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EVIA position paper: Achieving both high indoor air quality and low energy consumption in European buildings

Buildings account for approximately 40% of the EU's overall energy consumption and for 36% of the EU's overall emissions of greenhouse gas. 70% of the buildings that we will occupy in 2050 are already built. EVIA therefore supports the objectives laid down in the Energy Performance of Buildings Directive (EPBD) and the Renewable Energy Sources Directive (RES), which respectively aim to reduce the energy consumption of buildings and promote energy from renewable sources in the EU.

Compliance is essential to reach the targets of the EPBD and achieve the full energy efficiency and carbon savings potential of buildings. Compliance with and enforcement of the provisions of the EPBD is currently not adequate and could be significantly improved in the revised EPBD.

EVIA considers that in addition to strengthening compliance with EU legislation, it is essential to promote systems and solutions that result in both high indoor air quality and low energy consumption. EVIA considers therefore that improvements in the following four complementary areas are essential:

1. **Ensuring adequate indoor air quality in European buildings (EPBD)**
2. **Regular inspections of ventilation systems to achieve healthy buildings (EPBD)**
3. **Promoting the development of and the use of demand controlled options (EPBD)**
4. **Recognizing heat recovery as a waste energy technology (RES)**

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1. Ensuring adequate indoor air quality in European buildings (EPBD)

The EPBD has so far been implemented without enough consideration to Indoor Air Quality (IAQ) and thermal comfort (especially in retrofitted buildings). Energy efficiency measures result in tighter buildings to reduce uncontrolled energy losses and increased envelope performance, which may have adverse impacts on IAQ, health, productivity and comfort. There is significant scientific evidence on the health benefits of improved indoor environment quality in residential and non-residential buildings through source control, dedicated mechanical ventilation technology and adequate filtration of incoming air. Due to increasing air tightness of buildings, it is essential to ensure that sufficient fresh air is introduced to keep occupants healthy and to protect the building.

In addition, due to global warming, summer comfort is increasingly critical, particularly in southern countries. Measures should be set to ensure a minimum level of comfort, even with closed windows. In some cases air conditioning would be required but only as a last resort. There is a need to introduce passive measures such as ventilative cooling ideally with intelligence and combined glass / shading to reduce demand before using energy to cool. Ventilative cooling is also an efficient solution to ensure an acceptable summer comfort.

The following measures should therefore be set in the revised EPBD to:

- ✓ Member States shall take the necessary measures to ensure that minimum indoor air quality requirements for buildings or building units are set.
- ✓ They shall require minimum user independent ventilation airflow, which shall take account the intended use of the building.
- ✓ Member States shall establish a methodology to calculate indoor air quality level:
    - The indoor air quality level shall be reported in a transparent way in the energy performance certificate
    - The energy performance certificate shall include information about the indoor air quality (ventilation rate) and the indoor thermal environment (summer and winter).

2. Regular inspections of ventilation systems to achieve healthy buildings (EPBD)

Regular inspections of heating and air conditioning systems are currently required but it would also be necessary to have regular inspections and maintenance of ventilation, to ensure proper Indoor Environment Quality and energy efficiency. The energy impact of these systems is in current buildings, comparable to heating and cooling, and the dominating factor in nearly Zero Energy Buildings. Regular (energy and functional) inspections of ventilation systems will contribute to an energy efficient indoor air quality in buildings. Member States may reduce the frequency of such inspections or lighten them, as appropriate, where an electronic monitoring and control system is in place.

There can be two kinds of inspections:

- ✓ Functional inspection to keep the systems running as designed (at least every two years); and
- ✓ Energy inspection to consider new aspects of use (control), technology and design of the system (at least every ten years).

3. Promoting the development of and the use of demand controlled options (EPBD)

The use of demand-controlled options should be promoted in the revised Energy Performance of Buildings Directive (EPBD). They help reducing energy consumption while assessing, for instance, the correct ventilation needs that will ensure the provision of good air quality and a high level of comfort.

In addition, demand response, through smart appliances and products, will deploy itself only if time/demand flexible energy costs are available and visible at building level in order to yield a proper remuneration to users.

EVIA proposes in Annex I amendments to the current EPBD in line with the three key issues developed above.

4. Recognising heat recovery as a waste energy technology (RES)

EVIA considers that EU legislation should be technology neutral and open to innovation but this is currently not the case. The Renewable Energy Sources Directive (RES) for instance recognises heat pump as renewable energy technologies. In this context, other technologies using ambient and/or exhaust air as a renewable or waste heat use should also be recognised in the revised RES (e.g. free cooling with cooling towers, heat and cold recovery, direct and indirect evaporative cooling, waste water heat recovery to name a few).

The use of waste heat (heat recovery) is an alternative way to reduce and optimise energy use. Waste heat that is not used will be lost (ambient air). Direct use is more efficient than indirect use via ambient air and there is no technological or physical reason to handle exhaust air recovery differently from ambient air.

EVIA proposes in the Annex II a method to calculate how the energy delivered by heat recovery ventilation is accounted as renewable energy under the Renewable Energy Directive.

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About EVIA:
The European Ventilation Industry Association (EVIA) was established in July 2010 in order to represents the ventilation and fan industry both in Brussels with the EU institutions and relevant stakeholders and in the national capitals with our partners. Our membership is composed if 36 member companies and 5 national associations across Europe realising an annual turnover of over 7 Billion Euros and employing more than 45,000 people in Europe. Check our website: www.evia.eu

Annex I: EVIA proposed amendments to the EPBD

Proposed changes are marked in yellow.

Preamble:

(3) Buildings account for 40 % of total energy consumption in the Union. The sector is expanding, which is bound to increase its energy consumption. Therefore, reduction of energy consumption and the use of energy from renewable sources, waste energy and demand controlled systems in the buildings sector constitute important measures needed to reduce the Union's energy dependency and greenhouse gas emissions. Together with an increased use of energy from renewable sources, waste energy use, demand controlled systems, measures taken to reduce energy consumption in the Union would allow the Union to comply with the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), and to honour both its long term commitment to maintain the global temperature rise below 2 °C, and its commitment to reduce, by 2020, overall greenhouse gas emissions by at least 20 % below 1990 levels, and by 30 % in the event of an international agreement being reached. Reduced energy consumption and an increased use of energy from renewable sources also have an important part to play in promoting security of energy supply, technological developments and in creating opportunities for employment and regional development, in particular in rural areas.

(9) The energy performance of buildings should be calculated on the basis of a methodology, which may be differentiated at national and regional level. That includes, in addition to thermal characteristics, other factors that play an increasingly important role such as heating ventilation and air-conditioning installations, application of energy from renewable sources, waste energy, passive heating and cooling elements, shading, indoor air-quality, adequate natural light and design of the building. The methodology for calculating energy performance should be based not only on the season in which heating is required, but should cover the annual energy performance of a building. That methodology should take into account existing European standards

(12) When setting energy performance requirements for technical building systems, Member States shall use, where available and appropriate, harmonised instruments, in particular testing and calculation methods and energy efficiency classes developed under measures implementing Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (1) and Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy- related products (2), with a view to ensuring coherence with related initiatives and minimise, to the extent possible, potential fragmentation of the market.

(15) Buildings have an impact on long-term energy consumption. Given the long renovation cycle for existing buildings, new, and existing buildings that are subject to major renovation, should therefore meet minimum energy performance requirements adapted to the local climate. As the application of alternative energy supply systems is not generally explored to its full potential, alternative energy supply systems should be considered for new buildings, regardless of their size, pursuant to the principle of first ensuring that energy needs for heating, ventilating and cooling are reduced to cost- optimal levels.

(16) Major renovations of existing buildings, regardless of their size, provide an opportunity to take cost-effective measures to enhance energy performance and the indoor air quality. For reasons of cost-

effectiveness, it should be possible to limit the minimum energy performance requirements to the renovated parts that are most relevant for the energy performance of the building. Member States should be able to choose to define a 'major renovation' either in terms of a percentage of the surface of the building envelope or in terms of the value of the building. If a Member State decides to define a major renovation in terms of the value of the building, values such as the actuarial value, or the current value based on the cost of reconstruction, excluding the value of the land upon which the building is situated, could be used.

(17) Measures are needed to increase the number of buildings which not only fulfil current minimum energy performance requirements, but are also more energy efficient, thereby reducing both energy consumption and carbon dioxide emissions. For this purpose Member States should draw up national plans for increasing the number of nearly zero-energy buildings and regularly report such plans to the Commission. Nearly zero-energy buildings need a dedicated ventilation system to avoid negative effects such as bad indoor air quality caused by inadequate ventilation.

(22) The prospective buyer and tenant of a building or building unit should, in the energy performance certificate, be given correct information about the energy performance, the indoor air quality and the thermal environment of the building and practical advice on improving such performance. Information campaigns may serve to further encourage owners and tenants to improve the energy performance of their building or building unit. Owners and tenants of commercial buildings should also be encouraged to exchange information regarding actual energy consumption, in order to ensure that all the data are available to make informed decisions about necessary improvements. The energy performance certificate should also provide information about the actual impact of heating and cooling on the energy needs of the building, on its primary energy consumption and on its carbon dioxide emissions.

(25) Recent years have seen a rise in the number of air-conditioning systems in European countries. This creates considerable problems at peak load times, increasing the cost of electricity and disrupting the energy balance. Priority should be given to strategies which enhance the thermal performance of buildings during the summer period. To that end, there should be focus on measures which avoid overheating, such as shading and sufficient thermal capacity in the building construction, and further development and application of passive cooling techniques, primarily those that improve indoor climatic conditions and the micro-climate around buildings.
Increasing air tightness in new or renovated buildings may also deteriorate Indoor Air quality and priority should also be given to solutions that preserve Indoor Air Quality when building or renovating buildings, such as heat recovery systems and demand control ventilation.

(26) Regular maintenance and inspection of heating, ventilation and air- conditioning systems by qualified personnel contributes to maintaining their correct adjustment in accordance with the product specification and in that way ensures optimal performance from an environmental, safety, indoor air quality and energy point of view. An independent assessment of the entire heating, ventilation and air-conditioning system shall occur at regular intervals during its lifecycle in particular before its replacement or upgrading. In order to minimise the administrative burden on building owners and tenants, Member States should endeavour to combine inspections and certifications as far as possible.

(27) A common approach to the energy performance certification of buildings and to the inspection of heating, ventilation and air-conditioning systems, carried out by qualified and/or accredited experts, whose independence is to be guaranteed on the basis of objective criteria, will contribute to a level playing field as regards efforts made in Member States to energy saving in the buildings sector and will introduce

transparency for prospective owners or users with regard to energy performance, indoor air quality and thermal environment in the Union property market. In order to ensure the quality of energy performance certificates and of the inspection of heating, ventilation and air-conditioning systems throughout the Union, an independent control mechanism should be established in each Member State.

Article 1 Subject matter
(f) regular inspection of heating, ventilation and air-conditioning systems in buildings;

Article 2 Definitions
6. 'energy from renewable sources' means energy from renewable non-fossil sources, namely wind, solar, aerothermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases, energy recovery on waste air or water;

New definitions:
'waste energy' means energy in the exhaust air or waste water from technical processes and buildings.
'ventilation system' means an appliance, either fan assisted or driven by natural forces intended to replace utilised air by outdoor air in a building or a part of a building and which ensures optimal Indoor Air Quality and integrity of the buildings;

Article 4 Setting of minimum energy performance requirements
These requirements shall take account of general indoor climate conditions and Indoor Air Quality, in order to avoid possible negative effects such as inadequate ventilation and thermal comfort, as well as local conditions and the designated function and the age of the building.

New article: Setting of minimum indoor air quality requirements
1. Member States shall take the necessary measures to ensure that minimum indoor air quality requirements for buildings or building units are set. They shall require minimum user independent ventilation airflow.
These requirements shall take account the intended use of the building.
2. Member States shall establish a methodology to calculate indoor air quality level. The indoor air quality level will be reported to the energy performance certificate.

Article 6 New buildings
1. Member States shall take the necessary measures to ensure that new buildings meet the minimum energy performance requirements set in accordance with Article 4.
For new buildings, Member States shall ensure that, before construction starts, the technical, environmental and economic feasibility of high-efficiency alternative systems such as those listed below, if available, is considered and taken into account:

(a) decentralised energy supply systems based on energy from renewable sources;
(b) cogeneration;
(c) district or block heating or cooling, particularly where it is based entirely or partially on energy from renewable sources;
(d) heat pumps.
(e) Demand controlled ventilation
(f) Use of waste energy
(g) System recovering energy on polluted air

Article 8 Technical building systems

The system requirements shall cover at least the following:

(a) heating systems;
(b) hot water systems;
(c) air-conditioning systems;
(d) ~~large~~ ventilation systems;

or a combination of such systems.

Article 11 Energy performance certificates

1. Member States shall lay down the necessary measures to establish a system of certification of the energy performance of buildings. The energy performance certificate shall include the energy performance of a building and reference values such as minimum energy performance requirements in order to make it possible for owners or tenants of the building or building unit to compare and assess its energy performance. EN L 153/22 Official Journal of the European Union 18.6.2010

The energy performance certificate may include additional information such as the annual energy consumption for non- residential buildings and the percentage of energy from renewable and waste energy sources in the total energy consumption.

The energy performance certificate shall include information about der indoor air quality (ventilation rate) and the indoor thermal environment (summer and winter).

New Article

Inspection of ventilation systems

1. Member States shall lay down the necessary measures to establish a regular inspection of the accessible parts of ventilation systems. The inspection shall include an assessment of the system efficiency and the sizing compared indoor air quality requirements of the building. The assessment of the sizing does not have to be repeated as long as no changes were made to this ventilation system or as regards the requirements of the building in the meantime.

Member States may reduce the frequency of such inspections or lighten them, as appropriate, where an electronic monitoring and control system is in place.

…. Analog to Inspections of AC-Systems….

ANNEX I Common general framework for the calculation of energy performance of buildings (referred to in Article 3)

1. The energy performance of a building shall be determined on the basis of the calculated or actual annual energy that is consumed in order to meet the different needs associated with its typical use and shall reflect the heating energy needs, cooling energy needs (energy needed to avoid overheating) and ventilation needs to maintain the envisaged temperature conditions of the building, domestic hot water needs and optimal Indoor Air Quality.

3. The methodology shall be laid down taking into consideration at least the following aspects:

(c) air-conditioning installations;

(c1) ventilation systems

(d) natural ~~mechanical~~ ventilation which may include air-tightness;

(h) indoor climatic conditions and Indoor Air Quality, including the designed indoor climate;

4. The positive influence of the following aspects shall, where relevant in the calculation, be taken into account:
(a) local solar exposure conditions, active solar systems and other heating and electricity systems based on energy
from renewable sources;
(b) electricity produced by cogeneration;
(c) district or block heating and cooling systems;
(d) natural lighting;
(e) waste energy use; and
(f) demand control options.

Annex II: Calculation of renewable energy of heat recovery ventilation

1. Introduction

Recovered energy is not renewable energy but has to be addressed in the same way in European legislation regarding incentives or requirements at building level on renewables.
This document is a proposition for the calculation of the equivalent renewable part of energy recovered by a heat recovery ventilation unit (HRV). All the energy recovered is not accounted as renewable energy because of the fan and defrosting energy consumption.
The renewable part is not an additional saving or gain to be added to the already accounted savings of the HRV. It's only a part of it.

2. How it is done for Heat pumps

In the directive 2009/28/EC (Renewable Energy Sources) there is a methodology for calculating the Renewable part of Heat pumps.

$$E_{RES} = Q_{usable} * (1 - \frac{1}{SPF})$$

Where:

Q_{usable}	the estimated total usable heat delivered by heat pumps fulfilling the following criteria: SPF > 1,15 * 1/η
SPF	the estimated average seasonal performance factor for those heat pumps
η	is the ratio between total gross production of electricity and the primary energy consumption for electricity production Note: 1/ η = pef (primary energy factor) = 2.5 at European level

3. Simplified approach for HRV (residential)

- The renewable part is the energy recovered minus the energy input.
- The factors and metrics introduced in ErP (reg 1253/2014) may be used
  - Recovered energy during the summer season is not considered
  - Energy input of defrosting is considered
  - Fan consumption is accounted for the whole year

Note: the internal gains are already taken into account in the ErP data: average temperature difference indoors/outdoors and duration of the heating season. There is no need for additional factors.

1. Calculation of the energy recovered (Q_{usable})

$$Q_{usable} = t_h . \Delta T_h . c_{air} . q_{vref} . CTRL . MISC . \eta_t$$

Where:

q_{vref}	This is the reference airflow of the unit, acc to prEN 13142
Other parameters	See ErP regulation

2. Calculation of the energy input(Q_{input})

$$Q_{input} = t_a . q_{vref} . MISC . CTRL^x . SPI + t_{defr} . \Delta T_{defr} . c_{air} . q_{vref} . CTRL . MISC$$

Where:

Parameters	See ErP regulation

3. Calculation of the seasonal performance factor (SPF)

This is the ratio of the recovered energy and the energy input:

$$SPF = \frac{Q_{usable}}{Q_{input}}$$
$$= \frac{t_h . \Delta T_h . c_{air} . CTRL . \eta_t}{t_a . CTRL^x . SPI + t_{defr} . \Delta T_{defr} . c_{air} . CTRL}$$

In analogy with heat pumps, SPF has to fulfill the following criteria:

$$SPF > 1{,}15 * 1/\eta$$

4. Calculation of the renewable energy

$$E_{RES} = Q_{usable} * \left(1 - \frac{1}{SPF}\right)$$
$$= Q_{usable} * \left(1 - \frac{Q_{input}}{Q_{usable}}\right)$$

$$E_{RES} = Q_{usable} - Q_{input}$$
$$E_{RES} = q_{vref} . MISC . CTRL . (t_h . \Delta T_h . c_{air} . \eta_t - t_a . CTRL^{x-1} . SPI - t_{defr} . \Delta T_{defr} . c_{air})$$

4. HOLISTIC APPROACH (EPBD CALCULATION)

- This approach may be used for EPBD calculations
- The renewable contribution of the HRV is calculated for each time step or bin
- There is no need of an additional factor to take into account gains (solar, internal) because the useful energy is only accounted in case of heating demand.

For i = 1 to 8760
  If heating demand
    $Q_{usable}(i) =$ energy recovered by the unit
    $Q_{input}(i) =$ energy consumption of the unit
  Else
    $Q_{usable}(i) = 0$
    $Q_{input}(i) =$ energy consumption of the unit
  End
End loop

Then a yearly balance is done:

$$Q_{usable} = \sum_i Q_{usable}(i)$$
$$Q_{input} = \sum_i Q_{input}(i)$$

With:
i: time step
We calculate SPF:

$$SPF = \frac{Q_{usable}}{Q_{input}}$$

And if:

$$SPF > 1{,}15 * 1/\eta$$

Then we calculate the renewable part:

$$E_{RES} = Q_{usable} - Q_{input}$$