><td>185</td><td>228</td><td>256</td></tr>
</table></td><td></td></tr>
<tr><td>04.02</td><td>Number of EPCs since start of scheme</td><td>EPCs for the period 2010-2020:
Total 228,902
Residential buildings 186,523
Non-residential buildings 42,379</td><td></td></tr>
<tr><td>04.03</td><td>Number of EPCs for different building types</td><td></td><td></td></tr>
<tr><td>04.04</td><td>Number of assessors</td><td>Authorised natural and legal persons for energy certification of buildings:
Total 1,275
Natural persons 649
Legal persons 626</td><td>Registration in national database is mandatory</td></tr>
</table>

no	Key Implementation Decision – Energy Performance Certificates	Description / value / response	Comment
		Authorised persons for regular inspection of heating and cooling/AC systems in buildings (included in the authorisation for energy certification of buildings): • Total 350 • Natural persons 146 • Legal persons 204	
04.05	Basic education requirements for assessors	Basic education depends on the type of authorisation. The authorisation for energy certification and energy audits of buildings with a simple technical system and buildings up to 400 m^2 shall be granted to a natural person who has: • a completed graduate university study in the field of architecture, civil engineering, mechanical engineering or electrical engineering or • a completed specialist graduate professional programme in the field of architecture, civil engineering, mechanical engineering or electrical engineering. The authorisation for energy certification and energy audits of buildings with a complex technical system shall be granted to a legal person employing at least one natural person who has: • a completed graduate university study in the field of architecture, civil engineering, mechanical engineering or electrical engineering or • a completed specialist graduate professional programme in the field of architecture, civil engineering, mechanical engineering or electrical engineering and who has during his studies achieved at least 300 ECTS credits.	Building act (OG 153/2013, 20/2017)
04.06	Additional training demands for assessors	The successful completion of the appropriate professional training programme (Module 1 and Module 2) is mandatory. Programmes are carried out by authorised institutions. Module 1 enables authorisation for energy audits and certification of buildings with a simple technical system, and Module 2 enables authorisation for energy audits and certification of buildings with a complex technical system. Module 1 has a duration of 40 hours and contains themes related to regulations, themes from the field of building physics, on heating systems, electric lighting, on the methodology of carrying out energy audits and applying computer tools. Module 2 also has a duration of 40 hours. It builds on the themes of Module 1, but with additional themes, e.g., RES, alternative energy supply systems, cooling devices, regulation and automation systems in buildings, electric lighting in buildings, public lighting, etc. Authorised persons have the obligation to attend annual programmes of skill upgrading. In Croatia, there are 11 regionally distributed institutions (faculties and professional organisations) that were granted authorisation for carrying out the training programme.	
04.07	Quality assurance system	All issued EPCs undergo administrative controls during their entry into the data base (registry). Five legal persons have been authorised to carry out detailed quality controls of the EPCs and of reports on regular inspection of heating and cooling /AC system of a building.	

no	Key Implementation Decision – Energy Performance Certificates	Description / value / response	Comment
04.08	National database for EPCs	Yes, the 'Information system of energy certification (IEC)' is an application for issuing, storing and controlling energy certificates, reports on energy inspections of buildings, as well as reports on regular inspections of heating and cooling or air conditioning systems in buildings. The IEC contains a database of energy certificates, reports on energy inspections of buildings, reports on regular inspections of heating systems and cooling or air conditioning, as well as persons authorised to perform building energy certifications and audits and persons authorised to control and implement training programmes.	
04.09	Link to national information on EPCs / Database	https://eenergetskicertifikat.mgipu.hr/login.html	

Key Indicators & Decisions – Smart Buildings and Building Systems

no	Key Implementation Decision – Smart Buildings and Building Systems	Description / value / response	Comment
05.01	Is there a national definition of smart buildings?	No	
05.02	Are there current support systems for smart buildings?	No	
05.03	Are there currently specific requirements for technical building systems (for instance in building codes)?	Yes	Technical Regulation on energy savings and thermal protection in buildings (OG 128/2015, 70/2018, 73/2018, 86/2018, 102/2020).
05.04	Are there current requirements for automatics (for instance in building codes)?	Yes	Technical Regulation on energy savings and thermal protection in buildings (OG 128/2015, 70/2018, 73/2018, 86/2018, 102/2020).
05.05	Chosen option A or B for heating systems (inspection or other measures)	A	
05.06	Number of heating inspections; reports per year (if option A)	94	Reports are registered in the database IEC
05.07	Chosen option A or B for cooling systems (inspection or other measures)	A	
05.08	Number of air-conditioning / cooling system inspections; reports per year (if option A)		
05.09	Is there a national database for heating inspections?	Yes	Information system of energy certification (IEC)
05.10	Is there a national database for cooling / air-conditioning inspections?	Yes	Information system of energy certification (IEC)
05.11	Are inspection databases combined with EPC databases for registration of EPCs and inspection reports?	Yes	Information system of energy certification (IEC)
05.12	Link to national information on Inspection / Database	https://eenergetskicertifikat.mgipu.hr/login.html	

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