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EPBD and EU-Policy


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Focus on EPBD and EU policy

After the publication of EPBD-2024 many actions started. The EU Commission organised the preparation of EPBD guidance documents and delegated acts as mentioned in the EPBD. Guidance documents that should help the Member States and their national stakeholders to interpret the EPBD in a correct way. EU directives are policy documents which content is a compromise agreed by MS's, European Parlement, EU Council and Commission. This process doesn't guarantee a fully unambiguous text that also should be fully in line with the EPB standards. It is therefore very relevant that the EPBD mentioned that further guidance documents and delegated acts must be developed to support correct implementation in the MS's.

The EPBD allows MS's a level of flexibility in implementing the EPBD via their national regulation, the subsidiarity principle*. This is also facilitated by the current set of EPB standards (the annex A/B approach). The building and HVAC industry needs an EU harmonised approach in assessing the energy performance of buildings and the impact of their products and systems on the assessed EP. Their products and systems shall be awarded in the same way throughout Europe and beyond, if not, artificial barriers of trade will cause higher prices and less cost-effective energy saving measures. As cost-effectiveness is mentioned in the EPBD this is a real concern.

It is expected that this summer 2025 all EPBD guidance documents will be published by the EU Commission. These documents aim to provide guidance to MSs on the transposition of the EPBD. Contributing to better understanding and to facilitating a more uniform and coherent application in EU. Guidance documents reflect also the result of the communication on interpretation issues between the Commission, MS's and relevant experts and stakeholders. Ms's may publish national guidelines to support their national implementation. These guidelines are expected to be developed in cooperation with national stakeholder groups. REHVA EUPAG group could help the REHVA members to support a harmonised approach.

In this REHVA Journal attention is given to issues that are expected to be covered by these guidance documents. Articles on Zero Emission Buildings (ZEB) and IEQ, on phasing our fossil fuel boilers which seems not that straight forward. The application of Low Temperature Heating systems and how it improves the HP system efficiency. Attention is paid to subsidy schemes and EPBD and also to two new CEN Workshop Agreements (CWA's) on SRI and EPC's.

The REHVA news section includes an important article from Johann Zirngibl where he presents the REHVA EUPAG group. "European Directives and their national transpositions strongly impact the daily professional practice of HVAC professionals. These legal frameworks should take into account the competence and experience of the impacted professionals." This article reports on the activity of REHVA's new policy and advocacy support, the EUPAG group.

I sincerely hope to meet you all in Milano 4-6 June at our CLIMA 2025 conference on decarbonized, healthy and energy conscious buildings in future climates. ■

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* See: https://en.wikipedia.org/wiki/Subsidiarity_(European_Union). Given the fact that the EPBD is strongly related to the EU Environmental Policy, it is debatable till what extend this subsidiarity principle should be fully respected in the case of the EPBD implementing actions.

What new Zero Emission Buildings can bring for HVAC?

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Optimal indoor environmental quality (IEQ) and measuring and control devices for monitoring and regulation of indoor air quality (IAQ) may play an important role in HVAC development. Because of complex technical nature the essence of these requirements may be difficult to understand for national regulators struggling with many other new items to be implemented. Therefore, contribution by national experts and industry can be crucial to ensure adequate implementation quality that is evident precondition for improving and optimising IEQ in future buildings.

Keywords: ZEB, IEQ, EPBD, HVAC, smart control, CO_2 sensor, DCV

EPBD implementation to national regulation should currently run in high speed because Member States shall bring into force the laws and regulations by 29 May 2026. Zero-Emission Buildings (ZEB) requirements must apply in new buildings owned by public bodies from 1 January 2028 and in all new buildings from 1 January 2030.

Capacity to react to external signals

ZEB requirements set in EPBD Article 11 have mostly indirect impact on HVAC, because energy effective systems help to achieve primary energy and operational CO_2 thresholds. However, there is a specific requirement that ZEB shall offer the capacity to react to external signals and adapt its energy use, generation or storage. Together with fossil fuel ban, this is an important opportunity for heating and cooling generation with heat pumps where the most natural external signal is the electricity price. Therefore, price-based control of heat pumps, but maybe also ventilation systems can be important to satisfy this requirement. Another option would be the battery storage that will fulfil this requirement. Depending on national implementation, HVAC may play a big role, because HVAC is always present in buildings while electric battery investments may not be so easily justified if on-site electricity generation will be self-used in the building, i.e. if there will no surplus electricity that is typical situation in non-residential buildings.

Monitoring and regulation of IAQ

Another requirement stressing the importance of smart control of HVAC is in Article 13 for Technical Building Systems. It says that "Member States shall require non-residential zero-emission buildings to be equipped with measuring and control devices for the monitoring and regulation of indoor air quality. In existing non-residential buildings, the installation of such devices shall be required, where technically and economically feasible, when a building undergoes a major renovation. Member States may require the installation of such devices in residential buildings." While must in non-residential buildings it is important to understand which ventilation and air conditioning systems are needed to satisfy this requirement. EPBD does not specify at which level, i.e. single room, larger zone or ventilation system the regulation and monitoring should be applied. Technically it would be the easiest to add one CO_2 sensor to air handling unit extract air and adjust the fan speed of supply and extract fans accordingly. It is well known that this control can compromise IAQ in occupied zones, especially if these are located at the longer end of the ductwork. Therefore, it would be important to avoid such interpretation possibility in national regulation. This can be done by experts by referring to optimal IEQ requirement in Article 5 that states "those requirements shall take account of optimal indoor environmental quality, in order to avoid possible negative effects such as inadequate ventilation…". Thus, when looking Article

13 and Article 5 together, it should be clear that central control would not be an option for IAQ regulation and monitoring. Instead, in technical language it should be said that ZEB shall be equipped with measuring and control devices as a part of a demand-controlled ventilation (DCV) system. Here we understand DCV as a general expression for any variable air volume (VAV) ventilation or more simple air flow control satisfying occupant needs.

At which level the control needs to implemented remains a question to be decided at national level. It is evident that air flow control is not cost effective in small rooms occupied by 1-2 person or for instance having lower nominal supply air flow rate than 50 L/s. In continuously occupied rooms with higher number of persons the air flow control would be natural and can be implemented with many DCV systems which may be classified as pressure-independent and pressure-dependent systems depending on the control logic. Thus, it may be expected that implementation of Article 13 will make DCV systems standard solution in non-residential buildings. However, it is well known that these dedicated systems have had many problems in practice. In many cases ductwork design with pressure loss calculations has not been complete, and there have been issues by contractors in installation and commissioning. Also, the maintenance need has been much more than expected. Therefore, it would be an issue for HVAC industry to develop more robust and reliable DCV systems that are easy to design, install, commission and operate. New thinking is needed, because current systems with high-end reputation are to be changed to mainstream standard solutions. Damper-optimized pressure dependent systems with stepless air flow control are perfect, but a lot can be done already with simple two airflow steps especially in the case of low-pressure design. Some good ideas can be found from recent REHVA publication*, **Figure 1**. Low pressure design for the final pressure drop is described in REHVA GB No 17.

In DCV systems such as in **Figure 1**, supply air diffusers should manage a wide range of airflow rates

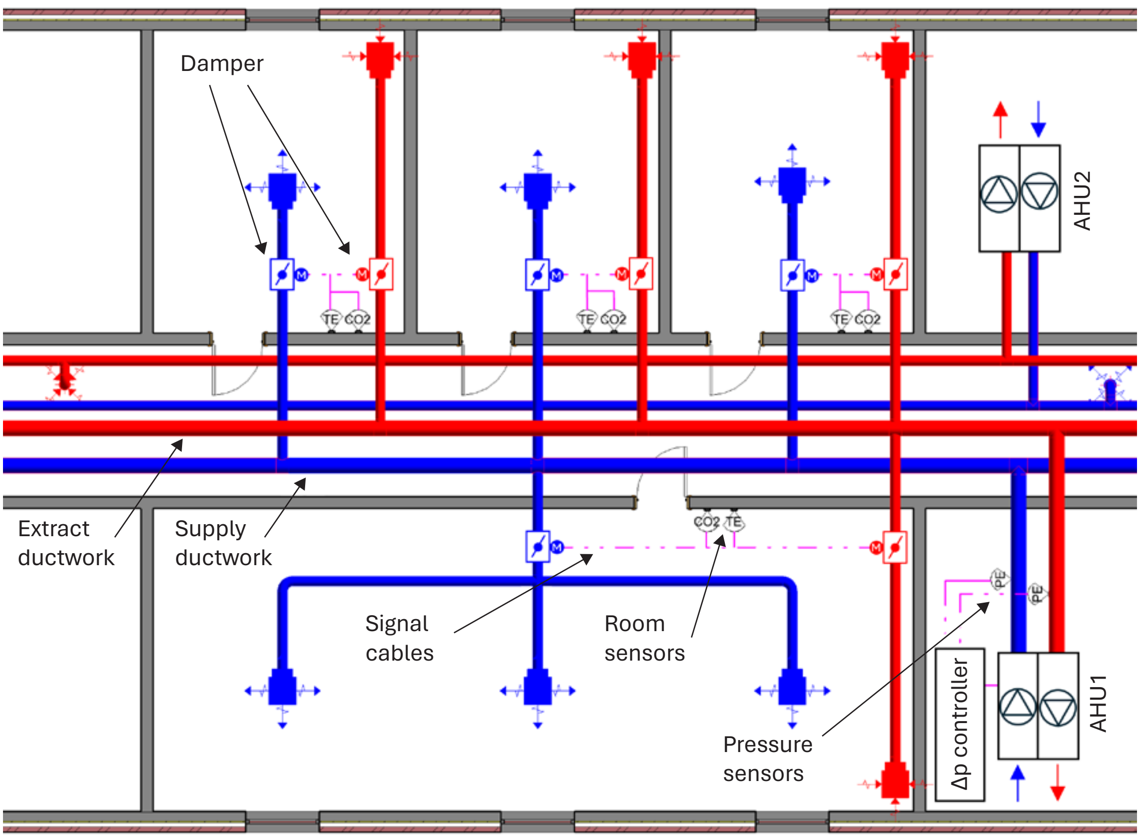

Figure 1. In pressure independent DCV system with the constant pressure control (AHU1), the fan speed is controlled to keep constant static pressure in the main ventilation duct, at the location of the pressure sensor. Dampers in each zone branch or diffuser adjust the air flow rates based on the room sensors CO_2 (and temperature) readings. Dampers may have continuous or stepwise control that should keep supply and extract air flows in balance with reasonable accuracy. AHU2 (CAV) with time control but not DCV serves toilets and corridors.

* https://www.rehva.eu/fileadmin/user_upload/2024/IEQ_Guidance_2025.pdf

so that air distribution patterns will not change too much, and draught will not be generated. For instance, active diffusers which have motorized parts for air throw length control can be used. Another option is to design the DCV system with on-off dampers so that all diffusers will have constant airflow rates. In such system the control will be less dedicated as based on switching on or off ductwork branches, **Figure 2**.

Operation for optimal IEQ

Operation for optimal IEQ is currently not addressed in standards, however it is included in ongoing revision of EN 16798-1:2019. Therefore, it might not be clear how to select relevant setpoints for CO_2 in different spaces. Here the issue is that common airflow rate sizing depends on number of occupants (7 L/s per person in Category II) and floor area (0.7 L/s per floor area in the case of low-polluting building materials). Therefore, a CO_2 value corresponding to ventilation rate of EN 16798-1:2019 perceived air quality method depends on occupant density. To calculate CO_2 setpoint corresponding for instance to Category II, first the total ventilation rate per person shall be calculated:

$$q_{sp} = \frac{q_s}{n} \tag{1}$$

where

q_{sp} total ventilation rate per person, L/(s person)

q_s design ventilation rate supplied by air distribution system, L/s

n number of the persons in the room corresponding to typical occupancy, -

Note that typical occupancy may be 50-60% of the design value and may be estimated from energy calculation usage schedules. CO_2 concentration setpoint above the outdoor CO_2 concentration can be calculated from metabolic CO_2 generation and CO_2 volume balance:

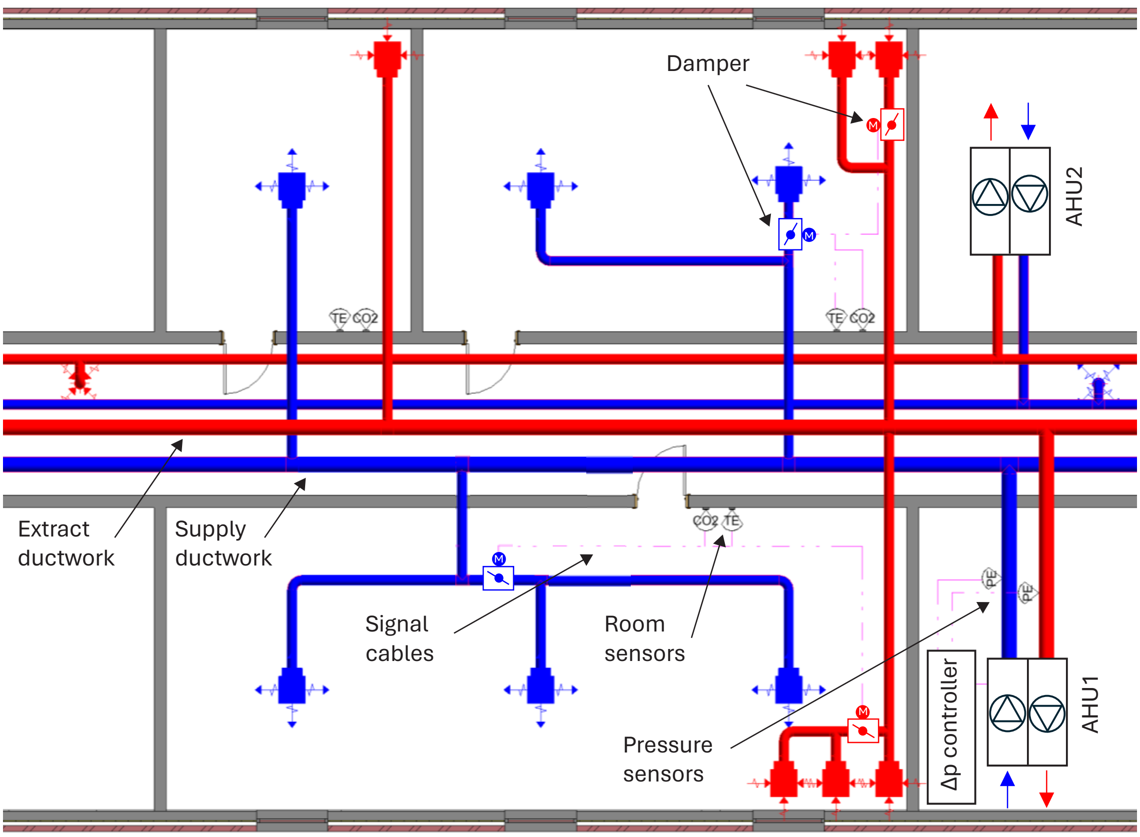

Figure 2. Pressure independent DCV system implemented with on-off dampers in larger rooms. Smaller rooms with one diffuser have constant airflow rates (CAV). Low-pressure design is recommended for main ducts** that helps to keep a constant static pressure (AHU 1). The control itself is as robust as possible, room branch dampers are just opened or closed based on the local room sensors CO_2 and temperature readings. AHU2 (CAV) with time control but not DCV serves toilets and corridors.

** See REHVA GB No 17, Designing for final pressure drop.

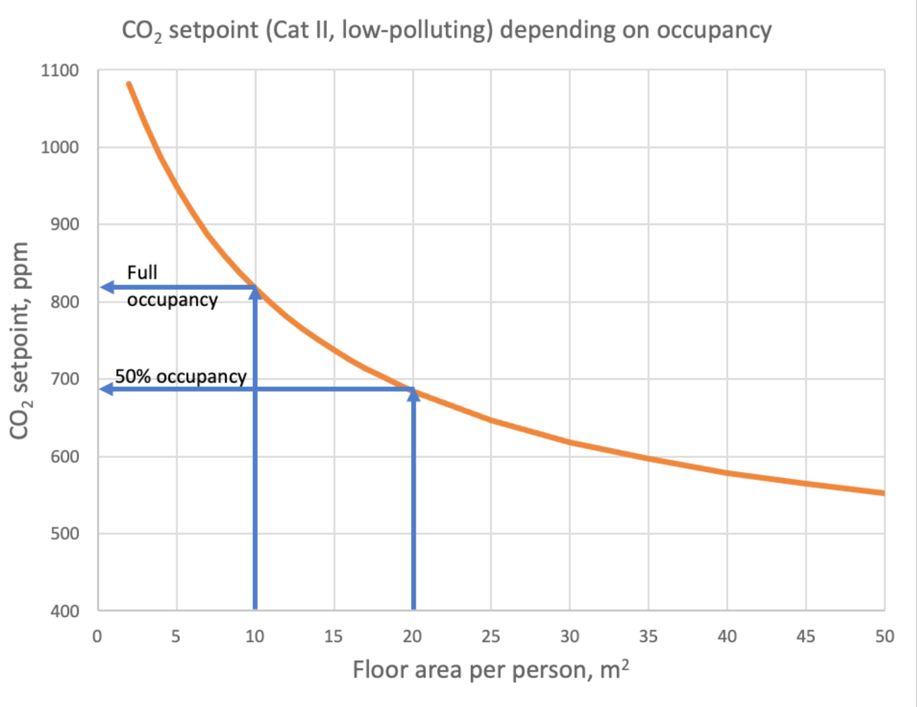

Figure 3. CO_2 setpoint depending on occupancy in typical non-residential spaces with 1.2 met activity level and 420 ppm outdoor air concentration.

$$C = \frac{q_{CO2}}{q_{sp}}\frac{1000}{3.6} \tag{2}$$

where

C — CO_2 concentration setpoint value above the outdoor CO_2 concentration, ppm

q_{CO2} — CO_2 generation rate, L/(h person)

$\frac{1000}{3.6}$ — 3600 and 10^6 are unit conversions from hour to second and litre to ppm

Figure 3 illustrates how Category II CO_2 setpoint calculated with these equations depends on occupancy in typical non-residential spaces with 1.2 met activity level.

It is also recommended to take the sensor accuracy into account. Thus, about 30-50 ppm should be reduced from values calculated with Equations (1) and (2). For instance, in offices which are designed for 10 m^2 per person floor area, CO_2 setpoint will change from 820 ppm to 685 ppm if 50% occupancy will be considered. When considering the sensor accuracy, the final setpoint should be about 640 ppm. In classrooms designed for 2 m^2 per person floor area, 50% occupancy setpoint is 990 ppm, with sensor accuracy consideration 950 ppm.

National implementation

Examples provided in previous figures illustrate technical challenge of IAQ issues. Without HVAC background these topics are not easy to understand for regulators. Therefore, HVAC experts and industry are needed to be in translator role when preparing national regulation. Otherwise, there is a risk that trajectories, minimum energy performance standards, ZEB thresholds and many other EPBD issues capture the most of effort and IEQ issues will not get necessary attention. However, high quality implementation would be a critical precondition to improve and optimise IEQ in future buildings. ■

Expert opinion formulated by Johann Zirngibl, EUPAG leader, REHVA Vice-President.

This document is a contribution to the Commission's guidance on Phasing Out Financial Incentives for Stand-alone Boilers Powered by Fossil Fuels https://energy.ec.europa.eu/news/commission-issues-guidance-phasing-out-financing-stand-alone-fossil-fuel-boilers-2025-2024-10-17_en. It contains a summary analysis of the Commission document and present possible interpretations for the national transposition, underlining the flexibility given to the Member States.

Contribution to Commission Guidance on Phasing Out Financial Incentives for Stand-alone Boilers Powered by Fossil Fuels

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The Commission notice provides guidance on Article 17(15) of the recast EPBD. It aims to support a better understanding of the EPBD provisions and to facilitate a more uniform and coherent application. But only the recast EPBD itself has legal force. The Member States have flexibility to interpret and specify the EPBD provisions within the legal frame of recast EPBD.

Keywords: EPBD, fossil fuel boiler, CO_2 emission, bio fuel boiler, heat pump.

Summary analysis of the Commission guidance proposal

The EPBD requires in Article 17(15) that "Stand-alone boiler powered by fossil fuels" should not be subsidised from January 2025 onwards. Recital 14 states that "hybrid heating systems with a considerable share of renewable energy" should still have the possibility to get financial incentives.

The Commission guidance document propose that:

- ✓ A stand-alone boiler is powered by fossil fuels, if the fuel mix in the gas grid, at the moment of installation of the boiler contains predominately fossil fuels. For off-grid boilers the Member States need to verify in a robust and credible manner that the unit will operate on renewable fuels at the time of installation and also over its lifetime.
- ✓ For hybrid heating system the considerable share of renewable energy should be defined by the Member States.

Comparison of CO_2 emission for 1 kWh energy input of the different heat generators

The CO_2 emissions of several heat generation systems are as follows (from most emitting to less emitting):

1) Boiler coal fired
Efficiency 80%, CO_2 emission 360 gCO_2/kWh (source EN ISO 52000-1): gCO_2/kWh = (1/0,805) × 360 = 450,0 gCO_2/kWh

2) Boiler oil
Efficiency 90%, CO_2 emission 290 gCO_2/kWh (source EN ISO 52000-1): gCO_2/kWh = (1/0,90) × 290 = 322,2 gCO_2/kWh

3) Boiler electrical (not covered by Article 17(15))
Efficiency 100%, CO_2 emission 251 gCO_2/kWh (source EU average 2022): gCO_2/kWh = (1/1,0) × 251 = 251,0 gCO_2/kWh

4) Boiler natural gas
Efficiency 95%, CO_2 emission 220 gCO_2/kWh (source EN ISO 52000-1): gCO_2/kWh = (1/0,95) × 220 = 231,5 gCO_2/kWh

5) Hybrid system (fossil fuel coal boiler + heat pump) with a considerable share of renewable energy (50%)
Fossil fuel coal boiler 30% of energy input, Heat pump 70%: gCO_2/kWh= 0,3 × 450,0 + 0,7 × 69,7 gCO_2/kWh= 183,8 gCO_2/kWh

6) Boiler gas mix
(50% Bio methane, 50% natural gas): gCO_2/kWh = 0,5 × 46,3 + 0,5 × 231,5 = 138,9 gCO_2/kWh

7) Hybrid system (fossil fuel gas boiler + heat pump) with a considerable share of renewable energy (50%)
Gas boiler 30% of energy input, Heat pump 70% of energy input: gCO_2/kWh = 0,3 × 231,5 + 0,7 × 69,7 gCO_2/kWh= 118,2 gCO_2/kWh

8) Heat pump electrical (not covered by Article 17(15))
Efficiency 360%, CO_2 emission 251 gCO_2/kWh (source EU average 2022): gCO_2/kWh = (1/3,6) × 251 = 69,7 gCO_2/kWh

9) Boiler bio methane
Efficiency 95%, CO_2 emission 44 gCO_2/kWh (source France): gCO_2/kWh = (1/0,95) × 44 = 46,3 gCO_2/kWh

10) Target 2050? 30 gCO_2/kWh?

Table 1 shows that the CO_2 emissions mostly depend on the energy carrier and not on the technology. The most CO_2 emitting heating device is the coal fired boiler. The 100% bio methane boiler has the lowest CO_2 emissions.

According to the Commission draft guidance document, the bio methane boiler, emitting the less CO_2 (46,3 gCO_2/kWh), might not be subsidised, whereas the electrical boiler (251 gCO_2/kWh), or a coal boiler – heat pump hybrid system 5 (183,8 gCO_2/kWh), might be subsidized.

These provisions are questionable with regards to the decarbonisation target.

The examples also show that by applying the draft Commission guidance rules with the same share of renewables (50% of minimum part of renewable energy) different CO_2 emission may be reached:

- Hybrid system
  Fossil gasboiler (30%) – Heatpump (70%): 118,2 gCO_2/kWh
- Stand-alone boilers
  Gas mix 50% renewables, 50 fossil fuel: 138,9 gCO_2/kWh
- Hybrid system
  Coal boiler (30%) – Heat pump (70%): 183,8 gCO_2/kWh

Therefore, when dealing with financing schemes, not only the part of renewables (ratio renewables / fossil fuels) should be considered, but also the CO_2 emissions.

Table 1. *CO_2 emissions of several heat generation systems in brief (from most emitting to less emitting).*

Heat generation system	CO_2 emissions, gCO_2/kWh
Boiler (coal fired)	450
Boiler (oil)	322,2
Boiler (electrical)	251
Boiler (natural gas)	231,5
Hybrid system	183,8
Boiler (gas mix)	138,9
Hybrid system	118,2
Heat pump (electrical)	69,7
Boiler (bio methane)	46,3
Target 2050?	30

How to determine the "minimum part of renewable energy" in the fuel mix?

For stand-alone boilers the draft Commission guidance states, "*Whether a gas boiler is considered as powered by fossil fuels depends on the fuel mix in the gas grid at the moment of installation of the boiler*".

If this rule is applied, only few bio methane boilers could be subsided because at this moment the % of bio methane in the gas grid is still low.

The consequence would be that the less emitting technology, and an important renewable energy source potential, would be excluded from the decarbonisation of heating systems.

In recast EPBD there is no requirement how the energy should be delivered and counted. For example, delivered via the public grid, via a dedicated distribution network, via road transport (oil, LPG), from an energy community via a contractual agreement, etc.

Article 11 (7b) states that energy from renewable sources provided from a renewable energy community are contributing to fulfil the requirement of zero emission buildings. The energy from the renewable energy community is not delivered to the end user via a dedicated grid but based on a contractual agreement. This is also the case for off-grid boilers (oil, LPG).

In some countries, e.g. Germany, the contractual agreement between the building owner and the energy supplier is admitted fulfilling the requirements on renewable fuels (e.g. the 65% of renewables requirement). In France, contractual agreements are worked out to ascertain the traceability, the sustainability over time and to avoid double counting.

The contractual agreement is in line with the draft Commission guidance stating, "*Member States need to verify whether a boiler is "powered by fossil fuels" on the basis of a robust, credible and forward-looking monitoring to ascertain that the unit operates on renewable fuels at installation and over its lifetime*". Such monitoring could be part of the regular on-site heating system inspections, bills or other types of verifications.

Comments and recommendations on the draft Commission guidance

In the following the proposed changes to the draft Commission guidance are summarized:

1) In the EPBD the term "predominantly" is not used. EPBD uses "considerable" which allows a wider interpretation of the minimum part.
   - ✓ The Commission guidance should use the term "considerable". The Member States should fix the percentage, but a preferred target value or target range (e.g. 30-60%) could be proposed in the Commission guidance. The same rule should apply to stand-alone boilers, on-grid and off-grid, hybrid systems and all energy carriers.

2) In the EPBD there is no requirement on how the renewable energy should be delivered or counted, e.g. dedicated distribution, public grid, contractual agreement (energy community, off-grid boilers, etc.). The draft guidance proposes the fuel mix in the grid, which cannot be used for off-grid boilers.
   - ✓ The Commission guidance should allow the contractual agreement for counting the delivered renewable energy in the energy share, if traceability and the sustainable use over time is ascertained and double counting is avoided. ■

Lowering System Temperatures Can Substantially Increase Beneficial Application of Heat Pumps in Existing Building Stock

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Improving building shell -insulation and airtightness is the way to go for a further reduction of the heat demand and a simultaneous increase of the seasonal efficiency of hydronic space heaters in the existing building stock of the EU27. With additional replacement of the existing emitters by low temperature emitters (LT-emitters), the seasonal efficiency of inverter-controlled full electric heat pumps can be further increased by another 30% to over 80%.

Keywords: low temperature heating, LT-emitters, heat pumps, existing building stock, energy saving.

Space heating is one of the largest energy consuming services in the existing building stock of the EU27. In 2020, 101 million central hydronic space-heaters were in use, consuming around 1 510 TWh in the same year [1]. There is a large saving potential, and application of heat pumps in the existing building stock is one of the means. But heat pumps generally require lower temperature regimes than those used for fuel boilers. Although some heat pump technologies are capable of producing higher system temperatures, further reduction of the system temperatures is very much preferred in order to achieve better seasonal efficiencies for space heating.

In existing buildings with fuel boilers, emitter-systems are dimensioned for temperature regimes of - depending on the age of the building - either 90/70°C, 80/60°C, 75/65°C or for the newest buildings 55/45°C. A temperature regime of 90/70 means that the envisaged supply temperature at the design point (i.e. –10°C for the average climate) is 90°C and the return temperature 70°C. The associated system design temperature is (90 + 70)/2 = 80°C and the associated system design ΔT = 20°C.

Only for floor heating system, lower temperature regimes are applied, but they are generally achieved by employing a mixing valve; not by lowering the temperatures coming from the boiler.

For heat pump systems, considerably lower temperatures regimes and preferably also lower ΔTs are required to maximise their seasonal efficiencies and fully exploit the energy saving potential of heat pumps. Only in newly designed dwellings with high insulation and airtightness, really low temperature regimes of around 35/30°C can be applied and combined with floor/wall heating systems.

For the existing building stock, it is essential to lower the required system temperatures and ΔTs wherever possible, to fully capitalise on the saving potential of heat pumps.

Heat Load to Emitter Capacity Ratio

The required system temperature (the temperature needed to comfortably heat the house) is determined by the ratio between Heat Load and Emitter Capacity:

HL/EC-ratio

The smaller this HL/EC-ratio, the lower the required system temperature. There are two options to reduce this ratio and consequently lower the system temperature:

1) Reduce the heat load of the room/dwelling, by improving insulation and airtightness
2) Increase emitter capacity in the rooms

Reduction of the heat load

A reduction of the heat load of the room or dwelling is the preferred option, because the benefits are twofold: 1) the actual heat demand is reduced by the improved insulation and airtightness and 2) the seasonal efficiency of the heat pump is increased because the lowered HL/EC-ratio reduces the required supply temperature. Lower supply temperatures improve the COP of the heat pump.

Improving insulation of existing dwellings and buildings is therefore the way to go, but unfortunately not in all cases an economically viable option. Filling cavity walls with insulation materials and replacing glass areas by multiple walled insulating glass are generally financially attractive measures. But when cavity walls are lacking, options for heat load reduction can become quite expensive and possibly financially unfeasible. In such cases, increasing the emitters capacity is the only remaining option.

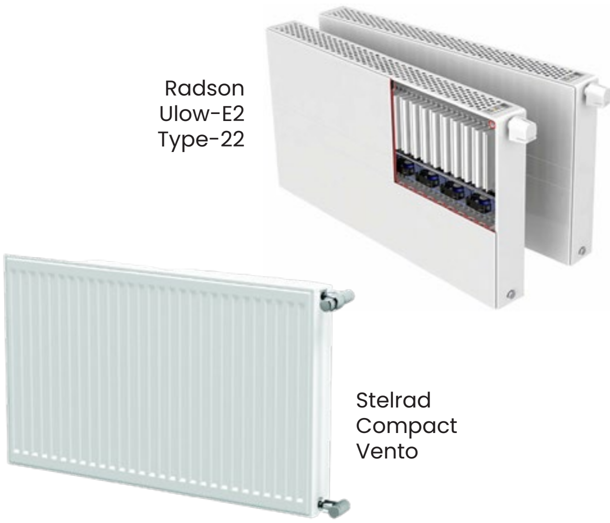
Increasing the emitter capacity

The principle here is, that the existing radiator capacity is increased to a capacity that allows a lower system temperature (preferably ≤ 40°C) at an outdoor temperature of e.g. –10°C.

An example

Let's assume a dwelling constructed in the sixties, with a heat load of 11 kW at –10°C for the whole house and a heat load of 5.5 kW for the living room where also the room thermostat is located. For this living room, two 2.0 m long type 21 steel panel radiators with a height of 50cm are needed to cover the 5.5 kW heat loss with the temperature regime of 90/70°C (system design temperature = 80°C) when combined with a flow of 120 l/h per radiator. Over the years, renovations to the building shell of this house have led to a heat load reduction of for instance 25%, bringing back the heat loss in the living room to around 4.1 kW. The same two steel panel type 21 radiators can now compensate for this 4.1 kW heat loss at a temperature regime of 76/61°C (system design temperature = 68.5°C) using the same flowrate. The room thermostat senses that the required room temperature setpoint is achieved at this lower system design temperature and prevents the boiler from further increasing the supply temperature.

When these two emitters are replaced by already existing same size LT emitters (e.g. Radson Ulow-E2 or Stelrad Compact Vento), the temperature regime will be further reduced to 59/44°C (system design temperature =51.5°C).



This option of further increasing the emitter capacity by replacing one or two of the existing emitters and consequently lowering the system temperatures, is not yet fully recognised in the replacement market. This is probably also caused by the fact that not much data is available as regards the achievable energy savings versus the related costs. Calculations show that this option in many cases is a viable efficiency measure, and sometimes even more economical than improving building shell insulation and glazing. The two new LT-emitters in the example above will cost around €2000, - and reduce the system design temperature with 17°C (from 68.5 to 51.5°C). The seasonal efficiency of a 10-kW inverter-controlled heat pump installed in this house will increase from 125% when combined with the original emitters, to 170% with the selected LT-emitters. The annual savings on energy costs will be around € 800, - resulting in a payback period of around 2.5 years.

Evidently, the existing emitter capacity can also be increased by installing bigger or more radiators. Replacing the two type-21 steel panel emitters by two almost 90-kilograms weighing same size type-33 steel panel radiators, will also result in lower system design temperatures. But generally, people prefer replacement by a similar sized or possibly smaller and lighter emitter. This is where the LT-emitter comes in.

LT-emitters are emitters that emit considerably more heat at low temperatures compared to their same-sized convectional counterparts.

LT-emitters

Several companies already manufacture and sell their version of the so called 'LT-emitter'. These products re-use the already manufactured heat-exchangers/emitters and add multiple axial low-noise fans to boost the heat output at low temperatures.

Tables 1-2 give a concise representation of the heat output at a system temperature of 40°C for some 2-meter-long conventional steel panel emitters and their similar sized LT-counterparts. The data are based on EN 442 test results and related characteristic equations, provided by the manufacturers. The tests were done with the fans switched on, producing a sound power level LwA of maximum 38 dB(A). **Table 1** lists the data for emitters with a maximum distance from front to wall between 10 and 15 cm, and **Table 2** with this maximum distance being between 15 –20 cm. The **bold** text and figures in **Tables 1-2** represent the LT-emitters. They illustrate that the similar sized LT-counterparts of conventional emitters, can deliver 40 to almost 70% more heat at low temperature.

However, **Tables 1-2** also reveal that the EN 442-tests result in higher flow rates for LT-emitters, up to 484 l/h for a single emitter. Real installations in existing dwellings however generally cannot achieve such flowrates because the pipework used to connect the emitters to the hydronic system is the limiting factor. A 15 mm diameter pipe can handle a flow of around 200 l/h without noticeable flow-generated noise. At higher flowrates, flow resistance and noise become limiting factors. Furthermore, if an existing emitter has a flowrate of for instance 130 l/h, this flowrate does not automatically change when this emitter is exchanged by an LT-emitter or a bigger emitter. These differences in test flowrates and real-life flowrate will also result in differences between measured and real-life heat-output. These effects will differ per type of heat emitters.

It is therefore recommended to adjust the related standards (EN 442, EN 16430) and apply test flowrates that are typical for pipe-dimensions predominantly used in existing installations and/or for the inlet opening and flow path area of the emitter under test.

Table 1. *Heat output at system temperature of 40°C (= mean emitter temperature) and ambient temperature of 20°C. Emitter dimensions: l = 200 cm, h = 50 cm, front-to-wall distance between 10–15 cm.*

Emitter type	W @40°C	Diff. conv. T22	Test flow [l/h]	Weight [kg]
Conventional type-21	678	−23.1%	100	48
Conventional type-22	882	0.0%	130	58
Compact Vento Type-22	**1 284**	**45.6%**	**173**	**60**
Radson Ulow-E2 Type-22	**1 262**	**43.1%**	**156**	**71**

Table 2. *Heat output at system temperature of 40°C (= mean emitter temperature) and ambient temperature of 20°C. Emitter dimensions: l = 200 cm, h = 50 cm, front-to-wall distance between 15–20 cm.*

Emitter type	W @40°C	Diff. conv. T33	Test flow [l/h]	Weight [kg]
Conventional type-33	1 226	0.0%	358	88
JAGA Strada	996	−18.8%	328	33
JAGA Strada Hybrid	**2 056**	**67.7%**	**484**	**44**

Saving potential

The saving potential of this additional option of replacing existing emitters by similar sized LT-emitters on top of economically feasible building shell renovation is huge. According to the impact assessment report accompanying the Energy Performance of Buildings Directive, around 55% of all existing dwellings hold Energy Label class E, F or G, having an average primary energy consumption for space heating of around 162 kWh/m² per year [2]. For an average sized dwelling with exactly this primary energy consumption for space heating, calculations were made to examine how big the energy saving can be when system temperatures are further reduced.

These energy saving calculations were performed with a purpose-built calculation model. See **Table 3**.

JAGA Strada Hybrid

Table 3. Calculation of achievable energy savings of a further reduction of system temperatures for an EU-average dwelling with a heated surface of 94 m² and a design heat load after already implemented building shell improvements 9 024 · 75% = 6 768 watts.

	Label Class E, F & G
Share in existing building stock	55 %
Estimated average prim. energy consumption space heating	162 kWh/m²/yr

Baseline situation

1. Dwelling			**2. Emitter system & space heater**		
Years of construction (Y.O.C.)	[-]	<1970	Design temperature regime	[°C]	90/70
Heated surface	[m2]	94	Design flowrate dwelling	[l/h]	392
Climate zone	[-]	average	Applied default emitter type	[-]	St-type 21-h50-d15
Outdoor system design temperature	[°C]	-10	Required length default emitter	[m]	6,12
Design heat load dwelling in construction year	[W]	9024	Installed emitter capacity @ system design tem	[W]	9024
Heat loss per square meter per year	kWh/m²/yr	198	Type of space heater	[-]	Cond. Boiler
			Min. boiler capacity	[W]	6000

3. Energy consumption space heating Y.O.C.			**4. Consumption since prior implemented building shell improvements**		
Load- and hours weighted supply temp.	[°C]	62,7	HL reduction due to building shell improvement	[%]	25 %
Load- and hours weighted return temp.	[°C]	52,5	Heat loss per square meter per year	kWh/m²/yr	148,5
Seasonal generator efficiency (GCV)	[%]	*90,1%*	Load- and hours weighted supply temp.	[°C]	55,6
Primary energy consumption space heating Y.O.C	kWh/m²/yr	220	Load- and hours weighted return temp.	[°C]	47,9
			Seasonal generator efficiency (GCV)	[%]	*91,5%*
			Baseline prim. energy consumption space heati	kWh/m²/yr	**162**

Improvement options

5. Boiler replaced by full electric inverter heat pump		
Capacity heat pump at system design temperatu	[W]	6000
Tbivalent heat pump	[°C]	-10
TOL	[°C]	-10
Minimum operating time + min. time-out heat pu	[min]	20
Volume CH-buffer tank if installed	[l]	0
Max. allowable flowrate for used pipe diameters	[l/h]	565
Related 'Design ΔT'	[°C]	10,4
Load- and hours weighted supply temp.	[°C]	51,6
Load- and hours weighted return temp.	[°C]	46,3
Seasonal generator efficiency	[%]	*105,6%*
Primary energy consumption space heating	kWh/m²/yr	**141**
Savings compared to baseline consumption	[%]	**13,4%**

6. Same heat pump + emitters replaced by same-size LTemitter

Heat pump specifications and flowrate similar to no. **5)**.

Additionally, existing standard type 21 emitters (height 50cm) in the reference room (living roomwhere the roomthermostat is installed), are replaced by same-size Radson ULOW E2 emitters.

Load- and hours weighted supply temp.	[°C]	41,1
Load- and hours weighted return temp.	[°C]	35,8
Seasonal generator efficiency	[%]	*154,1%*
Primary energy consumption space heating	kWh/m²/yr	**96**
Savings compared to baseline consumption	[%]	**40,6%**

The calculated savings of around 40% with existing average-performing LT-emitters and average flowrates, are already respectable. These figures include the electricity consumption of the auxiliary fans mounted on the LT-emitters (for this living room around 90 kWh per year).

With completely new LT-emitters, specifically designed to maximize the heat transfer at low temperatures and with optimized flowrates and water content for the emitter system, it is expected that in combination with heat pumps, savings can be achieved of over 80%, compared to this baseline primary energy consumption of 162 kWh/m² per year.

All in all, the energy saving potential of LT-emitters in the existing building stock is enormous and all actors (manufacturers, system designers, installers, legislative authorities, EPC-assessors, consumers etc.) are invited to move into action and help realising this potential.

Standards

EN 14825:2022 Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling, commercial and process cooling - Testing and rating at part load conditions and calculation of seasonal performance.

EN 15316-4-2: 2017 Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems, Module M3-8-2, M8-8-2. This standard is currently under revision, it is expected that a new prEN version will be published in summer 2025, a related updated excel file will become available at the EPB Center website: https://epb.center/support/overview-epb-standards/m3/.

EN 442-2:2014 Radiators and convectors - Part 2: Test methods and rating.

EN 16430-2:2014 Fan assisted radiators, convectors and trench convectors - Part 2: Test method and rating for thermal output.

References

[1] Overview report Ecodesign Impact Accounting 2024, Van Holsteijn en Kemna BV (VHK).

[2] SWD(2021) 453 final, impact assessment report accompanying the Proposal for a Directive of the European Parliament and of the Council on the energy performance of buildings (recast), Annex N, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52021SC0453. ■

Further explanation of the purpose-built calculation model:

The model calculates the seasonal efficiency of specific hydronic space heaters in dependence of the dwelling and its heat load, the emitter-system dimensioned for this heat load during year of construction, and the possible reduction of this head load due to building renovations since the year of construction. Seasonal efficiencies after all, are not solely determined by the selected space heater. They are the result of the interaction between the space heater, emitter system, heat load of the dwelling and the controls. The calculations are based on climate bins from EN 14825/July 2022 for the average climate. The calculation model incorporates a large number of parameters that can be changed, amongst which:

- The heat load the dwelling in the year of construction, and the percentage heat load reduction achieved through already implemented building shell improvements since construction
- The installed emitter capacity during year of construction and a selection of improvement options with similar sized LT-emitters
- The system flow, with options to maintain the flow based on the design temperature regime during year of construction, to maximize the flow based on pipe-diameters used and to increase pipe diameters and related flow
- The water content of the emitter system, based on selected emitters and with an option to increase the water content with CH-buffer tanks
- The type of hydronic space heater, with options for condensing boilers, hybrid inverter heat pumps and full electric inverter heat pumps, all with their specific minimum and maximum capacities in dependance of applicable climate bins; for heat pumps the minimum operating time is an additional parameter.

For each selected *'heat-load / emitter-system / space-heater / system-flow'* -combination the actual required supply- and return temperatures are calculated. It is assumed here, that the minimum required system temperature – based on the incidental heat load and installed emitter capacity - are correctly determined by the temperature control system (heating curves that are not properly set, or room thermostats that are not sophisticated enough, can impair the energy saving). Based on these values, the actual generator efficiency for each individual climate-bin is calculated. For a condensing boiler, the calculated efficiency is based on the achieved return temperature. For a heat pump, the calculated efficiency is based on the actual supply temperature and delta T, using the exergy method of the most recent version of the EN 15316-4-2 (using 2025 draft version path B). As a final step, the load- and hours weighted seasonal efficiency is calculated for the selected *'heat-load / emitter-system / space-heater / system-flow'* -combination.

Integrating Smart Readiness into Energy Performance Certification: A Unified Approach for Sustainable and Digitalized Buildings

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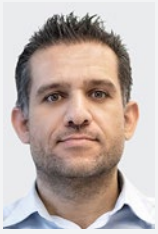

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Keywords: EPBD, EPC, SRI, certificate, GWP

Traditionally, EPCs have focused on energy efficiency, providing insights into a building's consumption patterns and compliance with sustainability targets. However, with the rise of digitalization and smart technologies, a more comprehensive evaluation is needed to reflect the evolving role of buildings in the energy system. The Smart Readiness Indicator (SRI), introduced by the European Commission, assesses a building's capability to integrate and leverage smart technologies to optimize energy use, interact with the grid, and enhance occupant comfort.

The SmarterEPC project aims to bridge the gap between energy efficiency and smart readiness assessments by proposing a joint EPC-SRI certificate. This approach ensures that building owners, policymakers, and professionals can access a single, standardized document that provides a holistic overview of a building's energy and smart performance. As the Energy Performance of Buildings Directive (EPBD IV) emphasizes the role of smart technologies in achieving EU climate targets, the integration of SRI into EPCs aligns with the European Green Deal's objectives. By combining these assessments, the joint certificate offers practical value to building professionals, investors, and regulatory bodies, enabling better decision-making for energy-efficient and future-proof buildings.

This article presents the concept, and structure of a joint EPC-SRI certificate, highlighting how SmarterEPC contributes to the ongoing evolution of energy performance assessments in Europe. The proposed approach aims to enhance transparency, usability, and compliance with EU policies, ensuring that the building sector accelerates its transition to sustainability and digitalization.

Energy Performance Certificates Under the EPBD Recast: Mandatory and Optional Elements

The EPBD recast (Directive (EU) 2024/1275) establishes a harmonized and comprehensive framework for Energy Performance Certificates (EPCs) to improve transparency, comparability, and usability across Member States. The updated requirements in Annex V ensure that EPCs provide essential and actionable information on a building's energy efficiency, environmental impact, and smart capabilities, making them a key instrument in the EU's energy transition. At a minimum, EPCs must display the energy performance class, assigned on a harmonized A-G scale, where A represents zero-emission buildings, and G corresponds to the least efficient buildings in the national stock. The document must also include calculated annual primary and final energy use, measured in kWh per square meter per year, as well as the percentage ▶

Integrated Energy Performance and Smart Readiness Certificate

Building ID University1	**Date of Assessment** 24-10-2024	**Assesor Name** Theoklitos Klitou	**Building Type** Non Residential
Building Usage Educational	**Location** Nicosia, Cyprus	**Net Floor Area** 20000m²	**Year of Construction** 2003

Building Energy Rating kWh/m²/yr

- A > 0.5
- B+ 0,51 - 0,75
- B 0,76 - 1,0
- C 1,01 - 1,50
- D 1,51 - 2,00
- E 2.01 - 2.50
- F 2.51 - 3.00
- G > 3.00

C
241
kWh/m²/yr
1.02

Reference values

• Minimum energy performance requirements	B
• Minimum energy performance standards	A
• Nearly zero-energy building requirements	A
• Zero-emission building requirements	A

Carbon Dioxide (CO^2) Emissions Indicator kgCO^2/m /yr

0 … >120

Very Environmental friendly — Not Environmental friendly

70.95 kgCO^2/m²/yr

Greenhouse gas emission class: D

Energy Use and Renewable Production

Calculated annual primary energy use in kWh/(m²y)	241
Calculated annual final energy use in kWh/(m²y)	241
Metered energy use kWh/(m²y)	310
Renewable energy produced on-site in %	0

Smart Readiness Indicator %

- A 90-100%
- B 80-90%
- C 65-80%
- D 50-65%
- E 35-50%
- F 20-35%
- G 0-20%

F
34%

Optimize Energy Efficiency and Performance
36%

Adapt to Occupant Needs
49%

Adapt to Signals from the Grid
17%

Smart Readiness Impact Criteria

Energy Efficiency	38%
Energy Flexibility and Storage	17%
Comfort	33%
Convenience	30%
Health, Well-being & Accessibility	80%
Maintenance and Fault Prediction	34%
Information to Occupants	51%

Energy Use, Production, and System Features Overview

Calculated annual primary energy use MWh/year	5,000
Calculated final energy use MWh/year	4,800
Renewable energy production (kWh)/year	0
Main energy carrier and type of renewable energy source	N/A
Calculated energy needs in kWh/(m²y)	241
React to external signals and adjust the energy use	Yes/No
Heat distribution system is capable to work at low or more efficient temperature levels	Yes/No
Renovation passport is available	Yes/No
Digital Building Logbook is available	Yes/No

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Smarter EPC

Building Envelope and Systems

Average U-value for the opaque elements (W/m²K)	2
Average U-value for the transparent elements (W/m²K)	1.5
Type of transparent elements	Double-glazed window
Number of recharging points for electric vehicles	0
Type of recharging points for electric vehicles	N/A
Energy storage systems	Yes / **No**
Type of energy storage systems	N/A
Size of energy storage systems (kWh)	0
Sensors that monitor the indoor environmental quality	**Yes** / No
Controls that respond to the levels of indoor environmental quality	Yes / **No**

Smart Readiness Technical Domain

Heating	38%
Domestic Hot Water	50%
Cooling	32%
Ventilation	N/A
Lighting	42%
Dynamic Envelope	N/A
Electricity	19%
Electric Vehicle Charging	N/A
Monitoring and Control	21%

Operational Energy Metrics

	Heating	Cooling	DHW	Ventilation	Lighting
Energy use (kWh/m²/year)	125	20	15	60	30
Peak load (kW)	2500	800	200	500	300
Energy carrier	Natural Gas/ Electricity	Electricity	Electricity	Electricity	Electricity

Detailed Smart Readiness Technical Domain and Impact Criterion Scores

	Energy Efficiency	Energy Flexibility & Storage	Comfort	Convenience	Health, Well-being & Accessibility	Maintenence & Fault Prediction	Information to Occupants	SRI
Total	38%	17%	33%	30%	80%	34%	51%	34%
Heating	38 %	20%	33%	50%	100%	25%	67%	
DHW	67 %	40%	0%	40%	0%	50%	67%	
Cooling	38 %	17%	29%	29%	37%	25%	67%	
Ventilation	-	-	-	-	-	-	-	
Lighting	33 %	0%	50%	50%	0%	0%	0%	
DE	-	-	-	-	-	-	-	
Electricity	40 %	0%	0%	0%	0%	33%	44%	
EV	-	-	-	-	-	-	-	
M&C	25%	0%	0%	29%	0%	50%	33%	

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of renewable energy produced on-site, indicating the level of reliance on clean energy sources. Furthermore, EPCs must report operational greenhouse gas emissions, expressed in kg CO_2 per square meter per year, while the life-cycle Global Warming Potential (GWP) must be included where data is available. In addition to these core indicators, EPCs must display energy needs, system efficiency, and responsiveness to external energy signals. A yes/no indication must specify whether a building has the capacity to adjust its energy use dynamically and whether the heat distribution system is capable of operating at efficient temperatures. The EPC must also provide information on the main energy carrier and include the contact details of one-stop-shop renovation advisory services, offering building owners access to guidance on energy upgrades and financial incentives.

Beyond the mandatory indicators, the EPBD recast allows Member States to include additional elements in EPCs to provide a more detailed and tailored assessment of building performance. These optional indicators enhance the practicality of the certificate, offering deeper insights into energy efficiency, environmental impact, and smart building features. One key addition is the greenhouse gas emission class, which categorizes a building's carbon footprint more clearly. EPCs may also include energy use and peak load data for heating, cooling, ventilation, and domestic hot water systems, as well as details on energy storage systems, recharging points for electric vehicles, and carbon removals linked to construction materials. The presence of indoor environmental quality sensors and smart control systems can also be reported, highlighting a building's digital readiness and occupant well-being. Additionally, EPCs can indicate whether a renovation passport or a Digital Building Logbook is available, offering long-term planning tools for improving energy performance and supporting a data-driven approach to sustainable building management

Content of the Smart Readiness Indicator Certificate Under Regulation (EU) 2020/2155

The Smart Readiness Indicator (SRI) certificate, as defined in Regulation (EU) 2020/2155, provides a structured assessment of a building's digital capabilities, focusing on its automation, control, and adaptability. This certificate conveys key information to building owners, professionals, and policymakers, ensuring a standardized evaluation of smart functionalities in the built environment. Each certificate contains a unique identifier, along with the date of issue and expiry, ensuring traceability and validity. It includes a descriptive section clarifying its scope, particularly in relation to the Energy Performance Certificate (EPC), helping users understand how smart readiness complements energy efficiency. General information about the building or building unit is recorded, including its type, surface area, year of construction or renovation, and location. If available, the energy performance class from a valid EPC is included to provide a broader perspective on both energy and smart readiness. A key feature of the certificate is the smart readiness classification, summarizing the building's overall digital and automation capabilities. This classification may be supplemented by the total smart readiness score, as well as detailed scores across the three key functionalities outlined in Annex I of the regulation: energy efficiency, responsiveness to user needs, and interaction with the energy grid.

Further breakdowns include individual scores per impact criterion, which can optionally be expanded to display technical domain-specific scores for greater granularity. Where possible, the certificate also includes details on connectivity infrastructure, such as high-speed internet readiness, and information on cybersecurity, interoperability, and data protection standards. An important clarification states that the certificate reflects the smart readiness level at the time of issuance, and any modifications to the building's systems would necessitate an update of the assessment. Where applicable, the certificate may also provide recommendations for improving smart readiness, taking into account factors such as heritage value. Finally, the certificate can include additional methodological details, such as assumptions and weighting factors used in scoring calculations, ensuring transparency in the evaluation process. This structured approach makes the SRI certificate a critical tool for advancing smart building technologies, supporting EU policies on digitalization, energy efficiency, and sustainable infrastructure.

Design of the Integrated EPC-SRI Certificate

The need for a joint EPC-SRI certificate arises from the increasing role of digitalization and smart technologies in achieving energy efficiency and climate neutrality in the building sector. While the Energy Performance Certificate (EPC) has long been the primary tool for assessing energy consumption, efficiency, and emissions, it does not account for a building's ability to optimize energy use, interact with the grid, or improve user comfort through smart technologies. Conversely, the Smart Readiness Indicator (SRI) evaluates a building's digital adaptability, but it lacks integration with quantitative energy performance metrics that are essential for compliance with the Energy Performance of Buildings Directive (EPBD) and investment decisions.

A separate evaluation of EPC and SRI leads to fragmented assessments, administrative duplication, and missed synergies between energy efficiency and smart functionalities. This separation makes it difficult for policymakers, building professionals, and property owners to understand how digital solutions can enhance energy performance and vice versa. By integrating EPC and SRI into a single, streamlined certificate, the assessment process becomes more efficient, user-friendly, and actionable, ensuring that energy efficiency and smart capabilities are evaluated together rather than in isolation. A joint certificate also improves regulatory compliance by aligning with the EPBD recast, which increasingly emphasizes smart-ready buildings as part of the EU's decarbonization strategy. It provides a completer and more transparent dataset for national authorities, ensuring that Member States can track both energy efficiency improvements and the deployment of smart solutions in buildings. Additionally, for building owners and investors, having a single certificate simplifies decision-making by presenting both energy and smart performance in a unified format, making it easier to assess the potential value, sustainability, and future-proofing of a property.

The integrated EPC-SRI certificate is structured into two main sections: the first page presents the mandatory elements, ensuring compliance with EPBD IV and SRI regulation requirements, while the second page includes non-mandatory but relevant indicators, offering additional insights that enhance decision-making.

- On the first page, the energy performance class is prominently displayed using the standardized A-G scale, accompanied by calculated annual primary and final energy consumption in $kWh/(m^2 \cdot y)$. The percentage of on-site renewable energy production is also included, reflecting the contribution of clean energy sources. Additionally, operational greenhouse gas emissions ($kgCO_2/(m^2 \cdot y)$) are reported, alongside the life-cycle Global Warming Potential (GWP) where available. The smart readiness class is presented next to the EPC score, establishing a direct connection between energy efficiency and digital capabilities. This page provides the core regulatory metrics required for compliance and comparability across EU Member States.
- The second page contains optional elements, allowing for a more detailed analysis of the building's smart features, environmental impact, and system efficiency. Here, the smart readiness score per key functionality is displayed, breaking down the building's ability to optimize energy use, respond to user needs, and interact with the grid. Additional indicators, such as connectivity infrastructure, interoperability, and cybersecurity considerations, may be included where data is available. This section also allows for detailed information on technical domains, indoor air quality sensors, electric vehicle charging infrastructure, and energy storage systems. Where applicable, recommendations for improving both energy efficiency and smart readiness are outlined, helping building owners and professionals plan strategic upgrades.

Advancing Building Performance Through Integration

The integration of the Energy Performance Certificate (EPC) and the Smart Readiness Indicator (SRI) represents a major step forward in how buildings are assessed, ensuring a more holistic, data-driven approach to energy performance and digitalization. This structured and standardized approach simplifies regulatory compliance, improves comparability across Member States, and provides building owners, investors, and professionals with a single, comprehensive tool to guide renovations and investments. The modular design ensures flexibility for national adaptations while maintaining harmonized core elements in line with EPBD IV and SRI regulations. By bridging the gap between energy efficiency and smart functionalities, the joint EPC-SRI certificate promotes the adoption of intelligent technologies, making buildings more resilient, efficient, and future-ready. This integration marks a crucial milestone in the transition toward a more sustainable and digitalized European building stock, fully supporting the EU's climate and energy objectives.

Acknowledgment

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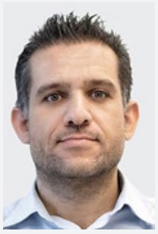
Standardizing On-Site SRI Audits: A Step Forward in Smart Building Implementation



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Keywords: CEN, CWA, SRI, EPBD, energy audit, BMS.

Europe's buildings are becoming smarter, not just in design but also in how they operate. As digitalisation becomes increasingly central to energy and climate policy, the Smart Readiness Indicator (SRI) has emerged as a promising tool for assessing how well buildings are equipped to deploy intelligent technologies. First introduced through the Energy Performance of Buildings Directive (EPBD), the SRI serves as a metric to evaluate how capable a building is in optimising energy efficiency, responding to occupant needs, and interacting with the energy grid.

Although the conceptual framework for the SRI has been developed at EU level, the absence of a harmonised, on-site methodology remained a barrier to practical deployment. This challenge has now been addressed with the publication of CEN Workshop Agreement CWA 18193:2025*, a voluntary standard defining how on-site SRI audits should be performed in a structured and repeatable manner. The agreement is a result of collaborative work conducted under the **LIFE-funded Smart Square project**, which aimed to align the SRI with existing energy audit practices while bringing it closer to market reality.

Building on Familiar Ground: The EN 16247 Audit Structure

Rather than create an entirely new system for smart readiness assessments, the workshop behind the CWA chose to base its methodology on the well-established energy audit standard **EN 16247**. This strategic decision ensures that energy auditors and building professionals who are already familiar with traditional auditing practices can easily transition into conducting SRI audits.

While EN 16247-2 focuses on identifying inefficiencies in energy consumption and proposing concrete improvements, the SRI audit is less about measuring current energy use and more about evaluating a building's capacity to host and coordinate smart-ready services. These include, for example, automated heating control, predictive ventilation, dynamic lighting systems, or integration with local renewable energy and grid signals.

The two audit types have overlapping steps, such as initial contact with the client, data gathering, site visits, analysis, and final reporting. However, the SRI audit excludes detailed energy measurements or sampling methods and instead centres on examining automation, user control, interoperability, and technological responsiveness of systems.

A Step-by-Step Framework for On-Site SRI Audits

The CWA outlines a clear and logical sequence of actions for auditors to follow. The process begins with preliminary contact, where the objectives and scope of the SRI assessment are defined. At this stage, the auditor and building stakeholders agree on the level of detail required and the timeframe for implementation.

* https://www.cencenelec.eu/media/CEN-CENELEC/CWAs/RI/2025/cwa18193_2025.pdf

The second step involves a start-up meeting, which provides an opportunity to designate responsibilities, agree on site access arrangements, and ensure that all necessary technical documentation is available. These preparatory stages are essential to establish a common understanding between all involved parties.

Following this, the auditor moves into the data collection phase. Here, the emphasis is placed on acquiring operational and technical information related to the building's automation and control systems. Sources include system drawings, maintenance records, building management system (BMS) outputs, and any existing energy performance certificates. This documentation is crucial to form an accurate picture of the building's readiness to integrate smart services.

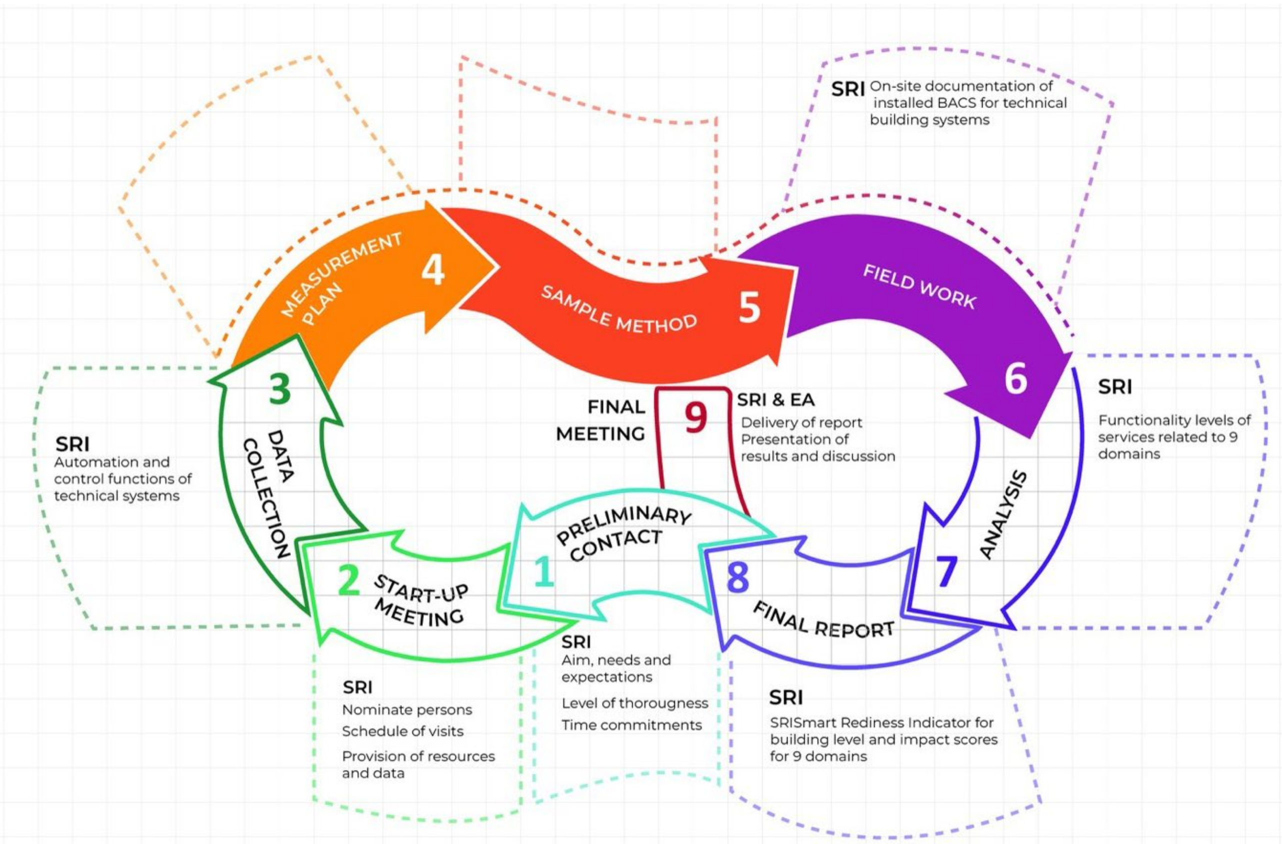
Once the data is reviewed, the audit progresses to the fieldwork stage. The auditor performs on-site inspections of the building's technical domains. The CWA identifies nine such domains, including heating, cooling, ventilation, lighting, dynamic building envelope, electricity, EV charging infrastructure, domestic hot water systems, and central monitoring and control. For each domain, the auditor determines whether systems are equipped with basic manual control, advanced automation, or predictive and self-optimising features.

Functionality Levels and Impact Criteria

At the core of the SRI audit methodology is the assessment of functionality levels. These levels reflect how advanced the technical services within each domain are in terms of automation, user interaction, and grid responsiveness. For example, a ventilation system with a simple on/off schedule would be considered less "smart" than one that adjusts airflow based on real-time occupancy and indoor air quality.

The functionality levels are translated into a smart readiness score using predefined impact criteria and weighting factors. These parameters evaluate the extent to which systems improve energy efficiency, enhance comfort, and contribute to demand-side flexibility. This approach allows auditors to identify not just the current status of smartness but also the potential for improvement.

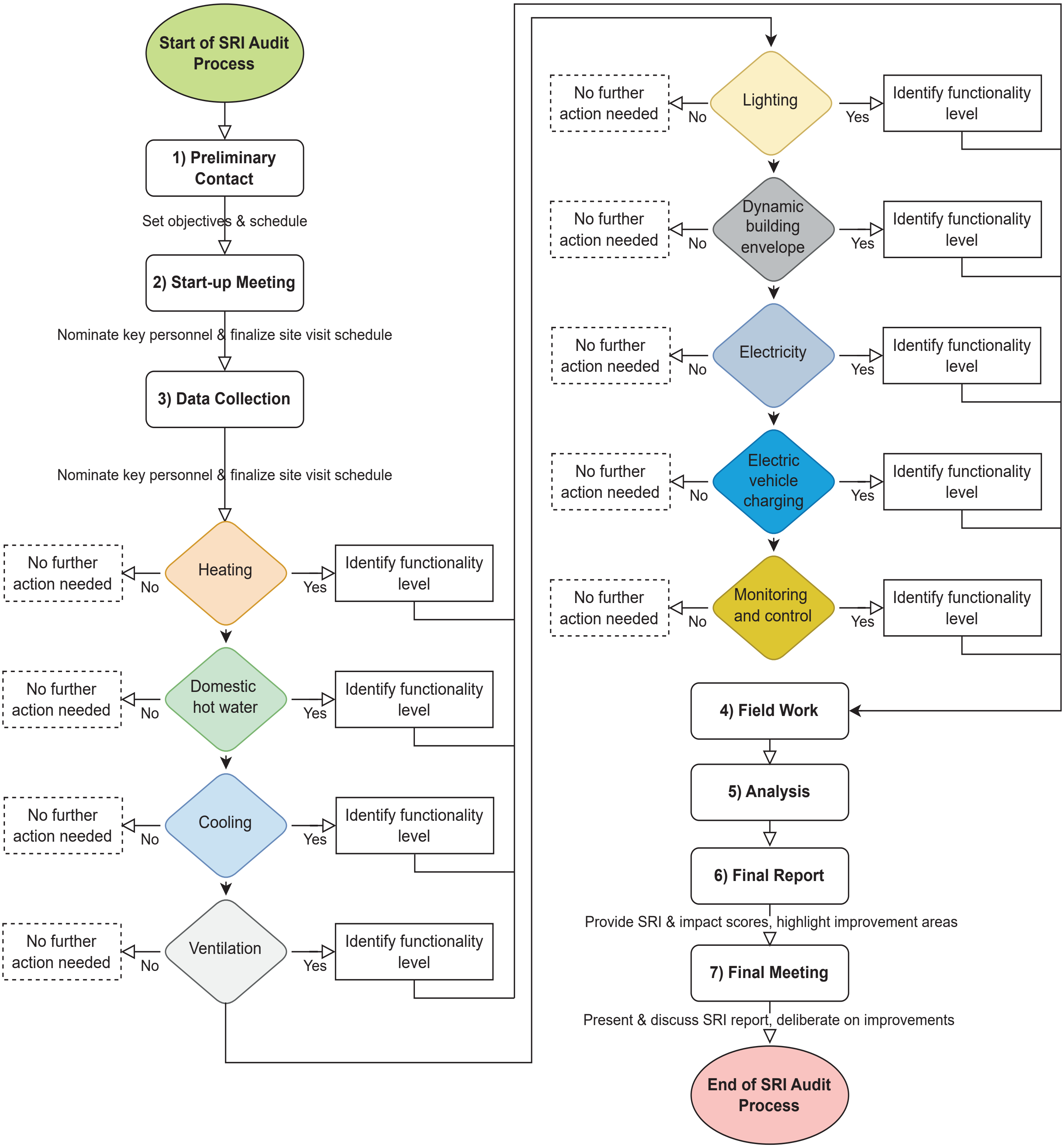
The CWA also introduces the concept of proportionality. Rather than evaluating the entire building uniformly, the auditor records the proportion of the building where certain smart features are present. This ensures a nuanced, realistic representation of building systems that may vary by zone or use.



The SRI on site audit process according to CWA 18193:2025: building upon EN 16247.

Reporting and Follow-Up

After completing the fieldwork and data analysis, the auditor prepares a final report. This report presents a structured summary of the building's smart readiness level, with scores presented across each technical domain and impact category. It also provides suggestions for targeted upgrades that could enhance the smartness of individual systems or the building as a whole.



The seven stepper SRI on site audit process according to CWA 18193:2025.

The reporting format is designed to be comprehensible to a broad audience, including technical staff, building owners, and policymakers. A final meeting is held with the building stakeholders to present the findings, clarify any uncertainties, and discuss next steps. This dialogue is vital for ensuring that the audit leads to actionable outcomes, whether through system upgrades, behavioural changes, or participation in incentive schemes.

Auditor Competence and Quality Assurance

A fundamental aspect of the CWA is its focus on the qualifications and ethical standards of SRI auditors. The complexity of evaluating smart readiness requires more than technical know-how; it demands a deep understanding of integrated building systems, user-centric design, and regulatory frameworks.

The CWA outlines a comprehensive profile for SRI auditors, including expected knowledge areas, professional experience, and continuous training. It also recommends the development of accreditation pathways to ensure consistent quality across the EU. The integrity, objectivity, and transparency of the audit process depend heavily on the competence of the professionals conducting it.

Practical Tools and Implementation Support

To make the CWA methodology easier to apply, the document includes annexes with practical examples, templates, and guidance on using digital tools. Notably, the Smart Ready Go! Platform (smart-ready-go.eu) —developed within the Smart Square project—allows auditors to input building data, assess functionality levels, and automatically generate SRI scores and reports. The user interface is designed to align directly with the CWA methodology, ensuring consistency and traceability.

These implementation tools are particularly useful for capacity building and training. They allow new auditors to practice the methodology in a controlled environment and ensure that early adopters in different Member States follow a shared protocol.

A Foundation for Policy and Market Uptake

The CWA comes at a time of heightened urgency for building decarbonisation. As the revised EPBD encourages Member States to adopt the SRI framework, having a harmonised and technically sound procedure for on-site assessment becomes essential. CWA 18193:2025 fills that gap by offering a structured yet adaptable approach that respects national contexts while promoting EU-wide comparability.

In addition to regulatory applications, the standardized SRI audit process supports market mechanisms. Building owners can use audit results to benchmark their properties, identify investment opportunities, and showcase digital capabilities. Technology providers and energy service companies can align their offerings with a recognised framework, building trust and opening new business channels.

Looking Ahead

CWA 18193:2025 represents an important step in translating smart building concepts into operational reality. It bridges the gap between policy objectives and everyday practice, providing a foundation for reliable, transparent, and scalable smart readiness assessments across Europe. By combining technical robustness with practical usability, it positions itself as a key reference for all actors involved in the digital transformation of the built environment.

As EU Member States regulators and industry stakeholders begin to adopt and apply this methodology, it is expected that the CWA will evolve. Feedback from practitioners, combined with technological innovation and policy developments, will shape future iterations. Whether through voluntary schemes or national mandates, this agreement enables Europe's buildings to become not just energy-efficient, but truly intelligent.

Funding

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Standard publications

CEN Workshop Agreement: CWA 18193:2025 Standardized On-site Audits of Smart Readiness Indicator (SRI) for Buildings.

EN 16247:2022 Energy audits - Part 1: General requirements; Part 2: Buildings; — Part 3: Processes; — Part 4: Transport; — Part 5: Competence of energy auditors. ■

Subsidy Schemes and Their Impact on the Assessment of the Energy Performance of Buildings

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By tightening the requirements for buildings, with a vision of achieving a carbon-neutral building stock by 2050, subsidy schemes are planned to support vulnerable households. One of them is the Social Climate Fund (SCF), which aims to reduce the impact of the introduction of the new Emissions Trading System for Buildings and Transport (ETS2) on energy poverty. For such subsidy scheme, it will be necessary to realistically set appropriate requirements not only in terms of primary energy, but especially in terms of correctly determining the potential energy cost savings. A product approach, such as an isolated investment in replacing a heat source, may not achieve the desired effect, i.e. reducing energy costs. The article compares some heat sources for heating and hot water preparation in terms of global costs and annual energy costs.

Keywords: SCF, ETS2, NECP, EPBD, EED, heat pump, boiler, SCOP, energy costs, NECP, Slovac Republic, France.

As part of the Fit-for-55 legislative package to achieve the objectives of the European Green Deal, the emissions trading scheme will be extended to the buildings and road transport sectors under Directive EU No 2023/959 (ETS2) [2]. Households' heating, cooling, lighting and cooking costs are likely to increase as fuel suppliers, subject to the buildings ETS2 obligations, pass on the cost of carbon emissions to consumers. This impact will be more significant for low-income households, as they spend a higher percentage of their income on energy.

To address the social impacts of the inclusion of emissions trading in the road transport and buildings sectors, the European Union Social and Climate Fund (SCF) was established, pursuant to EU Regulation 2023/955 [1], with a focus on vulnerable households, vulnerable micro-enterprises and vulnerable transport users.

The SCF will provide financial support to EU Member States to finance measures and investments. A maximum amount of EUR 65 billion will be provided for the implementation of the fund for the period 2026 to 2032. The maximum allocation for the Slovak Republic is EUR 1.53 billion, or EUR 1.28 billion (in the case of ETS2 only effective from 2028). Each Member State should submit its Social and Climate Plan (SCP) to the Commission by 30 June 2025.

The main form of support are measures and investments designed to increase the energy efficiency of buildings, decarbonize the heating and cooling of buildings, integrate renewable energy sources, and provide better access to zero-emission mobility and transport.

SCF is to be in line with the National Climate and Energy Plan (NECP) and also to contribute to the objectives of Directive 2023/1791/EU on Energy Efficiency (EED) [3] and the Energy Performance of Buildings Directive (EPBD) [4].

The definition of "vulnerable households" is important for understanding the SCF principles. These are households in energy poverty or households, including low income and lower middle-income ones, that are significantly affected by the price impacts of the inclusion of greenhouse gas emissions from buildings within the scope of Directive 2003/87/EC and lack the means to renovate the building they occupy.

The Social and Climate Fund allows for two types of financing to reduce energy poverty:

- temporary direct income support for vulnerable households (max. 37.5% of the estimated total costs of the Social Climate Plan). This type of financing does not address the root causes of energy poverty and does not deliver energy savings and greenhouse gas emissions reductions,
- measures and investments with lasting impacts, in particular building renovation, use of renewable energy and other measures leading to a long-term reduction in energy consumption, which should be translated into saved energy costs and contribute in the long term to reducing greenhouse gas emissions and energy poverty.

Energy poverty is broadly defined in Article 2(52) of Directive 2023/1791/EU on energy efficiency [3] and will be determined at the national level. The recast of Directive 2024/1275/EU on the energy performance of buildings [4] requires Member States in several articles to renovate the worst-performing buildings and to take a specific approach to vulnerable groups.

The SCF Regulation defines in Annex IV common indicators for indicative milestones and targets, for monitoring the implementation of the Social Climate Plan by Member States and for the assessment of progress towards the objectives of the fund by the Commission. The indicators of the results of the measures and investments are not only the reduction of greenhouse gas emissions, annual primary energy savings and final energy consumption, but also the reduction of the number of vulnerable households and households in energy poverty. An important aspect of the SCF is therefore the need to achieve **real reductions in energy costs**. A more accurate and realistic assessment of the energy performance of buildings is therefore needed.

There is a **link between EPBD and SCF**. EPBD requires specific solutions for vulnerable households in several articles and defines the buildings with the worst energy performance (Art. 3 National Building Renovation Plan and Art. 9 MEPS). On the other side the SCF Regulation requires in Annex IV that one of the result indicators for measures and investments is expressed in savings in annual final energy consumption. Energy savings in individual buildings shall be documented on the basis of Energy Performance Certificates or other criteria for determining the targeted or achieved energy savings set out in the relevant provision of the EPBD (recast).

Identification of target groups, beneficiaries of measures and investments from SCF

The identification of target groups should be based on the definition of vulnerable households. In the first step, these are households in energy poverty or households, including low and lower middle-income households, affected by the price impacts of the inclusion of greenhouse gas emissions from buildings. These are households that use coal, gas and other fossil fuels as fuel.

In the second step, these are households that lack the means to renovate the building they occupy. They must therefore have a relationship with the building, such as an owner, tenant, or social housing operator.

The third step is to identify households that will achieve significant cost savings through the investment, moving them out of energy poverty. The focus is therefore on buildings with the highest potential for energy cost savings, which are the worst performing buildings, or in colder climates.

There is a direct link here with the Energy Performance of Buildings (EPB) assessment. Member States are to identify the worst performing buildings in accordance with EPBD [4], for the national trajectory for the gradual renovation of the residential building stock in the National Building Renovation Plan (EPBD Article 3) with the aim of transforming the national building stock into zero-emission buildings (ZEB) by 2050. These buildings should be the main renovation target for the Social Climate Fund.

In colder locations, with the same investment, the cost-effectiveness of investing in improving thermal protection is higher, but for some technical systems, especially heat pumps, colder climate conditions have a negative impact on their efficiency.

Figure 1 shows the distribution of the population of the Slovak Republic in climatic conditions according to the heating degree days for each village in national annex to standard STN EN ISO 13790/NA [6].

Climatic conditions in the Slovak Republic are very different and a large part of the population lives in significantly colder conditions than those considered in the energy performance certificate (3422 K.day).

Proposal and assessment of appropriate measures and investments for the SCF

The SCF Regulation (EU) 2023/955 lists in Article 8(1) the eligible measures and investments to be included in the Social Climate Plan. For buildings, these are the following categories of measures:

- Building renovation and energy efficiency improvement
- Affordable housing, social housing
- Decarbonization of heating and cooling – replacement of heat generator
- Support through the provision of information, education, awareness and advice
- Support public-private partnerships in designing and providing affordable improving energy efficiency solutions and appropriate financial instruments.

There are two possible approaches to building renovation:

- **product approach** - isolated investment, for example just replacing the heat source (e.g. the French subsidy scheme MaPrimeRénov)
- **holistic approach** - in-depth renovation of the building (thermal protection, then replacement of the heat generator and use of renewable energy), which can also be implemented in gradual steps in accordance with the building renovation passport.

It is essential to set appropriate criteria for subsidies to really achieve energy cost reductions for vulnerable households in energy poverty. The principle of energy efficiency as a priority and a holistic approach to building renovation should be preferred.

Decarbonization of heating and cooling – heat generator replacement

Measures aimed at decarbonising heating and cooling often take a product approach, i.e. an isolated investment, for example in replacing a heat generator. Measures must meet the requirements of the Do No Significant Harm (DNSH) principle, a key element in the EU Taxonomy that refers to Regulation [5] on a framework to facilitate sustainable investment. This means that it is not possible to finance the installation of gas boilers from SCF because they use a fossil fuel. Given the importance attributed to heat pumps in

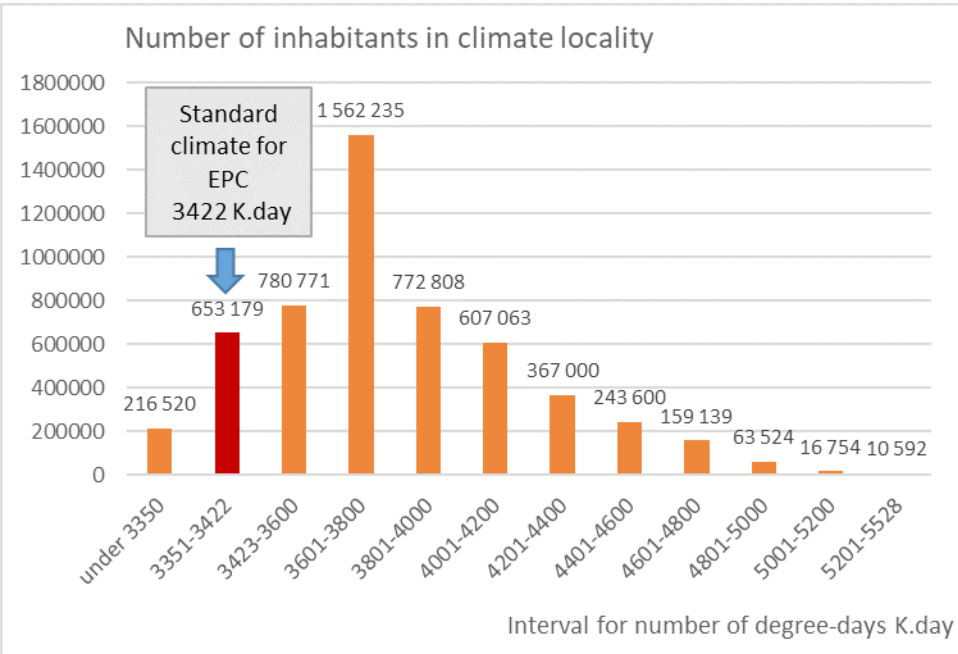

Figure 1. Distribution of the Slovak population in climatic conditions according to heating degree days in STN EN ISO 13790/NA. (Source: Statistical Office of the Slovak Republic and STN EN ISO 13790/NA)

the renovation and electrification of building heating systems, the analysis focuses on this device.

The parameters affecting the instantaneous coefficient of performance (COP) of heat pumps are:

- type of heat pump (air/water, water/water, etc.);
- climatic zone (source temperature, temperature distribution, etc.);
- heating system temperature (high temperature for radiators, low temperature for underfloor heating);
- distribution temperature control (constant temperature, variable temperature depending on the outside temperature, etc.)
- correct sizing (oversized, undersized heat pump)

Figure 2 shows the COP of the heat pump air/water pump depending on the operating conditions. The COP increases with the increase of the outdoor temperature (x-axis) and depends on the temperature of the heating system (see difference between the red line - average temperature and the blue line - low temperature in **Figure 2**) and on the heat load. The operating conditions strongly influence the COP, it varies from 0 to 6.

A reliable method for calculating the seasonal energy demand for heat pumps is important. In real calculations for subsidy schemes, simplified procedures are often used. **Tables 1 & 2** show the default values of the seasonal coefficient of performance (SCOP) in the French 3CL method for calculating the energy classes.

The 3CL method is also used by the MaPrimeRénov building renovation subsidy program (France). The SCOPs vary from 2.2 to 4.0 depending on certain operating conditions (climate zone H1, H2, H3, floor heating / other, age). No other factors are taken into account. The assessment of the heat pump performance using the 3CL method is therefore approximate. For calculating energy performance, even simpler default values are available in the Slovak regulation, which distinguish only the type of emission (radiators or underfloor heating).

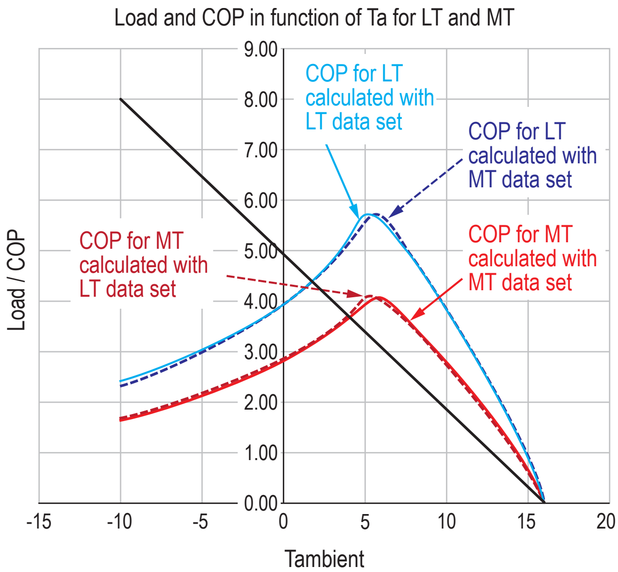

Figure 2. Heat pump COP as a function of temperatures and power. (Source: Heat Pump Expert Group EPB Standard)

Table 1. *Default SCOP values in zones H1 and H2 (3CL France method). [7]*

Type de PAC	Type d'émetteur	Avant 2008*	2008-2014	2015-2016	A partir de 2017
PAC Air/Eau	Autres	2.2	2.4	2.6	2.8
	Planchers / Plafonds	2.4	2.6	2.9	3.2
PAC Eau/Eau	Autres	2.2	2.4	2.7	3
	Planchers / Plafonds	2.4	2.6	3	3.3
PAC Eau glycolée/Eau	Autres	2.2	2.4	2.7	3
	Planchers / Plafonds	2.4	2.6	3	3.3
PAC Géothermie	Autres	2.2	2.4	2.7	3
	Planchers / Plafonds	2.4	2.6	3	3.3

Table 2. *Default SCOP values in Zone H3 (3CL France method). [7]*

Type de PAC	Type d'émetteur	Avant 2008*	2008-2014	2015-2016	A partir de 2017
PAC Air/Eau	Autres	2.5	2.8	3	3.2
	Planchers / Plafonds	2.9	3.1	3.5	3.8
PAC Eau/Eau	Autres	2.5	2.8	3.1	3.5
	Planchers / Plafonds	2.9	3.1	3.6	4
PAC Eau glycolée/Eau	Autres	2.5	2.8	3.1	3.5
	Planchers / Plafonds	2.9	3.1	3.6	4
PAC Géothermie	Autres	2.5	2.8	3.1	3.5
	Planchers / Plafonds	2.9	3.1	3.6	4

Comparison of technical systems in terms of annual energy cost

Examples of systems that could be installed in a building and financed from SCF are compared in the terms of achieved annual energy cost savings in **Figure 3 and 4**. The following systems are considered for heating (H) and hot water preparation (DHW):

- Gas boiler for heating and hot water preparation (H+DHW) (initial state)
- Air-to-water heat pump (HP) for heating + electric hot water heating
- Air-to-water heat pump (HP) for heating and hot water production
- Biomass pellet boiler + electric hot water heating

Alternative 1 considers current energy prices and a heat pump operating in conditions where it achieves SCOP (H) = 3.6 for heating and SCOP (DHW) = 2.5 for hot water. For gas, the CO_2 emission costs due to the introduction of ETS2 are considered to be €60/t.

Global costs (investment and discounted annual energy costs over 30 years) are calculated, taking into account the increase in energy prices.

In this case, compared to the existing gas boiler, the annual non-renewable primary energy savings for the heat pump will be 42% or 49% and the annual energy and CO_2 emission cost savings will be €668 (36%) or €819 (45%). While the annual primary energy savings for the biomass boiler are 60%, the annual energy costs will increase slightly (by 1%).

Alternative 2 assumes a slight increase in the price of electricity to €0.21/kWh and a heat pump operating in worse conditions, for example in a building with worse thermal protection, in a colder climate location and with a high temperature of the heating system (radiators), in which it reaches SCOP (H) = 2.6 for heating and SCOP (DHW) = 2.5 for hot water preparation. For gas, the same costs of CO_2 emissions

SR	Insulated family house (needs H: 100 kWh/m^2, DHW: 10 kWh/m^2)	
Floor area Ab =	200.00	m^2
Calculation period	30	
Discount rate	3%	
Macro, micro economic or ETS2 for CO2	ETS2-only gas	
External costs of GHG=	60.00	€/t CO2
SCOP(H)= 3.6	SCOP(DHW)= 2.5	

Carrier	Energy price €/kWh	Energy price increase %/a	Primary energy factor (nren)	CO2 emissions factor	Impact of ETS2
Gas	0.06	2%	1.1	0.220	0.0132 €/kWh
Biomass/pellets	0.06	2%	0.2	0.020	
Self-used PV	0.00	0%	0.0	0.000	
Grid electricity	**0.16**	2%	2.2	0.167	
Aux. electricity	**0.16**	2%	2.2	0.167	

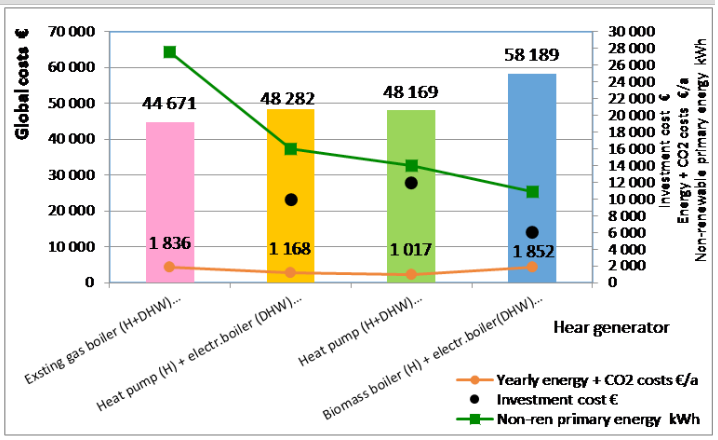

Figure 3. Comparison of technical systems in terms of annual energy cost - Alternative 1.

SR	Insulated family house (needs H: 100 kWh/m^2, DHW: 10 kWh/m^2)	
Floor area Ab =	200.00	m^2
Calculation period	30	
Discount rate	3%	
Macro, micro economic or ETS2 for CO2	ETS2-only gas	
External costs of GHG=	60.00	€/t CO2
SCOP(H)= 2.6	SCOP(DHW)= 2.5	

Carrier	Energy price €/kWh	Energy price increase %/a	Primary energy factor (nren)	CO2 emissions factor	Impact of ETS2
Gas	0.06	2%	1.1	0.220	0.0132 €/kWh
Biomass/pellets	0.06	2%	0.2	0.020	
Self-used PV	0.00	0%	0.0	0.000	
Grid electricity	**0.21**	2%	2.2	0.167	
Aux. electricity	**0.21**	2%	2.2	0.167	

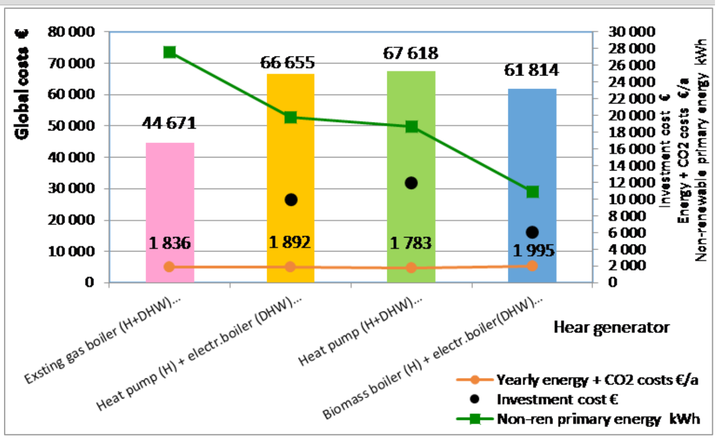

Figure 4. Comparison of technical systems in terms of annual energy cost - Alternative 2.

due to the introduction of ETS2 are considered, amounting to €60/t.

In this case, the annual non-renewable primary energy savings for a heat pump will be 28% or 32% compared to the baseline. A small annual energy cost saving of €52 (3%) will only be achieved with a more expensive heat pump with hot water preparation. A heat pump with electric hot water heating will increase annual energy costs by €56 (3%). Although the primary energy savings for a biomass boiler are 60%, the annual energy costs will increase by €160 (9%) after investment.

Replacing the heating system type alone will not automatically guarantee a reduction in annual energy costs, although the non-renewable primary energy savings are large. A holistic assessment of the building is needed with an appropriate calculation tool, taking into account the state of the building's thermal protection and the operating conditions of the heat pump.

Conclusion

Renovation subsidies with a "product" approach are based on a typology of installations completed by minimum performance criteria. The performance of the "product" is based on conventional operating conditions. The "product" approach is not suitable for installations such as heat pumps, whose performance depends to a large extent on operating conditions.

Product criteria are not a guarantee that the required savings will actually be achieved. Incorrectly set criteria for renovation subsidies can lead to an increase in public spending without a positive impact on vulnerable groups.

A more accurate assessment of energy performance is key to the efficient spending of public finances and to lifting vulnerable households out of energy poverty.

When implementing the revised EPBD [4] it is necessary to introduce into energy performance certificates the new indicators needed for the SCF. Subsidies should be conditional on a correct estimate of cost savings, calculated with reliable tools in line with European standards. In addition, the achieved results should be checked by measurements.

Literature

[1] Regulation (EU) 2023/955 of the European Parliament and of the Council of 10 May 2023 establishing the Social and Climate Fund and amending Regulation (EU) 2021/1060.

[2] Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 establishing and operating a market stability reserve for the greenhouse gas emission allowance trading scheme within the Union.

[3] Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast).

[4] Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast).

[5] Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088.

[6] STN EN ISO 13790/NA: 2010 Energy performance of buildings. Calculation of energy demand for heating and cooling (ISO 13790:2008). National Annex.

[7] MaPrimeRénov, subsidy program, France. ■

Contribution to Commission Future[1)] Delegated Act on Whole Life-Cycle Global Warming Potential Reporting for Buildings[2)]

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1)

2)

The Commission is currently working on a delegated act providing guidance on Articles 7(2), 7(3), 7(5), and Annex III of the recast EPBD. It aims to the clarification and implementation of the EPBD provisions relating to building whole life cycle Global Warming Potential (LC-GWP). Even if the delegated act has the same force of the Directive, it cannot overcome the basic principles stated there. Thus, the Member States will still have flexibility to interpret and specify the EPBD provisions within the legal frame of recast EPBD.

This document is a contribution to the Commission's work in progress, the preparation work of which is carried out through a supporting contract with a consultants' consortium (Viegand Maagøe, COWI and Exergia), referred herewith as study team. Up to now there is no official document available, but only the consultation documents and deliverables relevant to the stakeholders' involvement through two webinars. This document contains a summary analysis of the study team's current interpretation of these Articles and the foreseen potential issues, complemented by our opinion and suggestion.

Keywords: EPBD, GWP, LC-GWP, EPD, CPR, LCA, Delegated Act

Political framework

The EPBD requires in Article 7(2) that "Member States shall ensure that the life cycle GWP is calculated in accordance with Annex Ill and disclosed in the energy performance certificate of the building: (a) from 1 January 2028, for all new buildings with a useful floor area larger than 1 000 m²; (b) from 1 January 2030, for all new buildings.". While in Article 7(3) it requires the Commission "to adopt delegated acts in accordance with Article 32 to amend Annex Ill to set out a Union framework for the national calculation of life cycle GWP with a view to achieving climate neutrality. The first such delegated act shall be adopted by 31 December 2025." Such delegated acts shall be conformed to objectives, content, scope and duration of the delegation of power (Article 32). Furthermore, EPBD requires in Article 7(2) that "by 1 January 2027 Member States shall publish and notify to the Commission a roadmap detailing the introduction of limit values on the total cumulative life-cycle GWP of all new buildings and set targets for new buildings from 2030, considering a progressive downward trend, as well as maximum limit values, detailed for different climatic zones and building typologies. Those maximum limit values shall be in line with the Union's objective of achieving climate neutrality. The Commission shall issue guidance, share evidence on existing national policies, and offer technical support to Member States, at their request".

The Commission is required to provide two different sets of guidance documents:

- Delegated acts that set out a common Union framework for the national calculation of life cycle GWP.

- A guidance document to support the development of national roadmap to the progressive introduction of compulsory requirements on LC-GWP limits to be verified by new buildings.

Herewith, only the first will be discussed, which shall be provided for December 2025 (see LC-GWP timeline reported in **Figure 1**).

Delegated acts on LC-GWP

The aim of the delegated acts (DA) on LC-GWP, as required by Article 7(3), is to provide an EU harmonized approach, by setting out a framework aiming at a transparent and consistent LC-GWP calculation methodology. The aim is not to provide a step-by-step methodology, but to clearly define a **minimum harmonised** framework, clarifying the **legal terms** related to Article 7(2) and Annex III, and the **technical terms** related to Article 7(2) and Annex III.

A further aim is to support Member States in the national application of LC-GWP provisions, highlighting possible flexibility with methodological choices related to Article 7(2) and Annex Ill.

Annex III of the EPBD recast is requiring for the calculation of the life cycle GWP of new buildings that:

- The total life cycle GWP is for each life-cycle stage expressed as $kgCO_2eq/(m^2)$ (of useful floor area) calculated over a reference study period of 50 years.
- Data selection, scenario definition, and calculations shall be carried out in accordance with EN 15978 (EN 15978:2011) [3], which is currently under revision).
- The scope of building elements and technical equipment is as defined in the Level(s) common EU framework for indicator 1.2.
- Data regarding specific construction products calculated in accordance with Regulation (EU) No 305/2011 (CPR) shall be used when available.
- Where a national calculation tool or method exists, that tool or method may be used to provide the required disclosure.
- Other calculation tools or methods may be used if they fulfil the minimum criteria established by the Level(s) common EU framework.

The DA has the goal to clarify and improve what is described in Annex III ("to amend Annex Ill") more than setting up new requirements. For these reasons, the study team has foreseen a list of possible issues to be considered in the DA development by the Commission, which are grouped into legal clarifications, minimum harmonized framework, methodology clarifications, and other clarifications.

In the following, these potential issues are listed, and an answer is given based on a deep analysis of the EPBD text and the results of a stakeholder meeting [1].

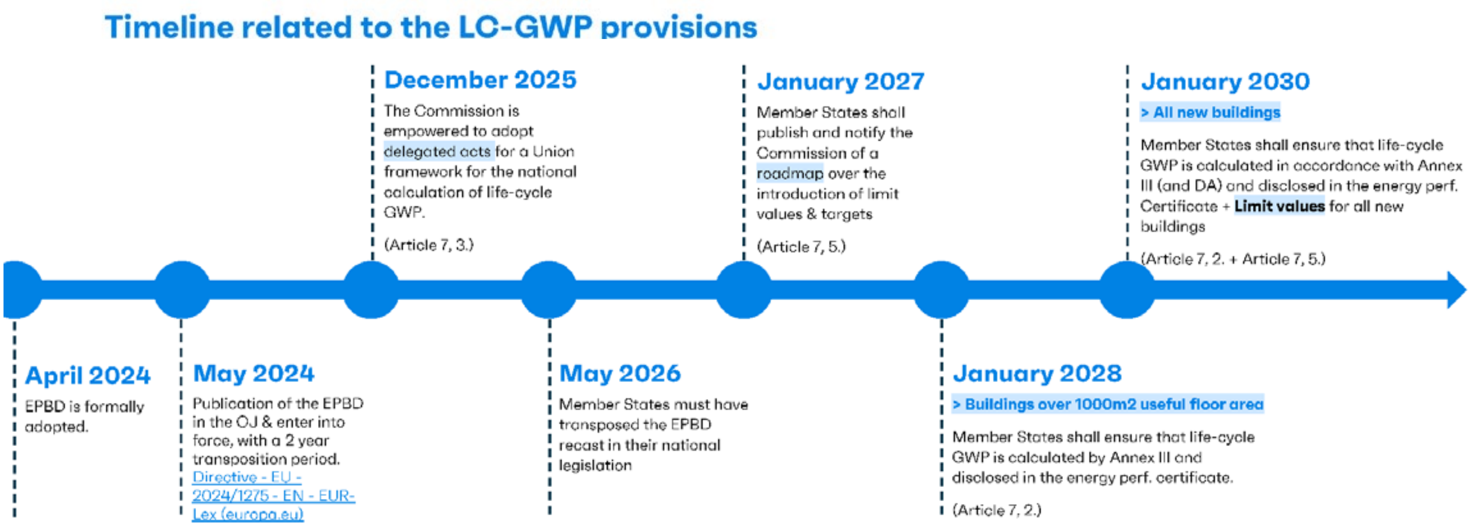

Figure 1. LC-GWP provisions timeline. [1]

Legal clarifications

The potential issues related to the legal interpretation of items reported in EPBD Annex III are:

- What is the scope, according to EN 15978 definitions (i.e., which buildings):
  - **Clear answer from EPBD analysis**: according to Art. 7(2) from 1 January 2028 all new buildings with a useful floor area larger than 1 000 m²; from 1 January 2030 all new buildings, with the exceptions that are allowed by Art. 20(6) (buildings for religious activities, temporary and non-residential agricultural buildings, standalone buildings with a total useful floor area of less than 50 m²) and by Art-4(d) of the EPBD 2010/31/EU (buildings used for few months a year), if implemented by Member States in their transpositions before 28 May 2024.

- What to do if the expected lifetime of the building is less than the reference study period of 50 years:
  - **Answer to be addressed by DA**: according to ISO 15686-1 (under revision) scenarios for refurbishment, or demolition and construction of an equivalent new building shall be developed in this case; thus, some clear indication shall be provided by the DA to avoid a completely free approach.

- EN 15978:2011 is reported in the EPBD, which is going to be replaced by a new updated version at the end of 2025:
  - **Answer to be addressed by DA**: the reference to the technical standard shall be updated and, if some delay is foreseen, the DA shall highlight some elements, like the description of modules and the building model, which are going to change from the old to the new version

- While other calculation tools or methods than EN 15978 (and related standards) may be used if they fulfil the minimum criteria established by the Level(s) common EU framework, existing or required-by-law National methodologies, and tools seem to be free of any constraint:
  - **Answer to be addressed by DA:** to avoid considerable differences among Member States, the DA shall put clear minimum requirements on national tools and methods.

- What kind of data can be used:
  - **Answer to be addressed by DA:** while there is a clear indication that, when available, data regarding specific construction products calculated in accordance with Regulation (EU) No 2024/3110 (new Construction Product Regulation, CPR, repealing Regulation (EU) No 305/2011 recalled by EPBD) or with product regulation derived from Directive 2009/125/EC, Regulation (EU) 2024/1781 and/or from Regulation (EU) /2017/1369 shall be used, there is no clear indication on what to do if that kind of data are not available. A reasonable answer could be to use self-declared EPDs (Environmental Product Declarations) according to EN 15804 until specific CPRs are available (see Box on CEN Standards, CPR, EDP, PCR, and c-PCR). If EPDs for a specific country are not available, EPD data from other countries may be used but with adaptation to the importing country conditions (mainly for transportation and end-of-life modules). Finally, if no EPDs are available in any form, conservative default values should be provided on national basis. That makes it evident that Member States must have the freedom to define generic and default data to be used when more specific data or calculations are unavailable.

Minimum harmonised framework

The minimum harmonised framework is the main object of the DA, because the reference assessment framework recalled by EN 15978, which deals only with the Environmental Sustainability of a building, defined by the EN 15643, is very general and applies to all kinds of construction works.

EPBD Art. 2(24) specifies only that the GWP must be assessed along the full life cycle of the building, while Art. 2(24) specifies that it must include "production and transport of construction products, construction-site activities, the use of energy in the building and replacement of construction products, as well as demolition, transport, and management of waste materials and their reuse, recycling and final disposal."

In **Figure 2** the representation of all life cycle stages and modules is reported with the specification of the scope of each of them. This representation, taken from EN 15643, is a bit different than what is included in the EN 15978:2011, but will be the same of what will be included in the new prEN 15978-1 to be published at the end of the year.

According to the definition of EPBD Art. 2(24), **Figure 3** illustrate a synthetic representation of a proposed minimum requirement of modules, to be defined in the Delegate Act. The proposed mandatory minimum harmonized framework is represented by the coloured modules.

CEN Standards, CPR, EDP, PCR, and c-PCR

The CEN standard EN 15643 “Sustainability of construction works – Framework for assessment of buildings and civil engineering works” is a general framework, which regards sustainability as a whole. Under this general umbrella, three specific CEN standards exist that deal with environmental sustainability, EN 15978, social sustainability, EN 16309, and economic sustainability, EN 16627. All these standards are currently under review and will be replaced by prEN 15978-1, prEN 15978-2 and prEN 15978-3. The latest two sustainabilities are not taken into consideration by EPBD as well as only one environmental sustainability indicator is considered, the Global Warming Potential. EN 15978, dealing with environmental sustainability needs specification rules to be applicable to a complex system as building. Some of them are specified through the reference to the Level(s) common EU framework, while data regarding specific construction products must be conform to the new Construction Product Regulation (Regulation (EU) No 2024/3110). This CPR specifies that all product environmental impact indicators, which are mandatorily reported in the Environmental Product Declaration (EPD), must be assessed using harmonised CEN product standards made mandatory by means of EU implementing acts. If these standards are not already available, the Commission may adopt implementing acts laying down essential characteristics, assessment methods and technical details for one or more product families or for one or more product categories within a family. These harmonised product standards or the implementing acts are labelled Product Category Rules (PCR). The CEN standard EN 15804 provides core product category rules (PCR) for Type III environmental declarations (LCA based analysis) for any construction product and construction service. If the PCR is still too general complementary PCR (c-PCR) may be developed for a more specific category of construction products. If mandatory PCR and/or c-PCR are not available, the required environmental impact indicators can be assessed or using PCR/c-PCR developed by third-party bodies or self-applying EN 15804 specifying the custom-made assumptions.

BUILDING ASSESSMENT INFORMATION																		
BUILDING LIFE CYCLE INFORMATION																		INFORMATION BEYOND THE BUILDING LIFE CYCLE
A - Construction Stage						B - Use Stage								C - End-of-life Stage				D - Net Benefits beyond the system boundary
Pre-construction, Stage	Product(ion) Stage			Construction Process Stage		Related to the building fabric					Related to the buildings operation							
A0	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	B8	C1	C2	C3	C4	D
Non-physical processes before construction, tests, acquisition of land/site and design	Raw material supply	Transport	Manifacturing	Transport	Construction, Site development, Deconstruction of Pre-existing Buildings, Installation Process	Use, installed products	Maintainance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Users'Activities	Deconstruction	Transport	Waste processing for Reuse, Recycling and Energy Recovery	Disposal	D1 Net Flows from Reuse-Recycling - Energy Recovery - Other Recovery D2 - Exported Utilities

Figure 2. Overview of the life cycle stages in EN 15643.

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Non-physical processes before constrution, tests, acquisition of land/site and design	Raw material supply	Transport	Manifacturing	Transport	Construction, Site development, Deconstruction of Pre-existing Buildings, Installation Process	Use, installed products	Maintainance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Users'Activities	Deconstruction	Transport	Waste processing for Reuse, Recycling and Energy Recovery	Disposal	D1 Net Flows from Reuse-Recycling - Energy Recovery - Other Recovery D2 - Exported Utilities

Figure 3. Overview of the proposed minimum requirement of modules.

▸ The main goal of the DA should be to avoid burden for manufacturers to create additional data, adopting the same life cycle stages for the building GWP as that required at the product level by the new CPR.

Each module (A1, A2, …) can be subdivided into sub-modules to better specify the scope. For instance, the current status of prEN 15978 introduces the subdivision reported in **Figure 4**.

As for the modules, a proposed minimum requirement of sub-modules can be given, excluding, for instance, sub-modules A5.1 and / or B1.1 from the mandatory set being, on average, very marginal on the whole assessing procedure.

Module B6 requires further attention because it is true that energy use is assessed by the Energy Performance Certificate (EPC), thus it is already available, but for its transposition in operational carbon spitting among the different energy carriers and eventually services are needed as required by prEN 15978. The EPBD provided template for the EPC does not include such spitting of the minimum requirement among the different energy carriers and/or services. Thus, if the prEN 15978 approach is followed DA should require or to include such information in the EPC (very difficult) or to impose that who is performing the energy assessment is the same subject that is performing the environmental assessment (in such case it has access to all detailed information on the energy calculation) or to simplify the prEN approach allowing to avoid this splitting among energy carriers and using directly the total operational carbon mandatory displayed in the new EPC. Also, another question arises about the energy service systems installed in the buildings when they export energy carriers: both operational and embedded emissions must be fully or only partially allocated to the building? If partially, what must be the share? Different approaches can be used, even if the more rational would be the physical based one, which allocates to the building the share of generated energy carriers used for self-consumption and then uses the same share for the embedded carbon. This point should be addressed by the DA to avoid that each Member State is going to choose completely different approaches.

Finally, it would be important that the DA specifies when, in each module or submodule, specific site data (i.e., primary data) must be used and/or when default data (i.e., secondary data) may be applied, even if data source and quality should be in the hands of Member State. This is to avoid that different data quality and adaptation procedures can be used, especially when imported products are used in a building.

Other than stages and modules scope, it is important to define in the DA the minimum scope of building elements, i.e. the minimum granularity of the building model. The Directive directly refers to the Level(s) common EU framework for the scope of building elements and technical equipment, but with reference to the indicator 1.2 (GWP). This may induce confusion in adopting the Level(s) minimum scope of building parts and elements as reported in the User manual 2 - Setting up a project to use the Level(s) common framework - as the minimum scope of building elements for the GWP assessment. A clear reference should be made in DA to the user manual 2 table, or an updated table has to be provided taking into account the balance between the assessment effort and cost and the results quality with an increased building granularity.

Methodology Clarification

The GWP assessment result can significantly vary in relation to the assumed floor area: larger it is lower is the building's GWP. Thus, a common definition of the reference floor area is mandatory if a harmonized methodology shall be used. Also, if building element

CONSTRUCTION PROCES STAGE – M. A5	USAGE STAGE - BUILDING FABRIC M. B1	USAGE STAGE - BUILDING OPERATION M. B6
A5.1 : Pre-construction demolition **A5.2:** Construction activities **A5.3:** Waste and waste management **A5.4:** Transport of construction workers	**B1.1.** Emissions from materials and carbonation **B1.2·** Fugitive emissions of refrigerants	**B6.1 :** Regulated building integrated systems (services) **B6.2:** Non-regulated building integrated systems (services) **B6.3:** Other energy use related to building user activities

USAGE STAGE - BUILDING OPERATION B7	USAGE STAGE - BUILDING OPERATION M. B8	NET BENEFIT BEYOND SYS.BOUNDARY – M. D1
B7.1 : Essential building-integrated systems **B7.2:** Other building-integrated systems **B7.3:** Non-building-integrated systems	**B8.1:** Transport of persons to and from the building **B8.2:** Charging of electric vehicles within the building site **B8.3:** Others, such as use of "consumables" like paper for offices, or furniture and equipment not fixed to the building	**D1.1.** Reuse **D1.2.** Recycling **D1.3·** Energy recovery

NOTE: 'Regulated' means energy demand from building integrated systems (services) covered by the EU Energy Performance of Buildings Directive

Figure 4. Sub-modules presented in the current status of the prEN 15978.

areas are not correctly defined, the billing of materials will be not correct and consequently their impacts. To use a standardized approach, Level(s) refers to the International Property Management Standard (IPMS) [2] for the surface area definition of building components and sub-components.

The main issue is that not all CEN standards use the same floor area definition. For instance, the EPBD overarching standard, EN ISO 52000-1, defines a reference floor area as floor area used as a reference size. That has caused that any Member States has adopted its own definition.

DA should finally oblige Member States to adopt a uniform description of the floor area, for instance, using the IPMS components area, with the double benefit of a same reference area for the GWP normalization and more clear and consistent billing of materials.

Another important methodological issue is related to the open question about dynamic versus static approach. According to [1], they can be defined as:

- **Static Approach:**
  Time-independent LCA method that aggregates environmental impacts over the building's life cycle without considering when they occur.

- **Dynamic Approach:**
  Time-sensitive approach accounting the impacts related over time (only for GWP fossil, and not on GWP biogenic, to ensure there is no imbalance in the carbon uptake and release).

Of course, while the dynamic approach can be more accurate (it depends on data availability), it is more complex and time consuming than the simplified static approach. Furthermore, there is an open discussion on what indicator is correctly describing the impact on atmosphere temperature of different emissions temporal profiles. It seems than, even if calculated with time-dependent characterization factor, the GWP indicator is not as correct as the Global Temperature Potential. Thus, it would be better to delay the dynamic models use for legal obligation till the research will converge on a unique indicator.

The use of steady models for the embedded carbon assessment is anyhow not in contradiction with the use of dynamic models for energy use and operation al carbon assessment. Such tools, based on hourly calculations, are able to assess operational carbon closer to the real situation, taking in account the possible various energy carriers and energy storage and grid interaction. But, even if building energy performance simulation tools exist since 1970s, the CEN standard allows to use quasi-steady state approach, seasonal or monthly based and almost all Member States are using today such models. There is still a strong resistance to switch to hourly base (true dynamic), even if designers are getting used to work with such tools. Thus, it will be even more difficult to convince all involved actors to use dynamic embedded carbon models. For these reasons today, it would be much better to spend time and money on making the data the static model needs better and more available than on adopting a dynamic method more difficult to use and with a lack of specific data.

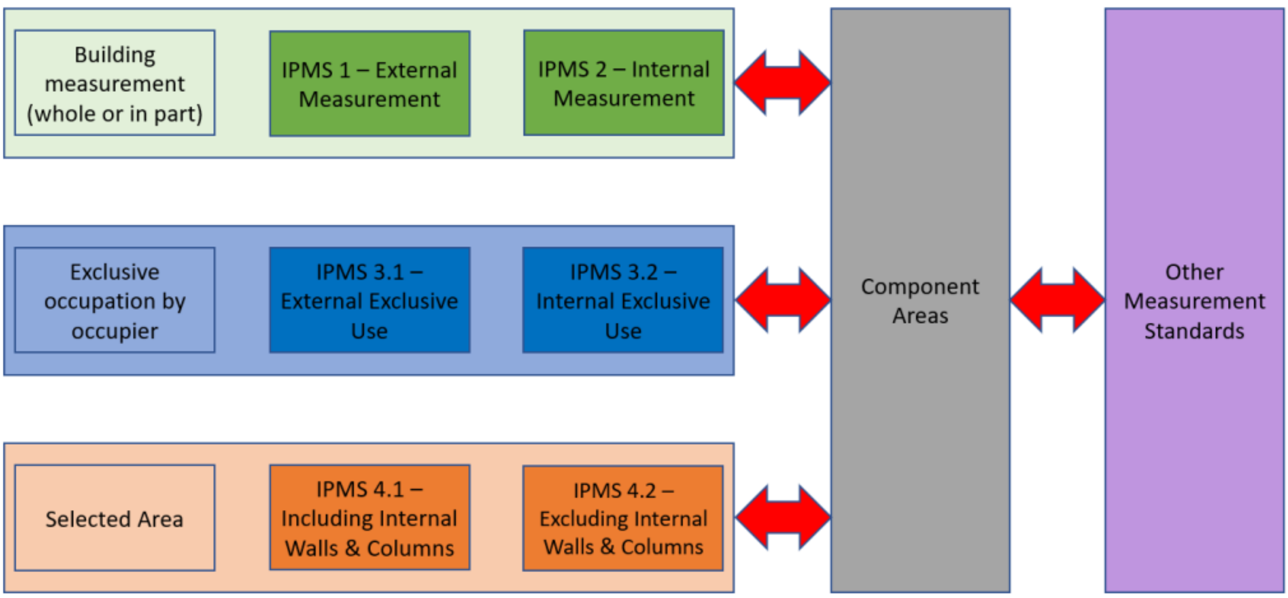

Figure 5. IPMS logic structure and interaction with other measurement standards [2].

Other Clarification

One question mark has been raised about the GWP assessment result submission: when it should be delivered and how many times.

Looking at the EPBD goal, maximum performances with the minimum environmental impact, which is technically feasible and economically sustainable, the same route has to be taken that has been chosen for the energy performance assessment.

In assessing the energy performance, EPBD requires first compliance of the building primary energy use with a maximum threshold at the design stage to get the building permit: first stage of assessment. After the building has been constructed, at the handover phase, a second assessment must be carried out for the building as built to release the Energy Performance Certificate. Because the introduction of a life cycle GWP limit value is planned to be in force from 2030, according to the roadmap any Member State has to prepared by 1 January 2027, the Zero Emission Building energy assessment can be synchronized with its Environmental assessment. That means that the building design can be optimized in a holistic way, evaluating at the same time both the energy and the environmental performances. Then, at the handover, the building will be certified on both aspects using actual building data referred to the installed materials and components (see **Figure 6**).

If an assessment tool is developed that allows to perform both calculations with a unique building description in input, the effort to produce the assessments is minimized.

Some clarification is also needed on the results format. The Directive requires the calculation of the total cumulative life cycle GWP for each life-cycle stage, which must be disclosed in the energy performance certificate, no more. Level(s), the reference EU framework for buildings sustainability assessment, referred several times, defines instead a reporting format for the GWP indicator that, as shown in **Figure 7**, is spitted in its components: fossil, biogenic, and land use and land use change other than total.

During the seminar [1], a simplified or more complex reporting format has been proposed respectively only with two macro-stages (A1 to C4 and D) or including all modules and sub-modules. While from the point of view of stages and components, the Level(s) format seems to be still the best compromise, what is lacking is what is common for primary energy reporting. Several Member States have set specific thresholds and report

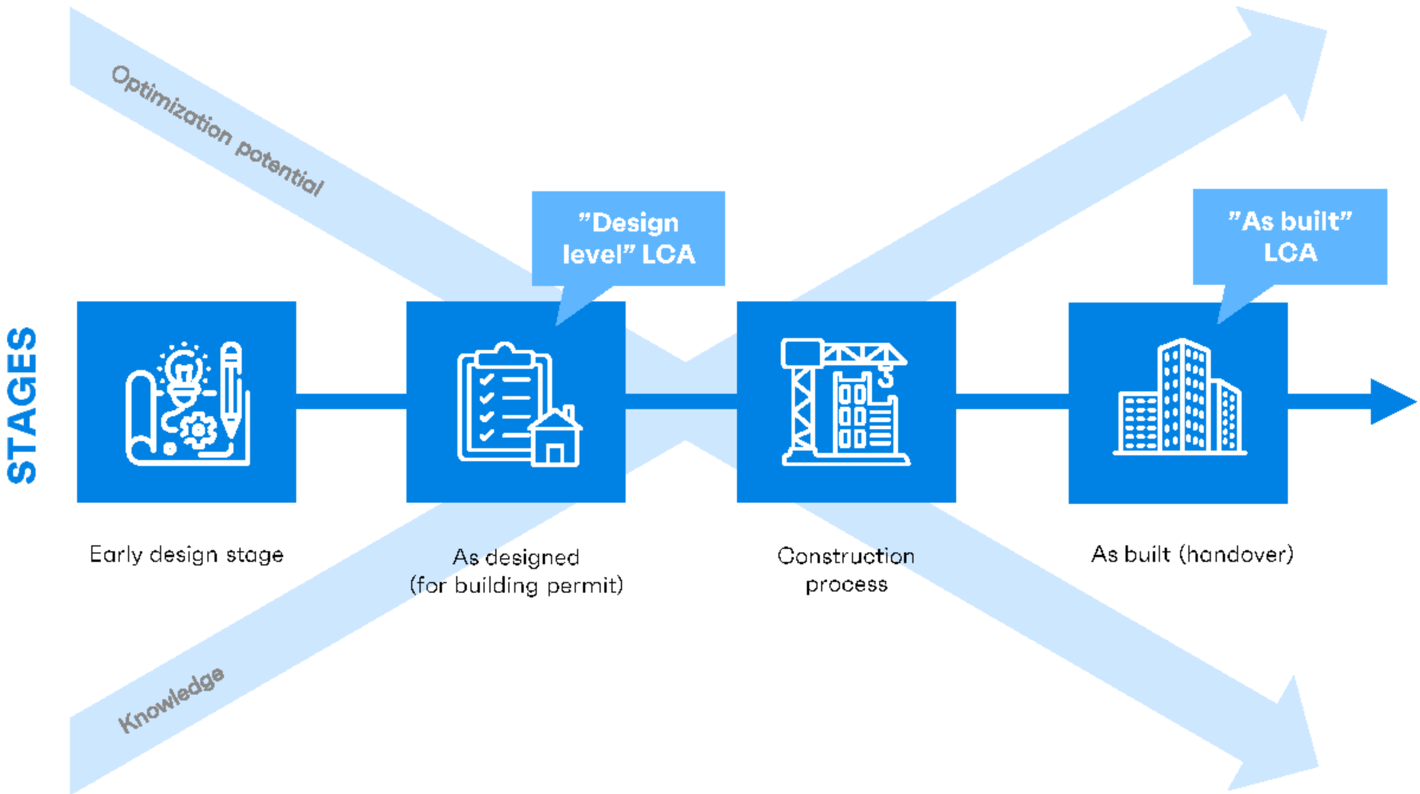

Figure 6. Building construction timeline and GWP report delivery [1].

on the primary energy use for each building service (heating, cooling, ventilation, domestic hot water, lighting at most), as required by EN ISO 52000-1. Thus, it would be better to adopt for the GWP the same spitting among services as for the energy assessment, other than stages and components. Such splitting is optional in prEN 15978 and it is possible only if this information is included in the EPC (they are not mandatory) or if the assessor for the environmental impacts is the same for energy use, as explained before.

Accuracy and completeness are the last issues identified that require some clarification in the DA, even if it is a very complex matter. The only way to guarantee accuracy is to force the use of certified EPDs values and databases, which provide average national values for all activities and components that do not have certified EPDs. It is evident that that should be a Member State task, even if some excellent work has been already done by the Commission through the JRC-Ispra, building a database with customized values for each Member State but only for basic physical substances. The completeness issue can only be solved using the building digital twin (i.e., a BIM), which can automatically link the building drawing to the bill of materials and then to the relative EPDs. In this way, all material flow will be taken into consideration without losing some components because this would result a "hole" in the drawing, in the economic accounting, and in the supplies logbook, and thus very evident to the designer.

Comments and recommendations

A delegated act (DA) on LC-GWP, as required by Article 7(3), is under development to provide an EU harmonized approach by setting out a framework aiming at a transparent and consistent LC-GWP calculation methodology. Some potential issues related to the large degree of freedom in the application of the mandatory standard to be used for the GWP calculation, EN 15978, also under revision (prEN 15978), must be solved by this DA if a clear and common calculation method shall be used. In the previous text, on the basis of a stakeholder meeting [1] (EU Commission contract for support to the clarification and implementation of the EPBD provisions relating to building whole life GWP), some of these issues have been examined and, in some cases, some potential solutions have been proposed.

When this text has been written, no public draft of DA was available, and thus, no clear view of the actual approach followed by the Commission is possible in facing such potential issues. We hope that such short compendium will be useful to address their work on the right track. The only main recommendation is on the need of better linking the two mandatory assessment requirements, energy performance and environmental impact, being today the GWP operational component the major part, but with the future application of the provision on the Zero Emission Building, the embedded component will be dominant. That means that the building designer, the energy assessor, and the environmental impacts assessor or must be the same subject or must share all information at the design stage to be able to correctly fulfil all requirements at the lowest possible cost. In this second case, an information exchange protocol has to be foreseen to avoid redundant information loops with loss of time and money.

References

[1] Slides for webinar about WLC - 22.10.24.pdf available on https://www.wlc-epbd-guidance.eu/.

[2] International Property Measurement Standards: All Buildings, International Property Measurement Standards Coalition, 2022.

[3] EN 15978:2011 Sustainability of Construction works – Assessment of Environmental Performance of Buildings – Calculation method. ■

Indicator	Unit	Product (A1-3)	Construction process (A4-5)	Use stage (B1-7)	End of life (C1-4)	Benefits and loads beyond the system boundary (D)
(1) GWP - fossil	kg CO_2 eq					
(2) GWP - biogenic	kg CO_2 eq					
GWP – GHGs (1+2)	kg CO_2 eq					
(3) GWP – land use and land use change	kg CO_2 eq					
GWP – overall (1+2+3)	kg CO_2 eq					
Notes: Impacts referred to the use of 1 m^2 of useful internal floor per year for a default reference study period of 50 years[1].						

Figure 7. Level(s) reporting format for GWP.

Harmonizing Key Performance Indicators for the Next Generation of Energy Performance Certificates (EPC)

A comprehensive overview of the new CEN Workshop Agreement CWA 18127:2024





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The next generation of energy performance assessments and certificates ought to address the transformation into an era where an increasing amount of data are available on the operational use of buildings, and the buildings can be observed with ever increasing details via a larger number of stakeholders.

The EuB SuperHub project (https://eubsuperhub.eu/) has supported the evolvement of the certification process in the EU through the development of a scalable methodology supported by an online platform to view, assess and monitor the buildings through their lifecycle in relation to an expanded set of indicators that go beyond the energy performance in the occupation stage (embedded energy, costs etc.).

The EU Level(s) initiative is already leading a way of a new, holistic view of the buildings taking into account sustainability principles (LCA, LCC etc.). Energy performance assessments and certificates of buildings therefore need to evolve to reflect the technological development, the needs of society, and within the EU, they must be consistent throughout Member States.

Holistic vision of buildings, social and technological changes in society require a change in the way we look at and manage the built environment, also encouraging public investments and incentives to improve the energy efficiency of assets. EUB SuperHub project tied the "distributed" systems, assessment schemes and certifications spread across Member States, based on common criteria (e.g. Level(s), SRIs, EVCS) through a digital one-stop shop platform.

The EuB SuperHub platform is intended to store, geo reference, display and organise the local public databases of EPC (Energy Performance Certificates), local sustainability and SRI (smart readiness indicators) ratings into a common digital "e-passport".

The EuB SuperHub e-passport is intended to be supported by a digital building logbook (materials used, HVAC systems, previous renovations, BIM files, etc.) and utilize the latest cutting-edge assessment techniques and innovative criteria - smart readiness, materials logbook for circular economy, LCC etc. - to boost transparency, reliability, and count on comparable good quality certifications. The project partners 'countries cover many climates, building typologies and construction types, sustainability and EPC scheme operators; the EuB SuperHub consortium was able to collect a large number of building (certificate and assessment) samples and store them in the geo-located cloud database.

Moreover, through adopting a bottom-up and a top-down approach (benefitting system operators' and assessors' experience) in the online deployment of the next generation holistic building assessment, the transparency and engagement between the policy makers, the funding agencies, the specialists and the building user was ensured throughout the entire project duration.

One of the main results of the project has been the development of a new European pre-standardization document: the CWA 18127:2024 "EUB SuperHub - A harmonization of KPIs for supporting the next generation of EPCs", aimed at creating a harmonized system of Key Performance Indicators (KPIs) for Energy Performance Certificates (EPCs). This document provides an essential reference framework to support the next generation of EPCs by ensuring consistency, interoperability, and a holistic approach to assessing the energy performance of buildings. The document is freely accessible and downloadable from the CEN website (https://www.cencenelec.eu/get-involved/research-and-innovation/horizon-europe-projects/cwa-download-area/).

Background and Objectives

The CWA 18127:2024 emerges from the need to enhance the effectiveness of EPCs across the European Union (EU). The European Commission's Renovation Wave Strategy, launched in 2020, underscores the urgency of increasing the rate and depth of building renovations to achieve climate neutrality by 2050. In response, the EUB SuperHub project, funded under Horizon 2020, has proposed a harmonized framework to improve the quality, visibility, and usability of EPCs across Member States (MS).

By addressing existing discrepancies among national EPC systems, this initiative ensures a more unified and efficient approach to building performance assessment, aligning with the Energy Performance of Buildings Directive (EPBD 2018).

Scope of CWA 18127:2024

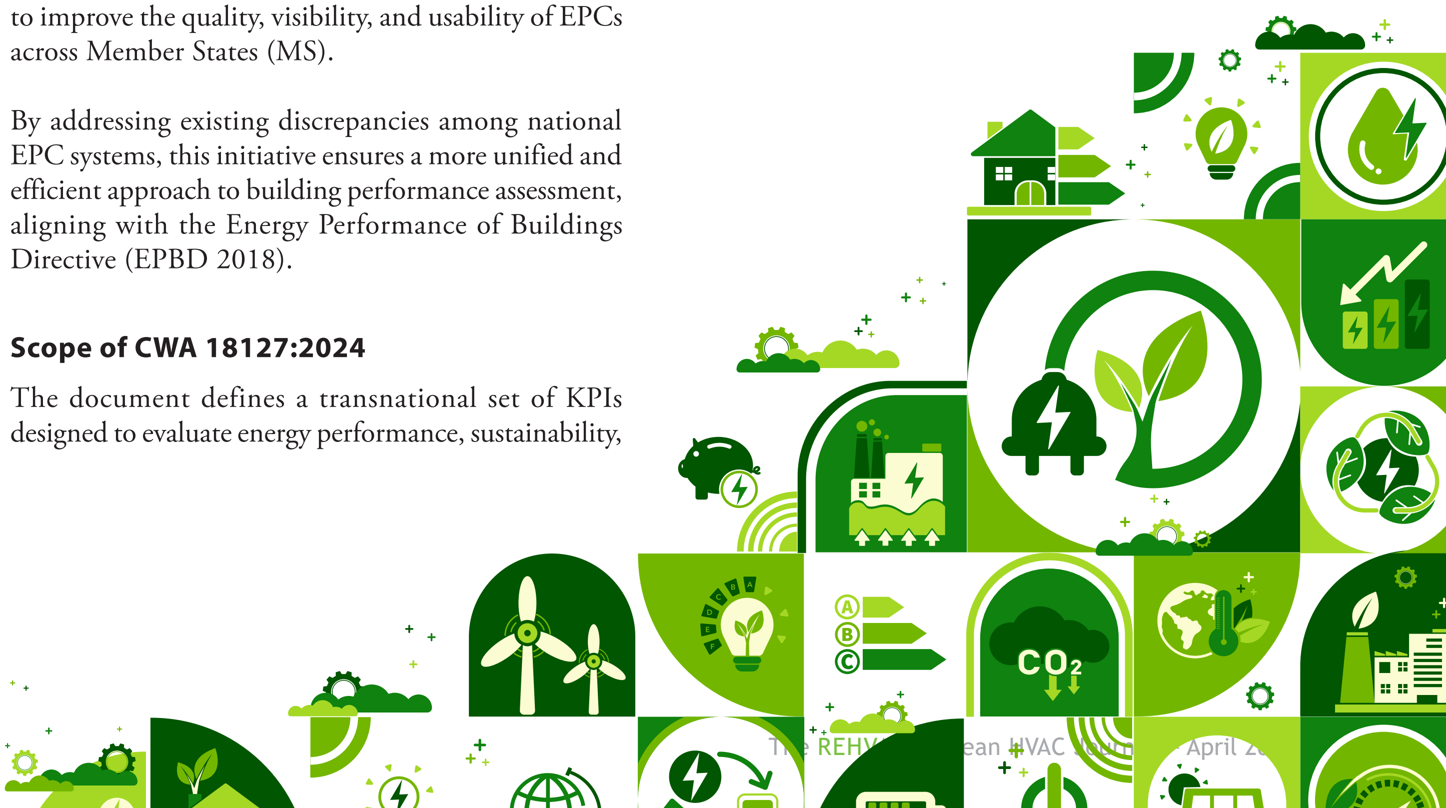
The document defines a transnational set of KPIs designed to evaluate energy performance, sustainability, and smartness in buildings. These indicators contribute to a digital building logbook and facilitate the creation of a harmonized 'building e-passport.' The framework serves various stakeholders, including policymakers, building owners, and energy professionals, by providing clear and actionable data for decision-making.

A Holistic and Integrated Approach

The CWA 18127:2024 adopts a comprehensive evaluation methodology, considering multiple interconnected factors influencing building performance. The traditional focus on energy consumption is expanded to include environmental, social, and economic dimensions.

Key motivations for this holistic approach include:

- **Environmental Stewardship**: Addressing climate change impacts and promoting sustainable building practices.
- **Technological Evolution**: Incorporating smart technologies that optimize energy use and operational efficiency.
- **Occupant Health and Well-being**: Ensuring buildings support a healthy indoor environment.
- **Energy Security and Autonomy**: Encouraging on-site energy generation and storage solutions.
- **Regulatory Compliance**: Aligning with evolving EU standards and legislation.
- **Economic Considerations**: Assessing long-term cost efficiency and return on investment.



The CWA identifies 21 KPIs grouped into ten thematic areas, each addressing crucial aspects of building performance:

1. Energy Consumption
    - Delivered annual energy per area unit
    - Total annual primary energy use per area unit (self-used)
    - Non-renewable annual primary energy use per area unit (self-used)
    - Embodied energy
2. Renewable Energy
    - Renewable annual primary energy use per area unit (self-used)
    - Renewable energy ratio (on-site, nearby)
3. GHG Emissions
    - Operational greenhouse gas emissions
    - Life Cycle Global Warming Potential (GWP)
4. Thermal Comfort
    - Percentage of time outside of thermal comfort range
5. Indoor Air Quality
    - Ventilation rate
    - CO_2 concentration
    - Relative humidity
    - Total VOCs and specific harmful pollutants
6. Costs
    - Operational energy cost
7. Smart Buildings
    - Smart Readiness Indicator (SRI)
8. Resilience to Overheating
    - Summer thermal discomfort in 2050 projections
9. E-Mobility
    - Percentage of recharging points and pre-cabling for electric vehicles
10. Daylight Sufficiency
    - Assessment of daylight provision

To facilitate consistent evaluation, each KPI is documented in a structured template outlining:

- Definition and scope
- System boundary and unit of measurement
- Applicable standards, calculation methods and comparability of the results
- Required data sources and assessor competencies

For example, the **Delivered Annual Energy per Area Unit** KPI considers both calculated (asset-based) and measured (operational) assessment methods. The framework allows for comparability across different climates and building types by standardizing reference conditions and energy factors.

The selection process followed a bottom-up approach, incorporating stakeholder consultations, initiatives from the European Commission and existing standardization efforts.

This to ensure that the final set of KPIs can effectively support the relevant EU legislations; it is applicable by the market stakeholders and relevant to them; with the final aim to support the strategy for an energy transition in the building sector.

The adoption of the CWA 18127:2024 has significant implications for the future of EPCs in Europe. By fostering standardization and digitalization, the framework enhances transparency and facilitates the integration of advanced energy management systems.

The CWA 18127:2024 represents a major step forward in harmonizing EPCs across the EU. By establishing a robust set of KPIs and aligning with the latest policy developments, it paves the way for more effective energy performance assessment and sustainable building practices. The EUB SuperHub initiative sets a precedent for future innovations in the field, ensuring that Europe moves towards its climate goals with a clear and actionable framework. The expected outcomes include indeed streamlining data collection and analysis to support renovation decisions; providing clearer and more reliable EPCs for real estate transactions; while enhancing policy implementation.

CWA 18127:2024 EUB SuperHub - A harmonization of KPIs for supporting the next generation of EPCs. ■

EPC RECAST: paving the way for the next generation of EPCs





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The EPC RECAST project developed an innovative protocol to facilitate the work of EPC assessors in their daily activities and improve renovation recommendations for building owners. It provides an integrated workflow, from the on-site visit to the delivery of the certificate. Extensive testing with professional EPC assessors in six countries allowed to prepare technical and policy recommendations for an EU-wide EPC framework in line with the EPBD IV directive [1].

Keywords: EPBD; Energy Performance Certificates; Energy audits; Building data models; Standardization; Building Renovation Passports; Renovation roadmaps; Digital tools; On-site visits; Dynamic energy simulation

Towards a new generation of Energy Performance Assessment and Certification:

Many EPC assessors, energy consultants and stakeholders agree on the need to reduce the time needed for a comprehensive data collection on the building geometry and technical characteristics (envelope, energy systems). Most professionals do not use advanced digital tools They often rely on default thermal parameters from reference tables to evaluate thermal characteristics of walls, windows, roofs (eg: France, Italy, Spain). Values are often obtained from proxies like the estimated year of construction or basic assumptions about wall compositions.

Most EPC simulation software rely also on static modelling methods of the energy balance and performance of energy systems. Dynamic energy simulation models better represent several key thermal and energy phenomena: daily and seasonal variations of HVAC system efficiency, electricity production from PV panels, thermal inertia of the building.

EPC simulation results rarely correspond to real energy consumptions. Asset ratings are not aimed at representing the reality, rather the intrinsic quality of the building envelope and energy systems. However, the parameters of the model are never verified with simulations under real conditions (weather data from nearby weather stations, realistic heating system use, etc), which would enable to compare the model with measured real consumptions.

EPCs must also contain renovation recommendations for owners. Most of the time, recommendations are basic and unreliable due to the low cost of EPCs and lack of time to define tailored renovation scenarios.

To tackle these challenges, EPC RECAST created a well-structured process and toolbox supporting a new generation of Energy Performance Assessment and Certification, with a focus on residential buildings.

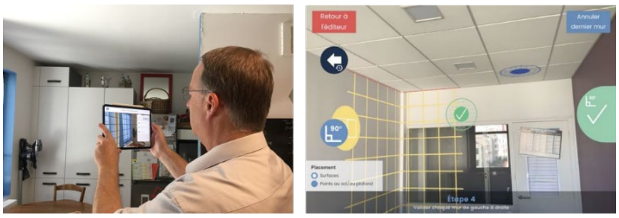
The EPC RECAST protocol

- Step 1: On-Site Visit and Diagnosis for data collection
- Step 2: Energy model calibration and energy simulations
- Step 3: Renovation roadmap and new generation certificate.

The digital implementation is based on a common data ecosystem relying on a software-neutral data model of the building (XML format) and a digital platform, which interconnect several applications. A detailed review of all technology components is provided in [2].

Step 1 – On-Site Visit and Diagnosis for data collection

The EPC assessor uses on-site the BIMEO augmented reality application on a tablet [3] to assess the precise dimensions of the dwelling, measuring the surface area of the walls, floors, ceilings and windows to create a 3D model and floor plans of each level. The model can be enriched with geolocated photos, notes, and by answering questionnaires to characterize the thermal performance of the building's components.



BIMEO app for the on-site visit.

Step 2 – Energy model calibration and Simulations

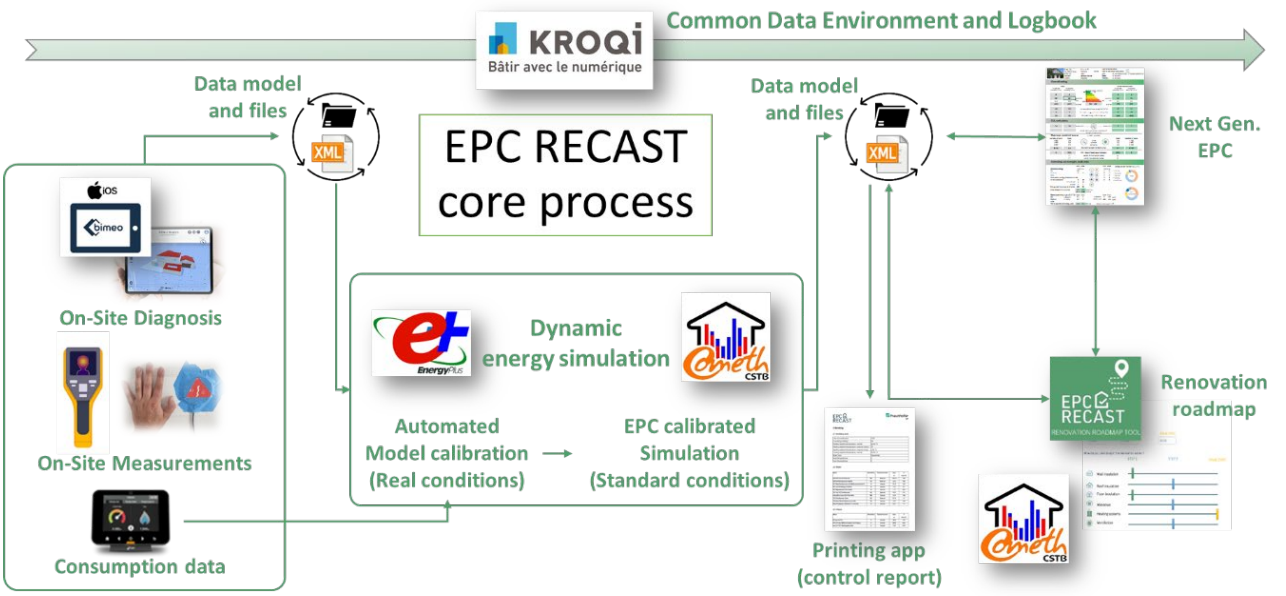
Information from Step 1 is used to generate automatically the building data model in XML format. This standardized file is stored in a secure digital logbook based on the KROQI technology. Both the owner and assessor can update it at any time by uploading files such as photos, invoices, estimates of past renovation works.

To evaluate the asset rating (A to G), the assessor runs a dynamic energy simulation from a simplified web form [4] that connects, through data conversion algorithms, the data model to an advanced simulation engines (COMETH or Energy Plus) compatible with ISO/CEN Standards (M/480 Mandate) [5].

When specific energy consumption and temperature measurements are available, the simulations can be refined with a calibration module. Some physical input parameters are then automatically readjusted (U-values, ventilation flow rates or infiltration rates, etc) [6]. The assessor can also generate a pdf report containing the key input and output data of the simulation. This allows additional checks of the EP assessment in an easy-to-read format.

Step 3 – Certificate and Renovation Recommendations

The assessor can finally use a Renovation Roadmap web service to define renovation scenarios in one or more steps with just a few clicks, relying on the same data model as the EPC [4][7][8].



The EPC RECAST core process.

The assessor fills in a EPC new template that was developed following the requirements of EPBD IV [7]. It contains numerous indicators about the building's performance before and after renovation like simulated and actual energy consumptions, energy costs, summer thermal comfort and CO_2 emissions. Renovation recommendations are a summary of the Renovation roadmap, ensuring consistency between both tools.

Testing on pilot cases and preliminary results

The process was tested on 80 pilot dwellings in six pilot countries (France, Germany, Italy, Luxembourg, Slovakia, Spain), in collaboration with professional EPC assessors. Half of the pilots were subjected to Long-Term Monitoring of the energy consumption, indoor and outdoor conditions. Standard EPCs and EPC RECAST EPCs were issued for each dwelling and compared in terms of working process, input datasets and simulation results. Additional technology components were tested some pilots, including:

- evaluation of the walls' U-values with heat-flux meters
- operational rating procedure (EN 15378-3:2017 standard) [5].

More information is available in deliverables [10] and [2][6].

The studies demonstrated the integrated process was feasible and could lead to reliable simulation results. This proves innovative digital services can be used to evaluate the energy performance if built around software-neutral data models as the foundation of data ecosystems. The ecosystem allows automatic connections and conversions between different datasets, file formats, simulation engines, digital tools, avoiding data duplication and inconsistencies.

However, such developments will take time with key elements needed:

- Strong and continuous support from public authorities, regulations and policy provisions
- Collaborative standardization processes at national and European levels, leveraging or improving existing sets of ISO and CEN standards
- Effective IT development and marketing strategies from R&D to market

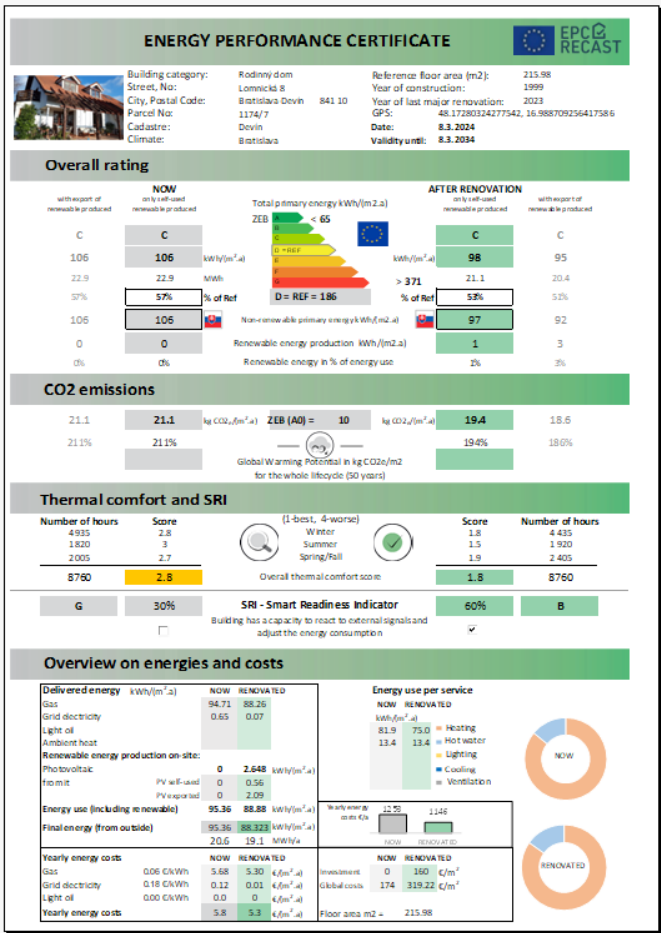


Figure 4. New EPC template compliant with EPBD IV.

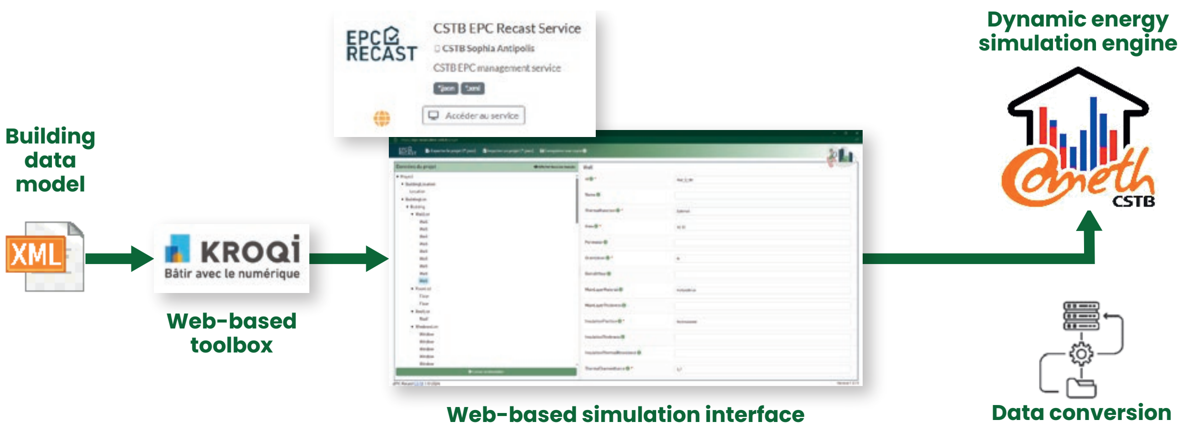


Figure 3. Dynamic energy simulation process.

Acknowledgment

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Project website: https://epc-recast.eu/

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[2] EPC RECAST – Overall journey of the EPC RECAST methodology.

[3] EPC RECAST – Data acquisition protocol for the geometry and semantics within the onsite visit.

[4] EPC RECAST – Online interfaces for EP assessment and renovation roadmap.

[5] EN ISO 52000-1:2017 Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures.

[6] EPC RECAST – Cross exploitation of energy-related measured data and EP modelling.

[7] EPC RECAST – EPC RECAST Certificate and Renovation Roadmap.

[8] EPC RECAST – User centric indicators and recommendation tool.

[9] EN 15378-3:2017 – Energy performance of buildings - Heating and DHW systems in buildings - Part 3: Measured energy performance, Module M3-10, M8-10.

[10] EPC RECAST – Lessons learned from the demonstration.

[11] EPC RECAST – Policy recommendation paper for an EU wide deployment of EPC RECAST. ■

EPC RECAST's final policy recommendations

The project's final outcome and perspectives [2] was compared with the EPBD IV to prepare final policy recommendations [11]. The main recommendations are summarized here.

R1 - Developing common data ecosystems and standardized building data models
EPC RECAST recommends establishing standardized and simulation software-neutral digital models of buildings at national and European level to facilitate the development of data ecosystems. This would foster interoperability between digital tools through a common digital description of building elements, technical systems and KPIs.

R2 - Ensuring compatibility between data ecosystems and national implementations of the EPBD
Data ecosystems for EP assessment can be designed as collaborative digital environments involving several software companies and application providers. Alternatively, they can be designed as integrated software maintained by the same organization. Common data ecosystems must be compatible and interoperable with national implementations of the EPBD and EP assessments calculated in this way.

R3 - Supporting the development and use of digital tools for on-site visits and data collection
Mature innovative digital technologies for on-site visits and automated connections to product database could reduce the EPC assessment process by 20-30%. Full interoperability with simulation tools could further reduce working times by up to 50% if the collected data automatically fills in the input dataset of the simulation model.

R4 - Collecting high-quality metered consumption and climate data for quality checks
Operational rating procedures based on EN 15378-3:2017 could be used to compare simulated heating and DHW consumptions with metered consumptions normalized against weather data and operating conditions. This would allow to detect major inconsistencies in EPC simulations or help confirm the energy model is valid. High-quality metered data is needed at a monthly time step.

R5 - Encouraging the use of calibration procedures for quality checks
As a longer-term perspective, independent EPC verifiers and EPC assessors could use calibration algorithms to run automated quality checks of the input data and heating/cooling simulation results, to detect potential inconsistencies. Anonymized and automated collection of metered energy uses from smart meters will be necessary.

R6 - Positioning the target cost of EPCs and BRPs compared to energy audits
The target cost of EPCs and Building Renovation Passports is a key question for public authorities: how much should an owner pay? This will strongly influence evolutions of working practices and design of software interfaces. Comprehensive on-site visits, careful adjustments of simulations and renovation roadmaps can be time-consuming: should EPCs and BRPs become closer to energy audits?

R7 - Getting the most in the EPC for its price
Building owners should get as much information as possible from the EPC for the price they pay. The EPC's content could be enriched with information collected digitally during the on-site visit and from remote metering: blueprints, photos, observations (eg: potential sources of good/bad IEQ, mould, wall cracks), operational rating, etc.

R8 - Specifying minimum requirements of software interfaces for BRPs
More discussions are needed at European and national scale on the levels of standardization and simplification of building renovation passport interfaces. Should the definition of renovation actions for energy simulations be highly flexible and the input data highly tweakable or should the user rely on default values and limited sets of options?

R9 - Leveraging synergies between Articles 9 and 12 of the EPBD IV
Renovation Passport and Roadmap tools could be used by Member States on sampled buildings representative of the national building stock to fine-tune their national renovation trajectories and strategies. Complementarily, a building renovation scenario should be comparable to the objectives set in the national trajectory: would the renovation project participate to targets set for 2030, 2040, 2050?

R10 - Developing digital logbooks as digital hubs for regulatory tools
Digital logbooks can constitute the basis of building data ecosystems by combining secure storage and management of datasets and files. They could become digital hubs that interconnect software and tools required by the EPBD IV: EPC and BRP software, national databases for the EP of buildings (Article 22), building product database.

Measures to Promote Grid Interaction When Applying PV

*Measures under discussion in the Netherlands**

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* Based on an article from Edwin van Gastel of Solarmagazine.nl

This article lists some of the most important measures under discussion by Dutch officials. From making the use of the power grid more flexible by consumers and SMEs, to a price guarantee for heat networks, boosting energy hubs, applying energy planning to control the locations of large-scale batteries, investing in electrolysers for hydrogen and putting more strain on the power grid, among other things.

Measure 1: Flexibilization of small-scale users

One of the most important measures proposed by the officials is flexible grid use by small-scale users. This includes all households, but also companies and institutions that have a connection up to and including 3 × 80 amps for which they pay a fixed capacity tariff. Several measures are needed to deploy flexible grid use by small-scale users.

For example, the officials want the Netherlands to advocate in an EU context for standard, open communication protocol(s) for smart devices and energy management systems, and standardization of smart grid-intensive flexible devices. This could be done through an amendment to the Ecodesign Directive. In anticipation of this, standards for smart charging stations, smart heat pumps, home batteries and solar panel inverters should be explored and, if possible, the financial support for heat pumps should only be made available for smart heat pumps from 2027 or 2028.

In addition, the officials propose to subsidize home energy management systems. According to the officials, an energy management system can, for example, help to increase the self-consumption of solar power, which will become more attractive in connection with the phasing out of the net metering scheme from 2027.

In addition, the officials argue in favour of introducing a network tariff that is differentiated in time and volume for small-scale users. A flexibility/peak shaving service for small-scale users should also be introduced on the basis of congestion management and redispatch. In addition to differentiated tariffs, small-scale users can then receive a – small – compensation if they adjust their consumption to the availability of the electricity grid. The grid operator gives a signal to which small-scale users can respond. The officials are also thinking of introducing additional grid protection, which means that production/consumption is automatically limited if there is an acute threat of overloading of the power grid.

Measure 2: increase the share of dynamic contracts

The officials think that increasing the share of consumers with dynamic energy contracts can help reduce grid expansion costs. At the moment, the Dutch government is neutral with regard to the type of contract chosen by consumers.

Currently, more than 400,000 consumers (around 5 %) have a dynamic electricity contract in the Netherlands. 'Standardisation, such as a minimum share of dynamic contracts sold, encounters objections in European legislation, quite apart from the question of whether it is desirable', the officials point out. 'A possible levy on fixed and variable contracts is currently not attractive from an implementation perspective.' According to the officials, the government should therefore focus on improving the provision of information about dynamic contracts and the subsidy for energy suppliers to increase the purchase of dynamic contracts.

Measure 3: Make large-scale consumers more flexible

Another policy measure proposed by the officials is to make the electricity consumption of large consumers more flexible. They want the government to extend the subsidy scheme for increasing flexible electricity consumption – the Flex-e subsidy scheme – until at least 2030. In their view, this can unlock a greater potential for flexibility.

Measure 4: Control location through energy planning

With location management via energy planning, the officials want local governments to proactively make reservations for the development of demand, flexibility and supply at network-efficient locations.

According to the officials, a stronger focus on placing generation, use and storage capacity closer together can reduce the investment task in the power grid or prevent an additional increase. "Energy storage in the right places in the electricity network and under the right conditions can contribute to reducing the investment task".

Measure 5: Stronger enforcement of energy saving obligation

The Dutch government requires locations of companies and institutions with an annual use of 50,000 kWh of electricity or 25,000 m^3 of natural gas to implement all measures with a payback period of 5 years or less. In 2027, measures with a payback period of 7 years or less will become mandatory. Solar panels are also subject to the energy-saving obligation.

Measure 6: Boosting local energy hubs

Another attractive option, according to the officials, is to strengthen the development of energy hubs. Energy hubs can ensure that companies can better coordinate their supply and demand for renewable energy. This allows them to electrify without a larger connection.

Measure 7: More targeted investment in electrolysers

This proposed measure aims to tighten up existing or upcoming subsidies for hydrogen projects. The proposal is to make subsidies available for hydrogen infrastructure and electrolysis projects and to use these subsidies to ensure that they are realized in the right place.

Without these hydrogen projects in the right place, the electricity generated must be transported over longer distances and the costs of grid reinforcement are therefore higher. According to the officials, making these subsidies available is necessary because hydrogen projects are not yet profitable.

Measure 8: Heavier load on the power grid

Officials also looked at the possibility of encouraging network operators to release more transmission capacity by taxing grid components more heavily and deploying fault reserves; Even if this increases the security of supply risk.

Measure 9: Price guarantee for heat networks

According to the officials, heat networks can significantly reduce electric grid reinforcement in existing build environment. They believe that this policy option will improve the attractiveness of heat networks for end users of heat networks.

'Heat networks enable the use of available heat sources such as residual heat and geothermal energy, so that less space is required for the generation of sustainable electricity, such as via wind farms or solar meadows,' they continue. 'In addition, the local electricity grid – including above-ground distribution stations in the neighbourhood – does not need to be reinforced as much. Netbeheer Nederland (association of all Dutch energy grid operators) is counting on 2 to 4 new transformer houses for e-cars and solar panels for a district on a heat network with 1 200 residents. If the same district switches to heat pumps, four extra transformer stations will be added.' ■

Impact of Indoor Air Quality on Mucosal Irritation in Danish Apartment Buildings

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Dry indoor air is a significant concern in residential buildings, particularly in Nordic climates where heating systems often reduce indoor humidity levels. This study investigates the relationship between indoor environmental conditions – specifically, temperature and relative humidity – and symptoms of dry eyes, nasal, and throat irritation among residents of Danish apartment buildings. Using survey responses and indoor climate measurements from 75 participants in Copenhagen and Odense, the study found a weak inverse correlation between indoor humidity/temperature and irritation symptoms. However, variations in symptoms suggest other contributing factors, such as air pollutants and ventilation rates, require further investigation.

Keywords: IAQ, relative humidity, residential, mucosal irritation, survey.

Introduction and Background

Dry eyes are a common condition influenced by multiple factors, including environmental conditions such as humidity, temperature, and air quality. Previous studies have indicated that dry indoor environments can contribute to mucosal irritation, particularly in office settings and urban residential areas. Studies have shown that indoor relative humidity (RH) levels below 70% are associated with increased symptoms of dry eyes and skin irritation (Martin, 2023). However, the relationship between indoor climate and mucosal irritation in residential settings—especially in Nordic countries—remains underexplored. According to EN 16798-1, the recommended indoor relative humidity (RH) for comfort and health ranges typically from 30% to 50%. Maintaining RH within this range helps minimize the risk of mucosal irritation and reduces the likelihood of microbial growth or other related indoor air quality issues.

The impact of air pollutants on dry eye symptoms has been documented, with particulate matter ($PM_{2.5}$) and volatile organic compounds (VOCs) contributing to eye irritation independently of humidity levels (Mo et al., 2019; Tan et al., 2018). Furthermore, studies have demonstrated that poor indoor ventilation can exacerbate the accumulation of these pollutants, thereby increasing irritation symptoms (Jones et al., 2022). Despite these findings, there remains a lack of consensus on the direct effect of indoor humidity on dry eyes and other mucosal symptoms (Huang et al., 2020).

The present study aims to assess indoor environmental conditions in Danish apartment buildings and their potential impact on dry eye symptoms. Through a combination of survey responses and environmental monitoring, this study seeks to provide insights into the role of indoor air quality in occupant comfort and health.

Methods

The study included a two-stage survey and indoor climate monitoring. The first questionnaire collected demographic data and self-reported symptoms of irritation in the eyes, nose, and throat over four weeks. Participants willing to continue were provided with an indoor climate monitor (LASCAR EL-USB-2) (**Figure 1**) to measure temperature and relative humidity over seven days. A follow-up survey collected additional symptom data after the monitoring period.

Results and Discussion

A total of 75 participants completed the first questionnaire, and 59 continued to the monitoring phase. Indoor temperature and humidity were recorded from March to May 2023. The results indicated that 46.3% of apartments had temperatures between 20–22°C, with 40.7% in the 22–24°C range. The majority (59.3%) had RH levels between 30–40%, which is within typical indoor comfort ranges.

Figure 2 presents the distribution of self-reported symptoms from the first questionnaire, showing that 51% of participants reported eye irritation, 60% reported nasal irritation, and 44% experienced throat discomfort.

Figure 1. Indoor climate monitoring device (LASCAR EL-USB-2) used in the study.

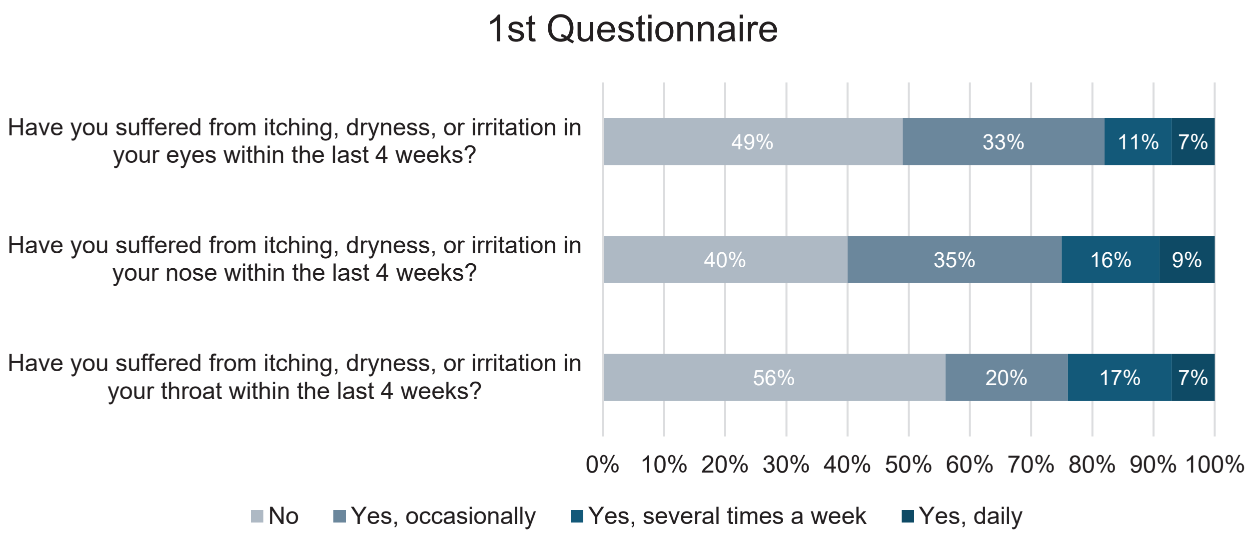

Figure 2. Prevalence of reported symptoms from the first questionnaire.

In contrast, the second questionnaire showed a slight decline in irritation prevalence, but an increase in daily symptoms for some participants (**Figure 3**).

Pearson correlation analysis indicated weak negative correlations between temperature/humidity and symptoms (r = −0.16 for temperature and −0.17 for RH). These findings suggest that while temperature and humidity may play a role, other indoor air quality factors such as particulate matter and volatile organic compounds (VOCs) could have a more significant impact. **Figure 4** (on the next page) illustrates the correlation trends between symptoms and environmental parameters, highlighting the lack of strong statistical significance.

Conclusion

This study found no strong evidence linking indoor temperature and humidity levels to mucosal irritation in Danish apartment buildings, though slight inverse correlations were observed. These findings suggest that other factors, such as air pollutants and ventilation rates, may contribute to irritation symptoms. Future studies should incorporate measurements of particulate matter, VOCs, and ventilation efficiency to provide a more comprehensive understanding of indoor environmental impacts on occupant health.

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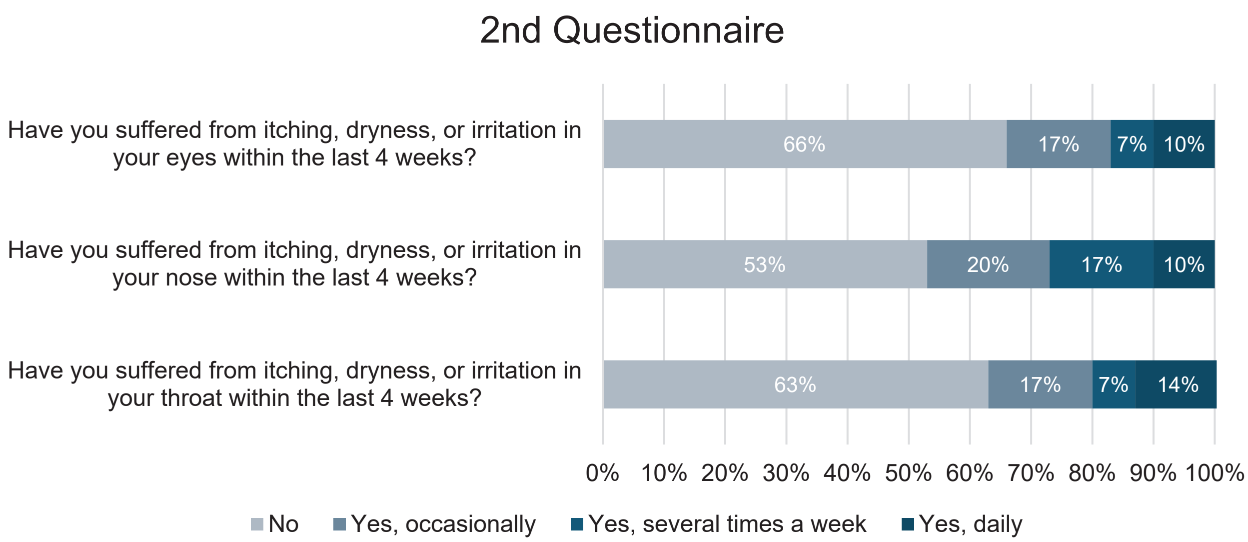

Figure 3. Comparison of symptom reports between the first and second questionnaires.

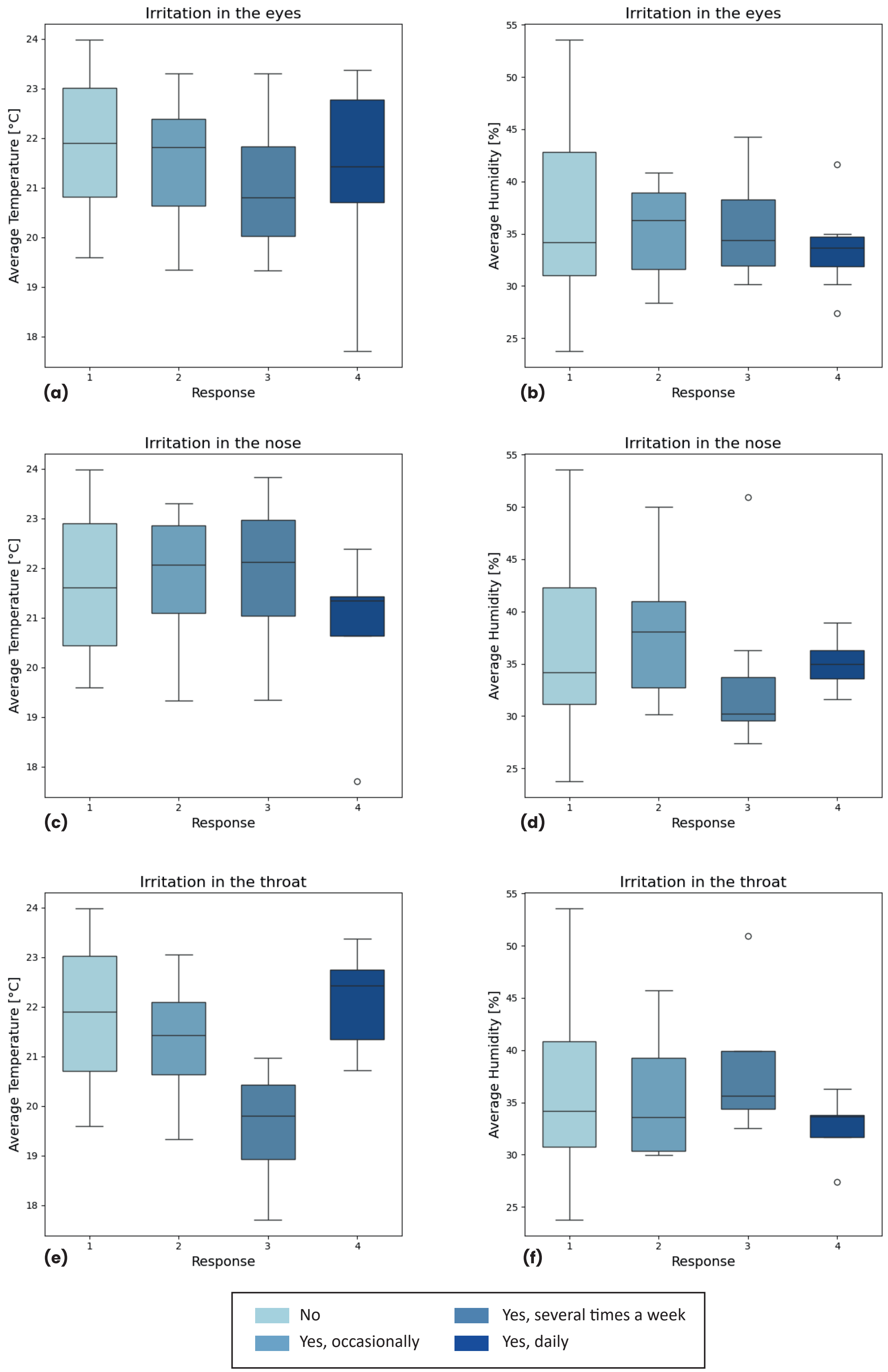

Figure 4. Correlation trends between indoor temperature/humidity and reported irritation symptoms.

Introduction to Interview Series 2025

In this issue of REHVA Journal (2/2025) we start with publishing a series of interviews focusing on smart technologies and HVAC systems. Our discussions will cover a wide range of topics, from intelligent buildings to PD (Proportional-Derivative) controllers to BACS (Building Automation and Controls Systems) and AI (Artificial Intelligence) controlled systems.

We will explore how technology can transform buildings into smart and intelligent structures. But what do we mean by "smart building "or "intelligent building"? Interestingly, Wikipedia redirects both terms to the "Building automation" page, which states: *A building controlled by a BAS (Building Automation System) is often referred to as an "intelligent building", a "smart building", or (if a residence) a smart home*. BAS is described as *the automatic centralized control of a building's HVAC systems.*

When did this all begin? The journey likely started in the late 1940s with the introduction of the transistor, a fundamental component of modern electronics. The next significant milestone was the development of the digital computer in the early 1950s. The third crucial innovation was the Internet, initially known as ARPANET, developed for the US military in the 1960s.

These inventions laid the groundwork for digital communication. However, the driving force for controlling and operating buildings more efficiently emerged during the Oil Crisis of the 1970s. This period marked a shift towards not only automating building operations but also enhancing energy efficiency. Consequently, ventilation rates were reduced, leading to the identification of SBS (Sick Building Syndrome).

From the late 20s century onwards, we have witnessed significant advancements in the design and operation of (office)buildings. The advent of the internet has greatly enhanced the intelligence and smart capabilities of buildings and their interaction with the energy grids. Let's talk about these developments with experts whose work helps to improve design and operation of buildings through smart technology. ■

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Timeline

1947	The transistor was invented
1951	The first digital computer was created
1966	US Military developed ARPANET (the predecessor of Internet)
1973	Start of Oil Crisis, and the first mobile phone call was made
1975	Founding of Microsoft (operating system for personal computers)
1986	The first time WHO used the term Sick Buildings Syndrome (SBS)
1987	The Global System for Mobile Communications (GSM) agreed
1989	Montreal Protocol entered into force
1990	1st BREEAM certificate, UK
1991	The World Wide Web is made available for public use
1996	Founding of Google
1998	1st LEED certificate, USA
2002	EU adopts EPBD (Energy Performance of Buildings Directive)
2003	3G was introduced and mobile connection to internet
2007	iPhone was introduced (smart phone)
2008	The first mobile using Android operational system
2013	1st WELL certificate, USA
2024	EU adopts the 4. version of EPBD with SRI (Smart Readiness Indicator)

Interview with Heikki Ihasalo by Lada Hensen Centnerová

What is an Intelligent building? Theory & practice

Professor of Practice **Heikki Ihasalo** (D.Sc.) works at the Department of Electrical Engineering and Automation at Aalto University His professorship focus is on smart building technologies and services. His research activities are within building data semantics, advanced control solutions, smart workplace applications and smart building rating systems. He has over 20 years' experience in research and development within smart buildings both in academia and industry. In addition to Aalto University, he works as an innovation director at Granlund.

LHC: You are a professor of practice focusing on smart building technologies. What is your definition of intelligent building?
HI: That is a good question. I would start with the basics. Intelligent building must provide a good environment and at the same time must be using as little energy as possible. And nowadays it is not only about energy consumption but also about the flexibility of energy demand. That is the traditional point of view to intelligent buildings. Already four years ago we widened this traditional point of view on user centricity a bit.

LHC: Yes, I think you mean the paper 'Smart workplace solutions – can they deliver the offices that employees have been waiting for?' based on the PhD research of Laura Remes [1].
HI: Indeed. We noticed already a few years ago that there were coming a new kind of startups to our area, providing mobile applications for building users to find and book meeting rooms but also to see where printers are located, type and opening hours of cafes in the building. Especially new students at our university really appreciate this kind of applications.

LHC: This kind of features are part of BREAM and LEED certification schemas, so if building owners want to score high in such a certification, they need to have these applications.
HI: That's true. Recently introduced SRI (Smart Readiness Indicator) under the EPBD rates buildings in 3 key functionalities [1]:

- Energy efficiency
- Grid flexibility
- Adaptation to users' needs

The adaptation to users' needs is defined in terms of four attributes: comfort, convenience, promoting health and wellbeing and the building's ability to provide information to occupants. The last attribute are mobile applications we are here speaking about.

LHC: I was shocked by one figure in the paper we are referring to. Here in Figure 1. Could you explain this figure, please?

HI: In our research we were looking at 30 different mobile applications where we identified 36 smart features and then based on the frequency of their occurrence, we made a graph of the most relevant features (for the users) and that is here the **Figure 1**.

LHC: Are you saying that the building users are not very much interested in the quality of their indoor environment, but they are more concerned about the safety of having an appropriate working place?

HI: Yes, exactly. These were results based on the technology available to building users (features that were mentioned in the applications). In our later research we interviewed many facility managers who use this kind of applications in their buildings and asked their point of view [2]. Also, here IEQ and even building performance were not in the core of the graph.

LHC: Let's come back to the definition of intelligent building. T. Derk and J. Clements-Croome wrote in 1997 in their paper, "What do we mean by intelligent building?" [3] …intelligent buildings can cope with social and technological change and also are adaptable to human needs… Is that the good definition?

HI: That sounds like AI (Artificial Intelligence). After collecting data from using a building, you see, for example, how people are using the meeting rooms. If there is more demand for smaller meeting rooms, you can adapt the building and make from one big meeting room a few small meeting rooms. The space is to meet the requirements of the users. That is how buildings adapt to human needs, so yes, I like that definition.

LHC: This is very different from what was originally seen as an intelligent building in the '80s [4]: The first intelligent buildings were mainly used to control heating, ventilation and airflow (HVAC).

HI: I would say that to some extent that is still very important. Also, SRI (in EPBD) concentrates more on energy efficiency and flexibility but there are also features related to comfort and convenience of use.

LHC: OK. Let's talk about practice. How can you make a house smart/intelligent in terms of energy efficiency?

HI: I can explain it with an example on room level presented in **Figure 2**. The traditional way would be to have a PI controller with a set point (blue line). In this case is the set point most of the time on 21,5°C. Then you have a valve (red line) which goes from 0 to 100% open. The PI controller is balancing the room temperature (orange line) by opening and closing the valve.

If we want to control the room temperature and at the same time optimize the cost of heating, we need to add a smarter solution, machine learning. The yellow line in our example represents the price of electricity, which has mostly its peak between 7.00 and 9.00 in the morning. This system preheats the room to avoid heating indoors in the price peak. This example still needs a bit of tuning to the model because right now, there is a short period of heating between 8.00 and 9.00.

LHC: You used the term 'machine learning'. What does it mean exactly? And what is the difference with 'reinforcement learning'?

HI: Reinforcement learning is one of the methods used in machine learning. We usually speak about three groups of machine learning [5].

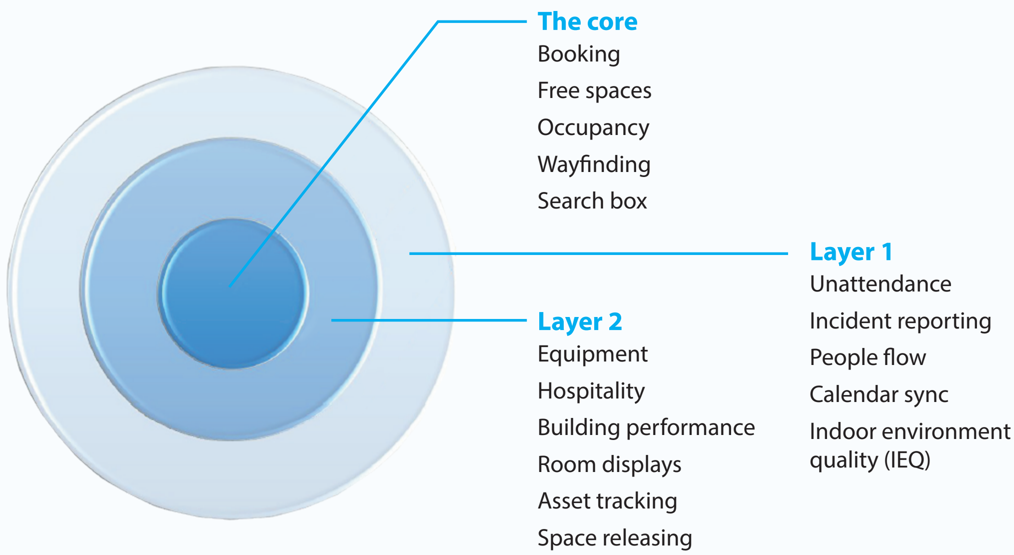

Figure 1. The core and two layers.

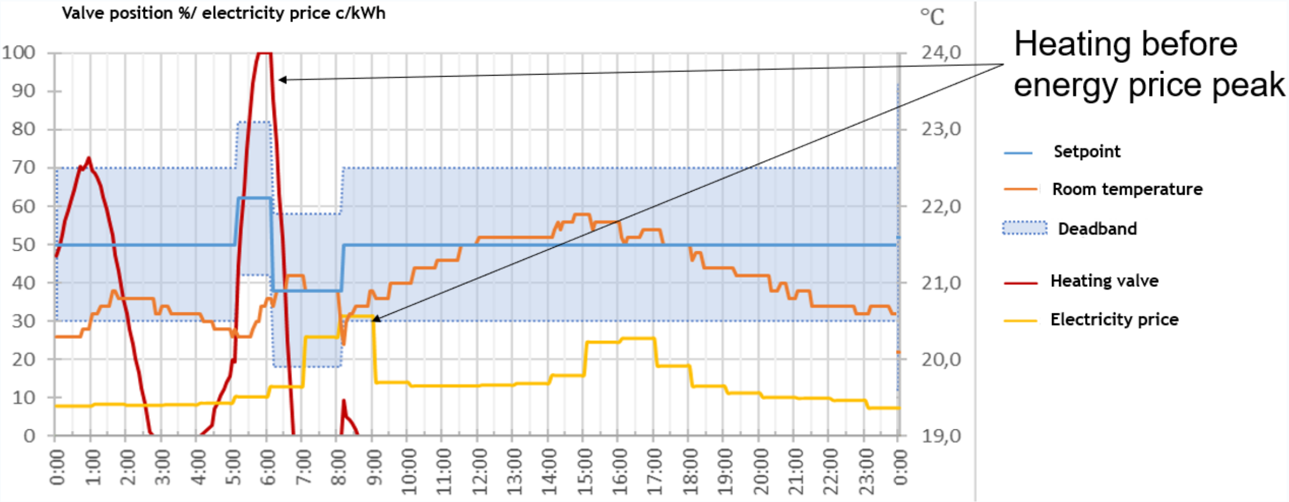

Figure 2. Room heating demand response.

Perhaps the most traditional way is 'supervised learning'. You train the model with a data set of input and output data and then the model learns the relationship between the input and output data. Using this kind of model, you can predict the future.

Then there's the unsupervised learning that is more like using different kind of statistical methods to find typical clusters in the data set. For example- it is possible to find abnormal energy consumption patterns from a group of buildings.

And then you have the reinforcement learning where you don't need any kind of human to tech system. It learns by itself. Just by trial and error.

LHC: Yes, I read about this. Sometimes it's called 'rewards and punishment'. Can you give an example of a building (system) where you can better use machine learning and not just a PID controller?

HI: PID is really good in simple control like single input and single output but when you need a multi objective optimization, like we spoke earlier about that, or you have a more complex system or when you need predictions for the future, then you use machine learning.

LHC: I read somewhere that the problem with using machine learning is having the operational data to teach the algorithm.

HI: That is true. You need data to teach the algorithm but that can be data from the existing building (historical data), or you can create them with simulation. The supervised machine learning model learns itself from historical data. It can only do things that have been already happening previously. But if something new happens, it's like, what do I do? But reinforcement learning, which learns from reward and punishment, can also adapt to the new situation.

LHC: When I supervise students' projects at our university, I ask them what they think is more sustainable: high-tech building or low-tech building. What is your thought about this?

HI: Well, if I take example from my own life, having a second home from the 40s in the countryside with natural ventilation, it works quite nice during autumn and spring but during summer it's too hot and during winter a bit cold. And if I compare this to a new building with good insulation and balanced mechanical ventilation, where I live in the city. I prefer when everything is automated in the background.

Sources

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CLIMA 2025

Decarbonized, healthy and energy-conscious buildings in future climates

4th - 6th June, Milan, Italy

REHVA WORKSHOPS WITH INTERNATIONAL PARTNERS

REHVA-ISHRAE: Indoor climate targets and design requirements in Indian and European education buildings

Poor indoor air quality in schools is a growing concern, with inadequate ventilation, exposure to outdoor pollutants, and thermal discomfort affecting students' well-being and performance. While energy efficiency in buildings has been prioritized in recent years, it has sometimes come at the cost of indoor environmental quality.

This workshop will explore the challenges of balancing energy efficiency with a healthy indoor climate in educational buildings. Participants will discuss strategies to improve IAQ, thermal comfort, and overall environmental conditions while maintaining sustainable energy use.

REHVA-CAHVAC: Healthy Sustainable Buildings in Europe and China

This workshop explores the integration of innovative HVAC technologies and sustainable building solutions, drawing from collaborative research by REHVA and CAHVAC. Presentations will address emerging challenges in energy efficiency, indoor environmental quality, and the health impacts of building designs.

Discussions will focus on multidisciplinary approaches and cutting-edge methodologies for optimizing HVAC systems. Experts will present insights into advanced energy performance assessments, case studies, and strategies to enhance both sustainability and occupant well-being. The session aims to foster knowledge exchange and collaboration among researchers, practitioners, and policymakers.

REHVA-SHASE: Introduction of Joint position document by REHVA (EU) and SHASE (Japan) and ZEB case studies

This workshop presents findings from a joint study by SHASE and REHVA on the definitions and calculation methods for Zero Energy and Zero Emission Buildings. Experts will discuss the latest updates following the 2024 EPBD revision and Japan's ZEB framework.

Key topics include energy performance assessments, results from model energy simulations in three European climates for ZEB apartments, and evaluations of office buildings in Japan. Additionally, the workshop will explore HVAC system comparisons, analysing thermal comfort, air quality, and energy performance to determine the most efficient solutions for ZEBs.

REHVA WORKSHOP ON IEQ IN EPBD

Long term assessment by simulation or monitoring, labels and regulation

The 2024 recast of the Energy Performance of Buildings Directive introduces significant new requirements for indoor environmental quality, setting a new standard for national regulations. This workshop will explore key changes, including the principle of optimal IEQ, the establishment of national IEQ requirements, and the mandatory integration of indoor air quality monitoring and regulation devices in new non-residential buildings.

Discussions will focus on the growing need for demand-controlled ventilation systems, which will become essential from 2028/2030, and the challenges of ensuring their long-term performance. With continuous monitoring generating vast amounts of data, we will examine tools and methodologies for assessing IAQ and thermal comfort, optimizing system operation, and improving occupant well-being.

WORKSHOPS BY EU PROJECTS

Energate & Moderate: Facilitating energy efficiency in buildings: smart solutions for real estate, energy service companies and financiers

The building sector is a significant contributor to global energy consumption and greenhouse gas emissions, accounting for approximately 36% of energy use worldwide. Despite the vast potential for energy efficiency improvements in building renovations, progress remains limited. Challenges include high upfront costs, complex regulatory requirements, and often lengthy return-on-investment periods, which deter many property owners. Additionally, awareness and access to information about available financial incentives and technical solutions are frequently insufficient. Overcoming these barriers requires streamlined financing options, more accessible policy frameworks, and broader awareness of the long-term cost savings and environmental benefits of energy-efficient renovations. Given the urgent need for energy efficiency improvements to meet climate goals, it is crucial to harness new and innovative technologies that make buildings more sustainable, smarter, and cost-effective. This workshop will be an opportunity for the MODERATE and ENERGATE projects to share insights, technologies, and best practices, as well as to explore synergies. The event will serve as a platform for stakeholders to discuss the barriers, opportunities, and actionable strategies for advancing energy efficiency in buildings using smart technology and innovative financial models.

Funded by the European Union

SmartSquare: Advancing SRI Implementation: Connecting EPBD provisions and regional adoption with project outcomes

The workshop will focus on discussing the project's Key Exploitable Results (KERs) and their contribution to the Smart Readiness Indicator (SRI) implementation. It will connect the project's outcomes with EU plans and explore the necessary steps to advance SRI adoption at regional and national levels. This will be supported by real case studies, showcasing the impact and opportunities from technical and market perspectives, particularly in design consulting and support services.

Funded by the European Union

EPB Center & tunES Project: Introduction of Next Generation EPC and SRI as measures to facilitate and enhance EPBD Implementation

This workshop aims to address the gap between directives and practical implementation of the EPBD Recast, a key element of the EU's sustainable energy strategy for the building sector. It will highlight the results already achieved, and the ongoing work of several projects funded by the EU's Horizon 2020, Horizon Europe, and LIFE programmes. Additionally, the workshop is designed to foster collaboration between these projects, promoting a unified approach to overcoming challenges and meeting the objectives of the EPBD Recast. The workshop will feature a moderated panel discussion with all speakers, fostering an in-depth conversation on the practical measures and collaborative actions required to fulfil the EPBD Recast's objectives. It will conclude with a summary of the next steps, reinforcing the EU projects' commitment to advancing sustainable energy in the building sector across the EU.

tunES has received funding from European Union's LIFE programme under grant agreement No. 707720926 ■

The grand finale of the Healthy Buildings Design Competition (HBDC25) will take place during CLIMA 2025!

Join us to witness the next generation's innovative vision for healthy buildings!

HBDC25 focuses on the revitalization of urban building stock, with a particular emphasis on the value-added renovation of existing educational buildings.

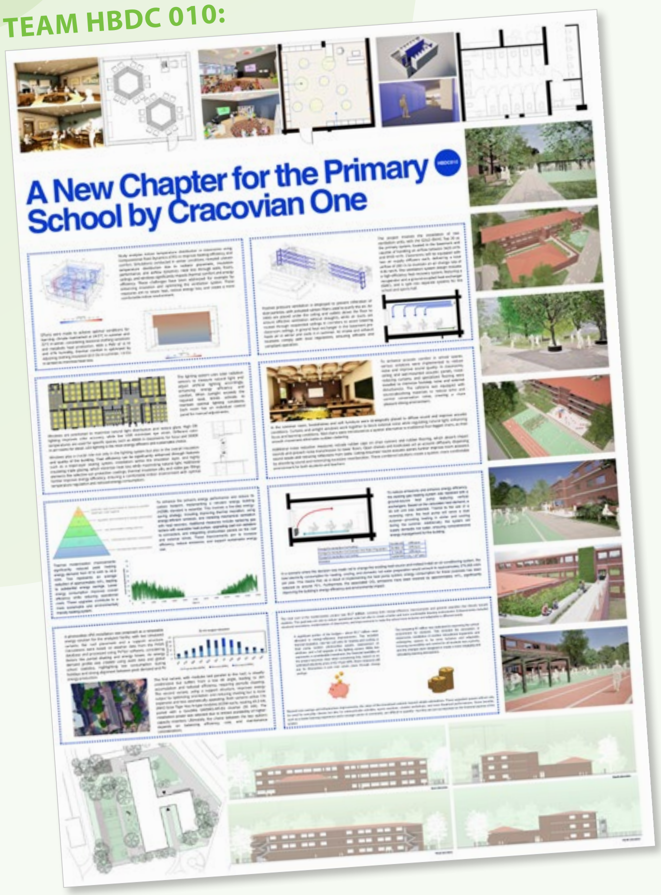
Participants were challenged to envision a desirable renovation scenario for an existing primary school in Milan, Italy, prioritizing children's well-being. The competition celebrates the privilege of being a student, encouraging participants to embrace their curiosity and think outside the box in reimagining the indoor environmental quality of future sustainable buildings.

The top three teams have been selected to present and defend their projects in the HBDC25 final, which will take place on June 6th, from 14:00 to 17:30.

Below, you will find the posters of the three finalist teams.

TEAM HBDC 020:

TEAM HBDC 010:



TEAM HBDC 027:

Introduction to the MIST project

MItigation **ST**rategies for Airborne Infection Control

People spend most of their time indoors, whether at home, work, school, or in different public spaces. This prolonged indoor exposure creates an environment where respiratory viruses can easily spread, especially when ventilation is inadequate. Yet, we often overlook the **quality of the air we breathe indoors**. This oversight has significant consequences; airborne viruses can circulate and linger in poorly ventilated spaces, substantially increasing the risk of infections. The COVID-19 pandemic served as a stark reminder that the air we breathe is not just a passive background to our lives but an active component of our health.

Research has shown that **proper ventilation** can significantly reduce the risk of airborne infection. By introducing fresh outside air and removing contaminated indoor air, we can decrease the concentration of viral particles in our living and working environments. But the key questions remain: **How can we effectively improve indoor air quality? And what science-based strategies can help mitigate airborne infection transmission?**

A science-based approach to airborne infection control

The **MIST project**, **funded by the Dutch Research Council (NWO)**, responds to this crucial need. This project unites a multidisciplinary team of experts in virology, epidemiology, fluid dynamics, molecular biology, medicine, and engineering. Together, they are dedicated to **developing evidence-based strategies to mitigate airborne infections**. With the collaboration of 28 industry partners, MIST bridges the gap between **scientific research and practical applications**. The research goes beyond theory, focusing on practical solutions that can be implemented in real-world settings to ensure clean indoor air in shared spaces.

Key objectives of the MIST project:

- Understanding the airborne transmission dynamics of various viruses
- Advancing fundamental research on effective ventilation systems, air purification, and personal protection measures, including proximity and mask usage
- Developing evidence-based guidelines for infection prevention in shared spaces such as offices, schools, and healthcare centres

By combining expertise across multiple disciplines and working closely with industry partners, the MIST project ensures that its findings lead to **effective, science-based solutions** for **ventilation, air cleaning, and personal protection measures to prevent infections**. As we continue to navigate the post-pandemic world, the MIST project remains committed to enhancing public health by creating healthier and cleaner indoor air in shared spaces.

For more information about our research, partners, and funders, visit our website: www.mist-project.nl. ■

Unlocking a New Era in HVAC Professionalism: The Competitive Edge of REHVA's In-Person Membership

Introduction

The built environment is undergoing a seismic shift towards sustainability, efficiency, and digital transformation. In this rapidly evolving landscape, HVAC professionals need a strong, dynamic network that offers cutting-edge knowledge, career growth opportunities, and policy influence at the European level. REHVA's newly launched In-Person Membership emerges as a groundbreaking initiative, setting a new standard for professional affiliation in the HVAC sector.

REHVA's In-Person Membership: A Visionary Leap for HVAC Professionals

Traditionally, HVAC professionals have had two main avenues for professional development: national associations or international memberships with large organizations. However, a gap has persisted—one that REHVA is now filling with its In-Person Membership.

This membership was created for professionals in countries without a national REHVA Member Association and extends an exclusive opportunity. REHVA's In-Person Membership is tailor-made for global HVAC experts looking for a European-centric platform offering:

- ✓ Access to Premium Educational Resources – Guidebooks, technical publications, and exclusive content via the REHVA Academy.
- ✓ Participation in REHVA Events – A direct link to policy discussions shaping the future of European HVAC legislation and standards.
- ✓ Professional Networking – Integration into a high-level European network of engineers, researchers, and policymakers.
- ✓ Certification & Competitions – Eligibility for REHVA certifications and specialized competitions recognizing excellence in the field.
- ✓ Affordable Membership Fees – A competitive annual fee of just €50, offering unmatched value.
- ✓ Participation in Standing Committees – In-Person Members may contribute as non-voting members in REHVA's existing Standing Committees, bringing perspectives from unrepresented regions.
- ✓ Exclusive Industry Updates – Members receive REHVA e-newsletters, EU policy insights, and HVAC sector news.
- ✓ Ethical & Professional Standards – All In-Person Members adhere to the REHVA Code of Ethics and professional conduct guidelines, ensuring high standards across the network.

A Gateway to EU Policy and Global Collaboration

One of REHVA's most compelling advantages is its strong link with EU policies and regulations. Unlike ASHRAE or ASME, whose policy influence is concentrated in the U.S., REHVA directly impacts European energy and building performance legislation. This is a decisive advantage for engineers and HVAC professionals working in or collaborating with the European market.

Through the EU Policy Advocacy Group (EUPAG), REHVA In-Person Members gain firsthand insights into EPBD implementation, green transition strategies, and upcoming EU regulations. Additionally, In-Person Members can participate in committee discussions, contribute expert insights, and gain visibility within REHVA's strategic initiatives.

Why Should HVAC Professionals Join?

For professionals looking to maximize their career potential, joining REHVA's In-Person Membership is an investment with high returns:

✓ Be part of an elite European HVAC network – Engage with industry leaders, researchers, and policymakers.

✓ Stay ahead of industry trends – Access premium knowledge and insights tailored to the European market.

✓ Influence HVAC policies – Contribute to committees and advocacy efforts that shape the future of the built environment.

✓ Enhance career development – Gain certifications, compete in industry-recognized contests, and boost your professional profile.

✓ Access to REHVA's Extensive Library – Members can explore technical guides, educational materials, and exclusive webinars.

✓ Commitment to High Standards – By adhering to the REHVA Code of Ethics and professional regulations, members become part of a high-integrity network of specialists.

Conclusion: The Future of HVAC Professionalism Starts Here

REHVA's In-Person Membership is more than a professional title—it is a strategic advantage for HVAC, mechanical, and building services engineers who want to be at the forefront of the European HVAC transformation. With unparalleled access to technical knowledge, networking, EU policy advocacy, and affordable membership fees, this initiative represents a new era of inclusivity, opportunity, and excellence.

For those looking to elevate their careers, expand their influence, and engage with the future of sustainable buildings, the answer is clear: Join the REHVA In-Person Membership today!

For more details and to become a member, visit https://www.rehva.eu/about-us/join-rehva/supporters-packages/in-person-membership. ■

Memorandum of Understanding on Co-operation Matters

Strengthening Global Collaboration: REHVA and ASHRAE Sign a New MoU

Orlando, 10 February 2025

During the vibrant ASHRAE Winter Conference in Orlando, REHVA and ASHRAE reaffirmed their long-standing partnership by signing a renewed Memorandum of Understanding. The festive ceremony brought together both organizations' leadership teams in person, marking a strong commitment to continued collaboration across the Atlantic.

The signing was conducted by Dr. Cătălin-Ioan Lungu, REHVA President (2022–2025), and Mr. Bill McQuade, ASHRAE President Elect (2024–2025). Also in attendance were representatives from ASHRAE Region XIV and REHVA Member Associations, highlighting the shared spirit of international cooperation.

This new MoU sets the framework for deepened technical exchange and joint initiatives. A key feature of the agreement is the establishment of a REHVA–ASHRAE Liaison Committee (LC), composed of at least three members from each organization. The LC will coordinate collaborative actions, ensure alignment of strategic goals, and convene regularly—preferably during the ASHRAE Winter Conference or the REHVA Annual Meeting.

This renewed agreement marks an important milestone, paving the way for impactful synergies in research, policy advocacy, and professional development within the global HVAC community. ■

Eduardo Maldonado (ASHRAE Region XIV), Mahroo Eftekhari (ASHRAE Region XIV Director and Regional Chair), Sarah Maston (ASHRAE Treasurer), Jeff H. Littleton (Executive Vice President, ASHRAE), Bill McQuade, ASHRAE President-Elect and Catalin Lungu REHVA President.

EUPAG group – REHVA's policy and advocacy support

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European Directives and their national transpositions strongly impact the daily professional practice of HVAC professionals. These legal frameworks should take into account the competence and experience of the impacted professionals. This article reports on the activity of REHVA's new policy and advocacy support, the EUPAG group.

Keywords: Energy efficiency in buildings, European Directives, Policy support, Green deal

➢ The origin of EUPAG

EU directives influence REHVA members' daily work, underlining the urgent need for more effective technical and political advocacy. Recent policy changes underscore this concern. For example, instead of focusing only on outcomes such as zero CO_2 emissions from fossil fuels and limits on primary energy use, the EPBD Recast actually also defines how to achieve these goals, hampering the possibility for HVAC professionals to optimize the buildings as a whole.

Although REHVA's Technology and Research Committee (TRC) provides significant technical feedback on directives, the EU Commission and the other EU policy-making institutions (EU Parliament and Council) do not always consistently incorporate this expertise. Therefore, the primary goal of an advocacy group is to increase the impact of REHVA's contributions to EU policies.

During the REHVA Member Association plenary meeting in September 2023, the decision was made to establish an advocacy group titled "EU Policy Advocacy Group" (EUPAG) under the leadership of **Johann Zirngibl**, REHVA Vice-President and Board Member. Today EUPAG has already more than 60 members from several national REHVA member associations and supporters.

➢ Means and working methodology

To better connect with EU regulators and policymakers REHVA updated its registration on the EU's transparency register to have permanent access to the European Parliament.

REHVA considerably increased the manpower by engaging a new full-time policy and advocacy officer **Francesco Robimarga**, fr@rehav.eu.

The EUPAG group is not a standing REHVA committee, like the TRC or the Supporters committee, but a transversal group, cooperating inside REHVA with all standing Committees and at European level with other European associations.

A key element of the work is the bi-directional cooperation with the national REHVA member associations. Our objective is to have an active EUPAG contact point in all interested member associations to enhance policy advocacy and communication at national level.

EUPAG advocacy efforts and working methods includes:

- drafting concise, widely endorsed REHVA technical proposals to resonate with EU regulatory and political audiences,
- promoting these unified stances directly at the EU level (via REHVA) and locally, either nationally or regionally, through member associations.
- strategizing the best ways to champion our viewpoints

Not all topics will only be dealt within EUPAG. For example, the lobbying for IEQ was managed mostly outside EUPAG because also other European associations have been very active. But the tight coordination with EUPAG could be an added value because REHVA is recognized as a technology neutral association with an appreciated high-level expertise.

➢ REHVA principles - the REHVA manifesto

To be able to deliver a common message, the common message has first to be defined.

REHVA, and its national member associations, contribute to the development of an economical, sustainable, safe and healthy built environment. These targets have been resumed by EUPAG in the "Principles for 2050 ready buildings" also called the "REHVA manifesto".

REHVA stands for:

- Technology neutral approach based on a holistic decarbonised design of buildings, interacting with energy distribution networks, and considering
  - the Energy Efficiency First principle,
  - the priority use of renewables throughout the entire energy chain,
  - a life cycle approach;
- High indoor environmental quality (IEQ), which also includes indoor air quality (IAQ);
- Social responsibility, by designing optimised, cost-effective and affordable buildings;
- European coordination, a European common technical language allowing harmonized upskilling of professionals and free circulation of professionals and services.

The holistic approach should be supported by performance-based building codes focusing on the results rather than prescribed methods.

There is no "one fits all solution" but a needed optimization of the solutions adapted to each building and worked out by qualified professionals.

➢ Enhancing the political network - Contacts with MEP

The last European elections for the European parliament, was an opportune moment to start the dissemination of the REHVA manifesto towards the candidates and to establish first contacts with them. The REHVA manifesto was send out to more than 60 lead candidates at European level and in the Member States. The manifesto was translated into French, German, Italian, Romanian and Slovak language.

The feedback was quite positive. The lead candidates shared in their answers the vision for sustainable, healthy and affordable housing. Some lead candidates signed already the manifesto. The lead candidates promised to consider the REHVA proposal for drafting their Commission Work Program for the next mandate.

Seán Kelly is among the member of parliament (MEP) who signed the REHVA manifesto. Seán Kelly MEP was shadow rapporteur for the Energy Performance of Buildings Directive (EPBD) in the last legislative term. His action was instrumental in shaping the directive.

During the meeting with the MEP in the European Parliament premises, the REHVA manifesto was further outlined and crossed with the priorities of a leading policy maker.

➢ EPBD – implementation – the guidance documents

Energy policy falls under the shared competences between the Commission and the Member States based on the subsidiarity principle. The EPBD has legal force but there is enough flexibility for the Member States to interpret and specify the EPBD provisions within the legal frame of EPBD. Therefore, the transposition period is crucial.

Figure 1 shows the time schedule for the implementation of the EPBD. After the publication in the Official Journal (OJ) and then enter into force 20 days later, the very important transposition period starts. Member States have two years to transpose the Directive into national regulations.

During this two years period the Commission is working out "Guidance documents" explaining the background of the requirements in the EPBD and to make proposals for the transposition.

Figure 2 list the topics of the guidance documents.

REHVA, together with its national member associations, is acting to bring their technical competence in the guidance documents and experience during the transposition period.

The guidance documents are worked out in two steps:

- First step: the consultation with national authorities on the draft text
- Second step: stakeholder consultation (associations, experts, etc).

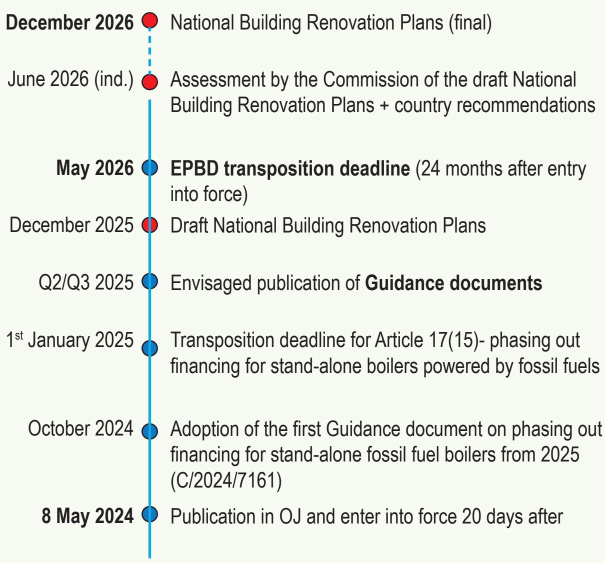
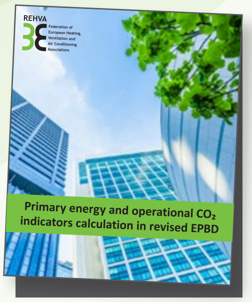


Figure 1. EPBD implementation timeline.



The most efficient way to bring in technical expertise is at the very beginning of drafting the guidelines. REHVA had discussion with the Commission, drafted comments on the first guidelines like the phasing out of stand-alone fossil fuel boiler, the technical details on zero emission buildings, the consideration of ambient heat, etc.

EUPAG is working on a "two ways" communication approach to bring its comments in the guidelines

- at the European level, by exchanges with the Commission,
- at the national level, by advising national authorities via the Member association.

This two-ways communication underlines the need for coordination and cooperation between EUPAG, together with the REHVA's standing committees, and especially with the Member associations.

➢ Become EUPAG member

If your organization is keen on joining the EUPAG advocacy initiative, please contact the REHVA Policy and Advocacy Officer, **Francesco Robimarga** (fr@rehva.eu).

With the proactive involvement of the Member Association the interests of HVAC professionals will be better defended and more effectively represented at European and national level. ■

Figure 2. Topics of the guidance documents.

From Skills to Sustainability: **The Repower Regions Project** officially kicked off from 19 to 21 March 2025 in Kildare County, Ireland

The European heating and cooling sector is at a crucial turning point. As the continent accelerates its transition to a net-zero future, the demand for skilled professionals with expertise in sustainable and digital energy solutions has never been higher. Recognising this need, the Repower Regions project, a three-year Erasmus+ Alliance for Innovation initiative, has been launched to address the skills gap and drive decarbonisation efforts. With Kildare County Council leading the project and a consortium of twelve partners from ten European countries onboard, REHVA (Federation of European Heating, Ventilation, and Air Conditioning Associations) is playing a pivotal role in shaping the initiative's impact on industry standards and professional training.

Bridging the Skills Gap in Sustainable HVAC

Heating and cooling account for nearly half of Europe's total energy consumption, making them key areas for climate action and innovation. The Repower Regions project aims to enhance the capacity of higher education (HE), vocational education (VET), and continuous vocational education and training (CVET) institutions to deliver updated and industry-relevant training in sustainable heating and cooling systems. Through curriculum development, training materials, and digital learning tools, the project seeks to equip current and future HVAC professionals with the necessary skills to contribute to Europe's green transition.

REHVA's role in this initiative is fundamental. As the leading European network representing national HVAC associations, REHVA brings extensive expertise in energy-efficient building technologies and sustainable climate solutions. Through its involvement, REHVA ensures that training content aligns with the latest industry standards, regulatory frameworks, and best practices. The federation will also facilitate knowledge exchange between academia and industry, fostering collaboration that drives real-world innovation.

Strengthening Industry-Academia Collaboration

A key strength of the Repower Regions project is its holistic approach to workforce development. By connecting educators, policymakers, and industry leaders, the project ensures that educational curricula meet market demands and technological advancements. REHVA's participation in this process is invaluable, as it provides a bridge between the academic community and the HVAC sector.

By engaging with REHVA's extensive network, the project will benefit from real-time industry insights, ensuring that training materials are practical, applicable, and aligned with future trends. Additionally, REHVA will support dissemination activities, promoting project outcomes across its member associations and the broader HVAC community. This outreach will help maximize the project's impact, enabling more professionals and organisations to benefit from new learning opportunities.

A Sustainable Future for the HVAC Sector

The launch of Repower Regions marks a significant milestone in the push for a decarbonised European built environment. The project will not only provide much-needed upskilling opportunities but will also create a lasting impact by fostering a more resilient, adaptable, and future-ready HVAC workforce. Companies in the sector will benefit from a highly trained talent pool, equipped with the digital and green skills necessary to implement innovative energy solutions.

REHVA invites all stakeholders—educators, industry professionals, and policymakers—to engage with the Repower Regions project and contribute to the transformation of Europe's heating and cooling landscape. Through collaboration, knowledge-sharing, and investment in skills development, the HVAC sector can lead the charge toward a sustainable and energy-secure future.

Whether you are an educator, policymaker, or industry professional, this project offers a unique opportunity to be at the forefront of Europe's clean energy transformation. Stay updated on upcoming opportunities to participate via our website: repowerregions.eu and social media channels. Repower Regions: About | LinkedIn, Facebook ■

SOFIA BAZZANO
EU Project Coordinator, REHVA, sb@rehva.eu

Please send information of your event to Ms Marie Joannes mj@rehva.eu

Exhibitions, Conferences and Seminars

2025

6 May	SmartLiving EPC Final event	Brussels, Belgium
2-3 June	REHVA Annual meeting 2025	Milan, Italy
4-6 June	CLIMA 2025	Milan, Italy
8-11 June	Healthy Buildings (ISIAQ Conference)	Reykjavic, Iceland
10-12 June	European Sustainable Energy Week	Brussels, Belgium
12-14 June	39th AICVF Congress	La Rochelle, France
21-25 June	ASHRAE Conference	Phoenix, USA
10-11 July	ISH	Iasi,Romania
6-8 August	Cold Climate HVAC & Energy	Harbin, China
24 August	Building Simulation Conference 2025 (IBPSA conference)	Brisbane, Australia
24-26 Sep	45th AIVC & ASHRAE 2025 IEQ joint Conference	Montreal, Canada
24-26 Sept	EUROVENT Summit 2025	Prague, Czechia
8 Nov	World Ventil8 Day	Brussels, Belgium
17-18 Nov	Brussels Summit 2025	Brussels, Belgium
12-14 Oct	60th anniversary of AIIR (conference)	Sinaia, Romania
29 Nov-2 Dec	ISHVAC 2025	Tokyo, Japan
TBA Dec	56th International HVAC&R Congress and Exhibition	Belgrade, Serbia

2026

19-23 May	Indoor Air Quality, Ventilation and Energy Conservation in Buildings conference (IAQVEC)	Los Angeles, USA

REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

MEMBERS

ATIC vzw–asbl – Belgium

STP – Czech Republic

DANVAK – Denmark

EKVU – Estonia

FINVAC – Finland

AICVF – France

VDI–e.V. – Germany

ÉTÉ – Hungary

MMK – Hungary

AiCARR – Italy

AHGWTEL/LATVAC – Latvia

LITES – Lithuania

AIIRM – Republic of Moldova

TVVL – The Netherlands

NEMITEK – Norway

PZITS – Poland

ORDEM DOS ENGENHEIROS – Portugal

AFCR – Romania

AGFR – Romania

AIIR – Romania

KGH c/o SMEITS – Serbia

SSTP – Slovakia

ATECYR – Spain

SWEDVAC – Sweden

DIE PLANER – Switzerland

TTMD – Turkey

CIBSE – United Kingdom

REHVA ASSOCIATE ORGANISATIONS:

BAOVK – Bulgaria

GBC – Croatia

ICA Europe – Belgium

OAER – Romania

ISIB – Turkey

REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

SUPPORTERS

Leaders in Building Services

Belimo Automation – Switzerland

gold

Eurovent Certita Certification – France

LG Electronics – France

Saint-Gobain – France

silver

Spacecool – Japan

Sunfly Europe – Serbia

Swegon – Sweden

Systemair – Sweden

Uponor – Finland

bronze

Rhoss – Italy

steel

Aermec – Italy

Camfil – Sweden

Daikin Europe – Belgium

E.E.B.C. – Romania

EPEE – Belgium

EVIA – Belgium

Fläkt Group – Sweden

Granlund – Finland

Halton – Finland

Lindab – Sweden

Royal Haskoning DHV – The Netherlands

SMAY – Poland

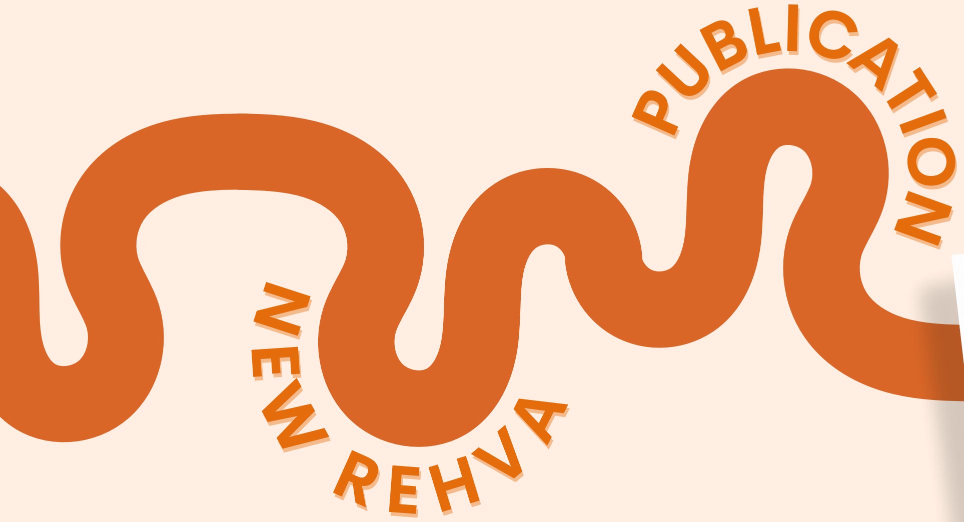
Velux – Denmark

Viega – Germany

Approximately two-thirds of showering energy needs is lost down the drain as wastewater at temperatures of around 35°C. This represents a considerable opportunity for **energy recovery.** Instantaneous wastewater heat recovery systems (WWHRSs) are designed to capture and reuse this wasted energy, which effectively reduces the energy needed from hot water generators and leads to a significant **decrease in overall energy consumption**.

NEW REHVA PUBLICATION

The design of WWHRS is inherently efficient. They are compact, durable, and lack moving parts, which not only makes them **cost-effective** in terms of production but also contributes to their **low maintenance requirements.** Their straightforward installation process further enhances their appeal, as they can be integrated into various building configurations with relative ease.



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