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# Energy efficiency in buildings

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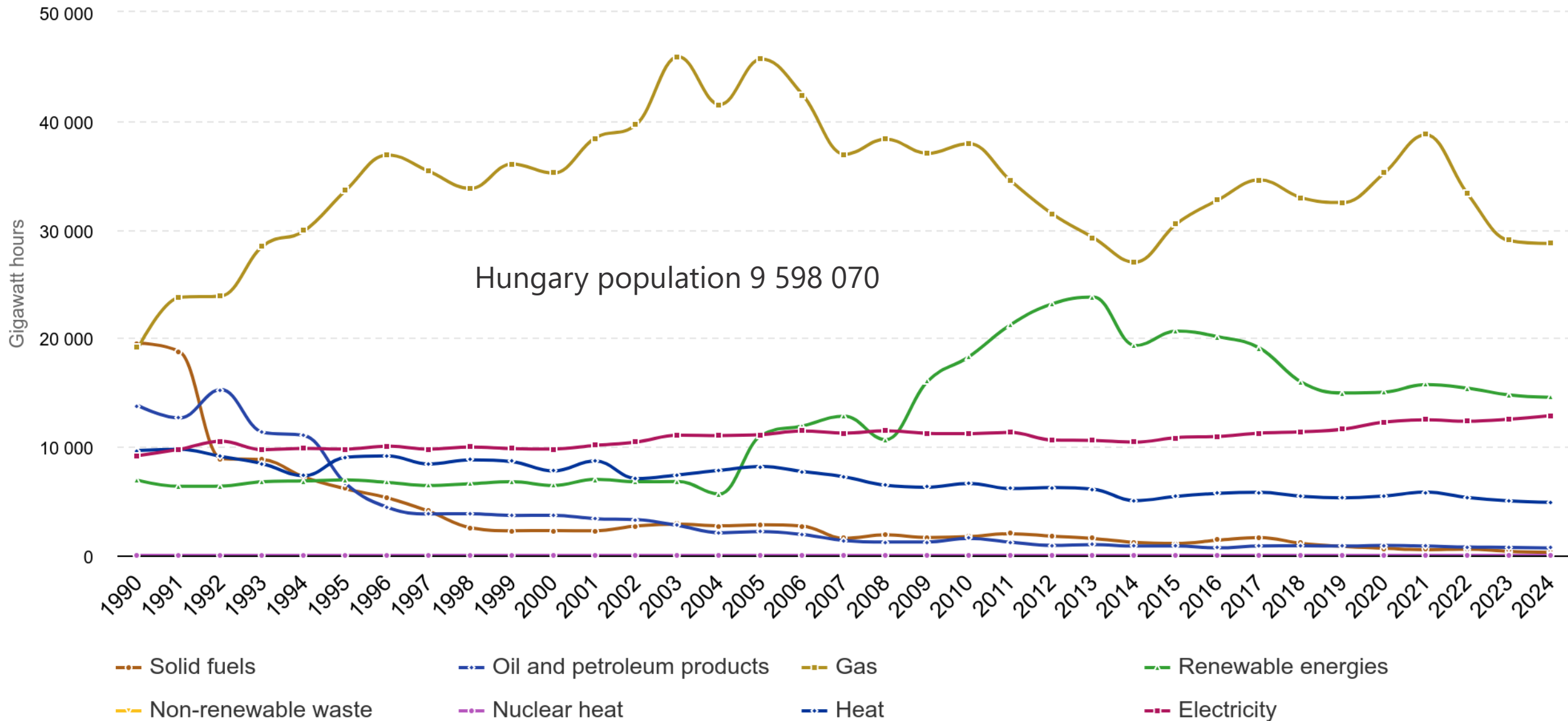
Energy efficiency in buildings involves using less energy to achieve the same level of comfort and functionality. This approach not only lowers energy costs but also reduces greenhouse gas emissions, contributing to environmental sustainability.

**Achieving technical optimum with acceptable financial outlay.**

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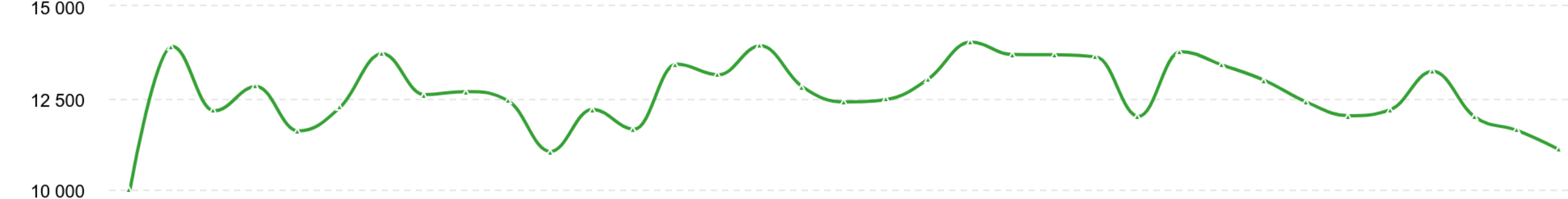
# Fuels going into households

Country: Hungary; Unit: gigawatt hours

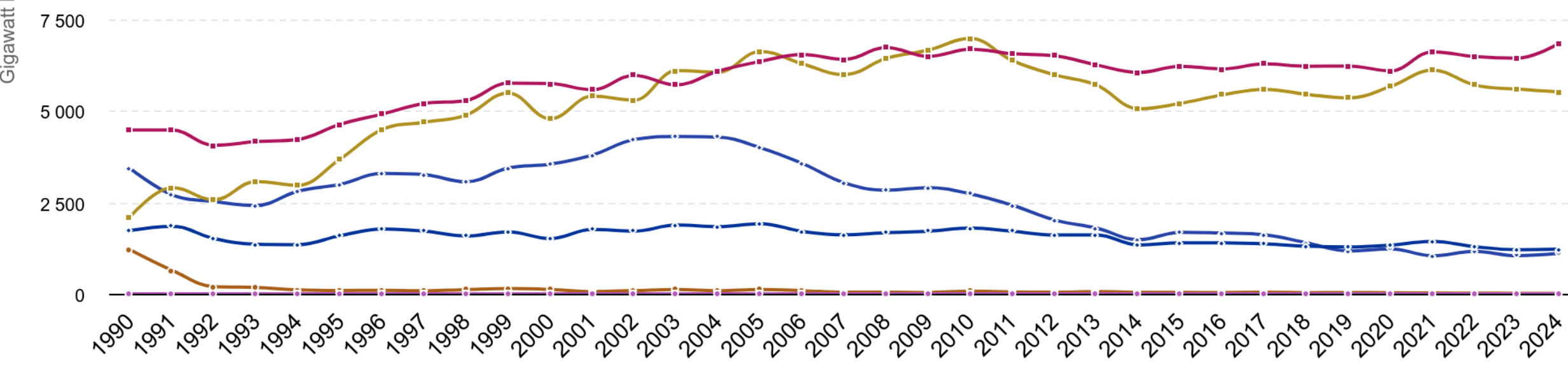


# Fuels going into households

Country: Croatia; Unit: gigawatt hours



Croatia population 3 827 004



# Energy Performance Indicator – EnPI

## Energy Efficiency Indicator - EEI

Final energy consumption	GWh	GWh	MWh/p.c.	MWh/p.c.
	Croatia	Hungary	EnPI - CRO	EnPI - HU
Households	25 749	61 958	6.73	6.46
Commercial	9 159	19 001	2.39	1.98
Agriculture	2 845	6 275	0.74	0.65
Fishing	240	38	0.063	0.004
Industry	13 458	48 348	3.52	5.04
Transport	31 953	57 074	8.35	5.95
Population	3 827 004	9 598 070		

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**Insulation:** Proper insulation minimizes heat loss in winter and heat gain in summer, reducing the need for heating and cooling.

**Heating and Cooling Systems:** Energy-efficient HVAC systems use less energy while maintaining comfortable indoor temperatures.

**Appliances and Lighting:** Utilizing energy-efficient appliances and LED lighting can significantly decrease energy consumption.

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## Strategies for Improving Energy Efficiency

- Conduct Energy Audits
- Energy renovation of buildings
- Install more Energy-Efficient Systems
- Use Smart Technology
- Incorporate Renewable Energy

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Energy Performance of Buildings Directive, the EU's key legislation promoting energy efficiency in buildings to cut emissions and energy use.

EPBD (2002/91/EC): required energy performance certificates (EPCs) for new buildings by 2006

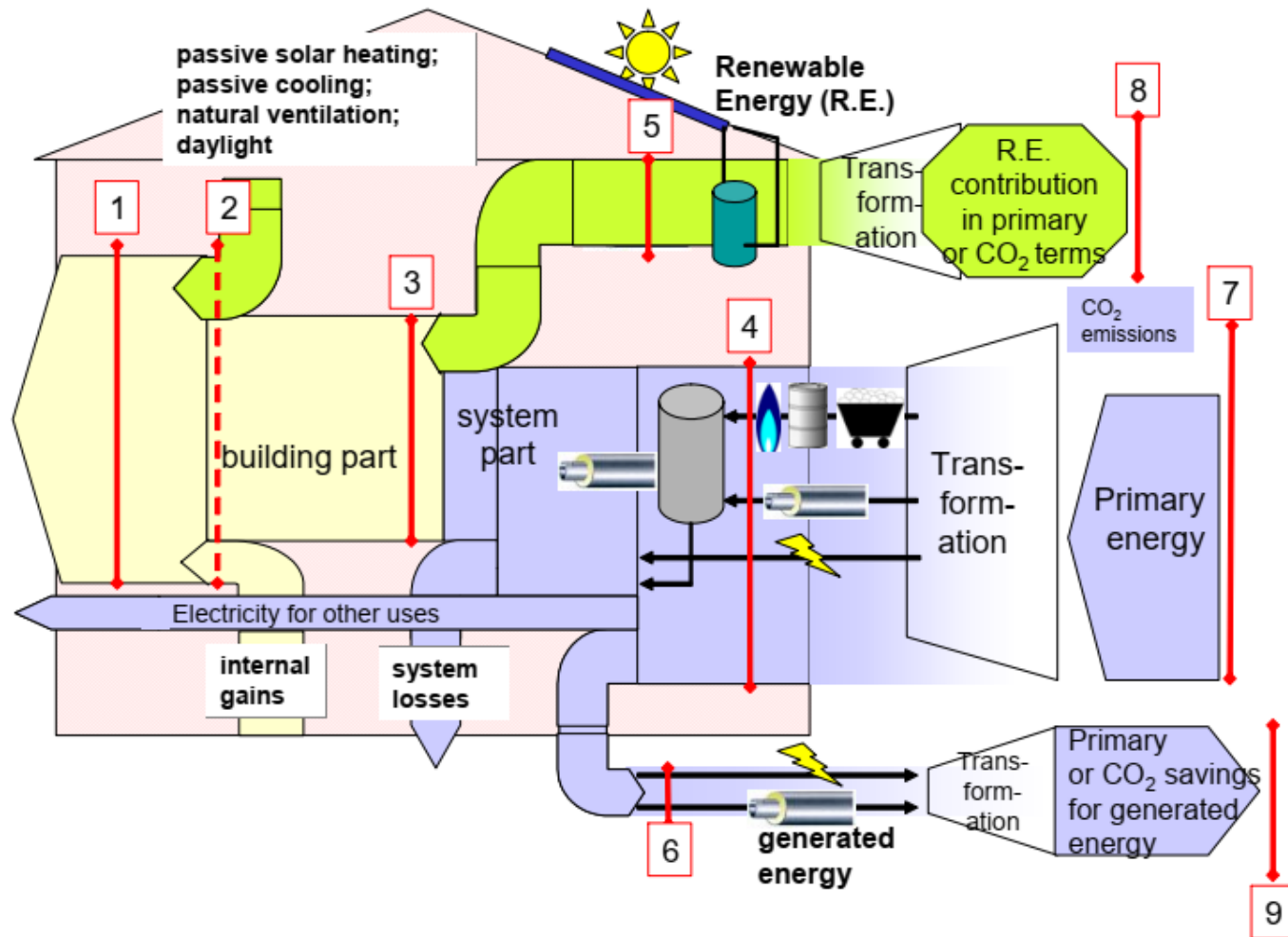
Recast 2010 (2010/31/EU): Expanded to nearly zero-energy buildings (nZEB) by 2020.

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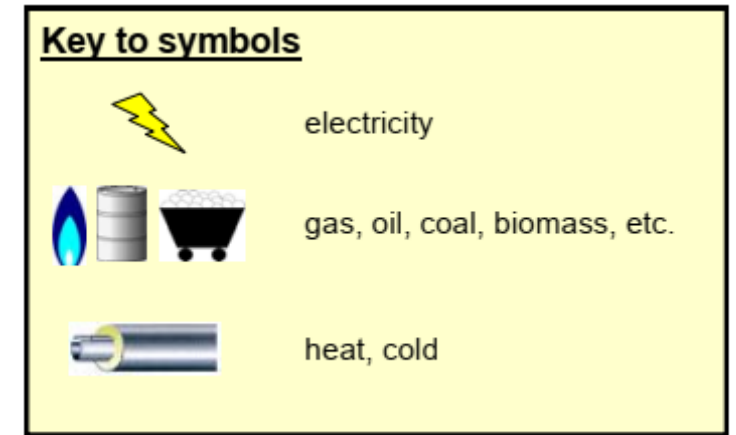
2018 amendments: Part of Clean Energy package, focusing on renovation.

Latest (2024/1275): Entered force May 2024; targets zero-emission buildings by 2050, with transposition deadline May 2026. Mandates renovations for worst-performing assets (16% non-residential by 2030)

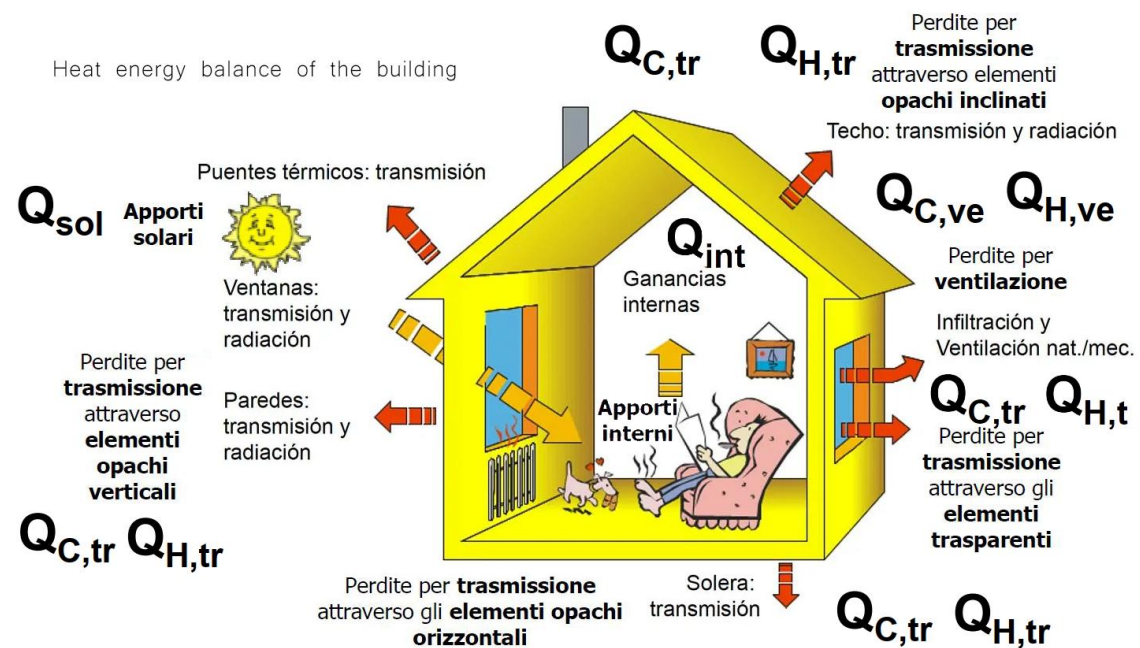
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- [1] is the energy needed to fulfil the user's requirements for heating, lighting, cooling etc, according to levels that are specified for the purposes of the calculation.
- [2] is the "natural" energy gains – passive solar, ventilation cooling, daylighting, etc. together with internal gains (occupants, lighting, electrical equipment, etc)
- [3] is the building's net energy use, obtained from [1] and [2] along with the characteristics of the building itself.
- [4] is the delivered energy, represented separately for each energy carrier, inclusive of auxiliary energy, used by heating, cooling, ventilation, hot water and lighting systems, taking into account renewable energy sources and co-generation. This may be expressed in energy units or in units of the energyware (kg, m<sup>3</sup>, kWh, etc).
- [5] is renewable energy produced on the building premises.
- [6] is generated energy, produced on the premises and exported to the market; this can include part of [5].
- [7] represents the primary energy usage or the CO<sub>2</sub> emissions associated with the building.
- [8] represents the primary energy or emissions associated with on-site generation that is used on-site and so is not subtracted from [7].
- [9] represents the primary energy or CO<sub>2</sub> saving associated with exported energy, which is subtracted from [7].



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Ministry of Environmental Protection, Spatial Planning and Construction	
Methodology For Conducting Energy Inspection of Building 2009	91 pages
Methodology For Conducting Energy Audit Building - 2012	85 pages
Methodology For Conducting Energy Audit Building - 2014	97 pages
Methodology For Implementing The Energy Audit of Buildings 2017	359 pages
Methodology For Conducting Energy Audit Building 2021	444 pages

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## Energy audits -- Part 1: General requirements (EN 16247-1:2012)

This European standard specifies the requirements, common methodology and deliverables for energy audits. It applies to all forms of establishments and organisations, all forms of energy and uses of energy, excluding individual private dwellings.

This European standard covers the general requirements common to all energy audits. Specific energy audit requirements will complete the general requirements in separate parts dedicated to energy audits for buildings, industrial processes and transportation.

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## Energy audits -- Part 2: Buildings (EN 16247-2:2022)

This document is applicable to specific energy audit requirements in buildings. It specifies the requirements, methodology and deliverables of an energy audit in a building or group of buildings. It is applied in conjunction with, and is supplementary to, EN 16247 1, Energy audits - Part 1: General requirements. It provides additional requirements to EN 16247 1 and is applied simultaneously. If processes are included in the scope of the energy audit, the energy auditor can choose to apply EN 16247 3, Energy audits - Part 3: Processes. If on-site transport on a site is included in the scope of the energy audit, the energy auditor can choose to apply EN 16247 4, Energy audits - Part 4: Transport.

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## Energy audits -- Part 3: Processes (EN 16247-3:2022)

This document specifies the requirements, methodology and deliverables of an energy audit within a process. These consist of:

- a) organizing and conducting an energy audit;
- b) analysing the data from the energy audit;
- c) reporting and documenting the energy audit findings.

This part of the standard applies to sites or parts of sites where a significant part of the energy use is due to processes. It is used in conjunction with and is supplementary to EN 16247-1, Energy audits - Part 1: General requirements. It provides additional requirements to EN 16247-1 and is applied simultaneously.

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## Energy audits -- Part 4: Transport (EN 16247-4:2014)

The procedures described here apply to the different modes of transport (road, rail, marine and aviation), as well as the different ranges (local to long distance) and what is transported (basically, goods and people).

This European Standard specifies the requirements, methodology and deliverables specific to energy audits in the transport sector, every situation in which a displacement is made, no matter who the operator is (a public or private company or whether the operator is exclusively dedicated to transport or not), is also addressed in this document.

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## Energy audits -- Part 5: Competence of energy auditors (EN 16247-5:2015)

This European Standard specifies the competence requirements of the energy auditor.

This European Standard can be used to specify energy auditor qualification schemes at a national level; used by organizations undertaking energy audits to appoint a suitably competent energy auditor and used by organizations, in conjunction with EN 16247-1, EN 16247-2, EN 16247-3 and EN 16247-4, to ensure a good level of quality of the energy audits.

This European Standard also recognizes that all the competence required can reside in the energy auditor or a team of energy auditors.

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New laws came into force in Croatia on January 1, 2026:  
Law on construction - Official Gazette 155/25  
Law on Spatial Planning - Official Gazette 155/25  
Law on Energy Efficiency - Official Gazette 155/25  
Law on Energy Efficiency in Buildings – OG 155/25

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PRIJEDLOG MJERA				
- prijedlog ekonomski opravdanih mjera za poboljšanje energetskih svojstava zgrade temeljem <i>Izjela o energetskom pregledu zgrade</i> - za nove zgrade se daju preporuke za korištenje zgrade vezano na ispunjenje temeljnog zahtjeva gospodarenja energijom, očuvanja topline i ispunjenje energetskih svojstava zgrade				
Redni broj	Element zgrade na koji se mjera odnosi	Opis mjera	JPP [a] <sup>4</sup>	
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
Opis preporučene kombinacije mjera za poboljšanje energetskih svojstava zgrade		Potencijal razreda ( $E_{pot}$ ) <sup>5</sup>	Potencijal smanjenja CO <sub>2</sub> [t/a] <sup>6</sup>	JPP [a] <sup>4</sup>
DETALJNIJE INFORMACIJE (uključujući one koje se odnose na troškovu učinkovitost prijedloga mjera ili preporuka)				

<sup>4</sup> Jednostavni period povrata investicije izračunat za stvarne klimatske podatke i stvarni režim korištenja prostora i rada tehničkih sustava, izražen u godinama  
<sup>5</sup> potencijal razreda za referentne klimatske podatke i algoritmom propisan režim korištenja prostora i rada tehničkih sustava, izražen u  $E_{pot}$   
<sup>6</sup> potencijal smanjenja CO<sub>2</sub>, izračunat za stvarne klimatske podatke i stvarni režim korištenja prostora i rada tehničkih sustava, izražen u tonama u godini

OBJAŠNJENJE SADRŽAJA ENERGETSKOG CERTIFIKATA	
<b>Općenito</b>	Energetski certifikat je certifikat iz kojega je vidljivo energetsko svojstvo zgrade ili samostalne uporabne cjeline zgrade izračunato u skladu sa Metodologijom provođenja energetskog pregleda zgrade. Energetski certifikat daje i prijedlog ekonomski opravdanih mjera za poboljšanje energetskih svojstava zgrade radi smanjenja potrošnje energije. Zgrade se klasificiraju u jedan od ukupno 9 energetskih razreda (A+, A, B, C, D, E, F, G), gdje A+ označava energetski najpovoljniji, a G energetski najnepovoljniji razred. Rok važenja energetskog certifikata je 10 godina. Energetski certifikat se odnosi na zgradu u cjelini ili na samostalnu uporabnu cjelinu.
<b>Prva stranica</b>	Navode se osnovni podatci o zgradi. Za promatranu zgradu navedene su vrijednosti <i>specifične godišnje potrebne toplinske energije za grijanje</i> $Q_{t,ud}$ [kWh/(m <sup>2</sup> a)] i <i>specifične godišnje primarne energije</i> $E_{tot}$ [kWh/(m <sup>2</sup> a)] izračunate prema <i>Algoritmu za izračun energetskih svojstava zgrade</i> za referentne klimatske podatke i Algoritmom propisan režim korištenja prostora i rada tehničkih sustava (npr. propisana unutarnja proračunska temperatura u sezoni grijanja/hlađenja, standardno razdoblje korištenja, propisano vrijeme rada sustava grijanja/hlađenja/ventilacije/klimatizacije/rasvjeta), na temelju kojih se određuju dva energetska razreda promatrane zgrade, grafički prikazani u strelicama. Referentni klimatski podatci su klimatski podatci za meteorološke postaje preuzete kao karakteristične za područje kontinentalnog i za područje primorskog dijela Hrvatske. Stvarni klimatski podatci su klimatski podatci dobiveni statističkom obradom prema meteorološkoj postaji najbližoj lokaciji zgrade. Godišnja potrebna toplinska energija za grijanje $Q_{t,ud}$ [kWh/a] je računski određena količina topline koju sustavom grijanja treba tijekom jedne godine dovesti u zgradu za održavanje unutarnje projektne temperature u zgradi tijekom razdoblja grijanja zgrade. Godišnja primarna energija $E_{tot}$ [kWh/a] je računski određena godišnja energija iz obnovljivih i neobnovljivih izvora koja nije podvrgnuta niti jednom postupku pretvorbe. nZEB (nearly Zero-Energy Building - zgrada gotovo nulte energije) je zgrada koja ima vrlo visoka energetska svojstva utvrđena u skladu s <i>TRUJETZZ</i> <sup>7</sup> . Navodi se podatak je li zgrada ima status pojedinačno zaštićenog kulturnog dobra (Z) ili se nalazi unutar zaštićene kulturno-povijesne cjeline (C). Navedena vrijednost specifične godišnje emisije CO <sub>2</sub> [kg/(m <sup>2</sup> a)] izračunata je za stvarne klimatske podatke i Algoritmom propisan režim korištenja prostora i rada tehničkih sustava, te grafički prikazana. Navodi se datum izdavanja i datum važenja certifikata, te podatci o osobama koje su sudjelovale u izradi energetskog certifikata. Ukoliko se radi o zgradi sa složenim tehničkim sustavom, u provedbi energetskog pregleda i izradi energetskog certifikata moraju sudjelovati sve tri struke.
<b>Druga stranica</b>	Navode se izračunate vrijednosti koeficijenta prolaska topline pojedinih građevnih dijelova zgrade za pretežite građevne dijelove zgrade (najvećih ukupnih ploština) i pripadajuće vrijednosti najvećih dopuštenih koeficijenata prolaska topline propisane u <i>TRUJETZZ</i> <sup>7</sup> . Ovisan je tehnički sustav zgrade (grijanje, priprema potrošne tople vode, hlađenje, ventilacija, obnovljivi izvori energije, sustav automatizacije i upravljanja zgradom, sustav samoregulacije), podatak o ugrađenosti dizala, te su navedene vrijednosti proračunskih parametara izračunatih u sklopu energetskih potreba zgrade za referentne i stvarne klimatske podatke. Godišnja potrebna toplinska energije za hlađenje $Q_{t,hl}$ [kWh/a] je računski određena količina topline koju sustavom hlađenja treba tijekom jedne godine odvesti iz zgrade za održavanje unutarnje projektne temperature u zgradi tijekom razdoblja hlađenja zgrade. Godišnja potrebna energija za rasvjetu $E_r$ [kWh/a] je računski određena količina godišnje potrebne energije za unutarnju rasvjetu što uključuje potrebnu energiju za osvjetljavanje prostora, te parazitne gubitke na sustavu kontrole rada rasvjeta. Godišnja isporučena energija $E_{in}$ [kWh/a] je godišnja potrebna količina energije, izražena po nositelju energije, koja se dovodi u tehnički sustav u zgradi kroz granicu sustava kako bi se zadovoljile potrebe za grijanjem, hlađenjem, ventilacijom i klimatizacijom, potrošnom toplom vodom i rasvjetom.
<b>Treća stranica</b>	Na kraju stranice se navodi podatak o proizvodnji obnovljive energije (električne i toplinske) na lokaciji zgrade. Navodi prijedlog mjera za povećanje energetskih svojstava zgrade s prikazom jednostavnog perioda povrata investicije JPP u godinama za svaku predloženu mjeru. Za preporučenu kombinaciju mjera za poboljšanje energetskih svojstava zgrade, koja se u konačnici predlaže, istaknut je potencijal energetskog razreda ( $E_{pot}$ ), godišnji potencijal smanjenja emisije CO <sub>2</sub> i jednostavni period povrata investicije JPP u godinama.

<sup>7</sup> Tehnički priručnik o racionalnoj uporabi energije i toplinskoj zaštiti u zgradama

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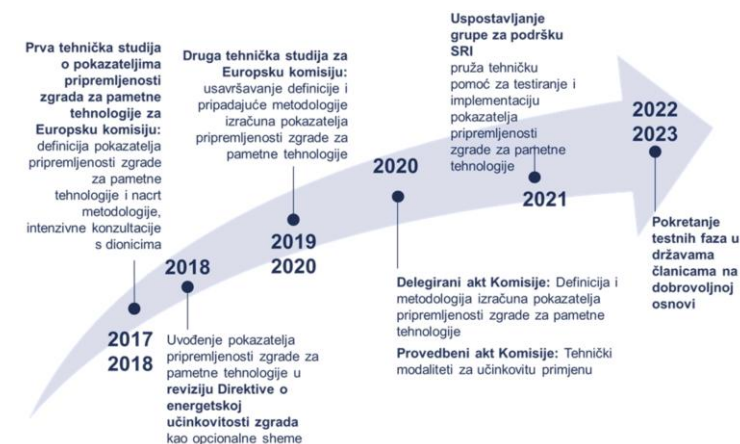
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## Smart Readiness Indicator

The smart readiness indicator (SRI) is a Commission initiative under the Energy Performance of Buildings Directive that measures a building's ability to use smart technologies.

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Member States are to introduce a scheme for renovation passports by 29 May 2026 (Article 12(1) of the recast EPBD), in line with the transposition deadline of the Directive.

Renovation passports should target deep renovation – the ultimate goal of the renovation journey and therefore of the tailored roadmap is to transform the building into a nearly zero-energy building (before 1 January 2030) or a zero-emission building (after that date).

Annex VIII to the recast EPBD:

1. list of the elements that renovation passports must include (mandatory elements), for instance a graphical representation or graphical representations of the renovation roadmap and its steps for a staged deep renovation;
2. list of the elements that renovation passports may include (optional elements), for instance information on how to access a digital version of the renovation passport;
3. the requirement to consider the information contained in the energy performance certificate of the building or building unit for which a renovation passport is issued, where possible, in order to assess the status of the building or building unit prior to renovation;
4. the requirement to rely on a set of standard conditions for the metrics used for estimating the impact of renovation steps.

# Thank you for your attention!



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