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REHVA position - EPBD review and nZEB status

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REHVA position paper on the European Commission proposal of the revised ENERGY PERFORMANCE OF BUILDINGS DIRECTIVE COM(2016)0765

General remarks

REHVA supports and appreciates the principles of EPBD aiming both at the improvement of energy performance in new buildings with cost optimal minimum requirements, as well as at the improvement of energy performance in existing buildings with incentives. REHVA welcomes the binding 30% energy efficiency target of the revised EPBD and is confident that the building sector can and should contribute more to achieving it. While staying on track with highly ambitious nZEB targets for new buildings, **the EPBD must put more focus on the energy refurbishment of the existing building stock,** including the **replacement and upgrade of inefficient technical building systems that waste energy and don't deliver good indoor environment quality.** The revised EPBD shall better tackle this challenge and aim at **strengthening the implementation and its enforcement**.

Ensuring high indoor environment quality and energy efficiency at the same time

Health and comfort of consumers should be ensured and improved in all buildings, especially when implementing deep energy retrofit projects. To achieve this, REHVA advocates for indoor environment quality (IEQ) related requirements in the EPBD. REHVA welcomes that Annex I of the legislative proposal mandates Member states to ensure minimum environment quality levels. However, to provide and maintain good and healthy indoor climate, IEQ aspects should be further strengthened in the directive.

1. The revised EPBD should set a clear mandate for Member States to **define indoor environmental quality requirements that are monitored and reported in a harmonised way** in building regulations across Europe.
2. **IEQ criteria shall be part of the inspection** of heating and cooling systems, and continuously monitored alongside the energy performance of the buildings.
3. REHVA recommends developing an indoor environmental quality indicator to be used beside the primary energy indicator. This **IEQ indicator shall be reported in a transparent way in the energy performance certificates**. EPC-s shall provide information about indoor air quality (ventilation rate) and about the indoor thermal environment (summer and winter). This can be implemented based on the prEN 16798-1 standard (or its equivalent the ISO 17772-1), displaying in the EPC-s a reference to the IEQ categories as defined by the standard.
4. The **definition of technical building system** should be changed to: "Technical equipment and systems for heating, cooling, ventilation, humidification, dehumidification, domestic hot water, lighting, building automation and control and electricity production used to control **indoor environmental parameters** in a building." to cover also solar shading and daylight control, and air cleaning.

Ensuring quality, proper maintenance, and performance through mandatory inspection of heating, ventilation, and air-conditioning systems

The EPBD should address the quality of installed technical systems, including their regular maintenance, and support the replacement of the old equipment where appropriate. The inspection of technical building systems is of key importance in this process, because it can ensure quality, compliance with standards and building codes, as well as high energy performance. Therefore, the **EPBD shall maintain and improve Articles 14-15** on the inspection of heating and air-conditioning systems. Furthermore, it is advisable to extend the scope **to ventilation and air-conditioning systems**, as these are often combined and ventilation has a significant impact on energy and IEQ. The original articles were poorly implemented as it was not clear how the outcomes were to be used or enforced. REHVA welcomes that the Commission aims at improving the current requirements. However, some important aspects are not clear or missing in the proposed new version, and the requirements on the alternative continuous monitoring and BAC are technically and practically too complex to be implemented and enforced. The issues to improve are detailed below.

1. Setting and measuring clearly defined target values in a transparent way

The primary intention of the EPBD is to cost-effectively improve the energy performance of buildings. This primary intention can be achieved by stating performance requirements, but the technical means of implementation should be let open and technology neutral. Then the market can find cost optimal solutions that is important for encouraging innovation and continuous development.

The **EPBD shall mandate Member States to set up and enforce a transparent inspection process with clearly defined criteria** ensuring the following points:

- The inspection must be based on a set of generally defined system parameter values (system temperatures, flowrates, schedules, specific fan powers, COPS etc.) for individual components and systems (e.g. boilers, air handling units, CHP, chillers, heating circuits etc.). Data for the testing must be provided by the systems (components, BAC, monitoring systems, etc.) for inspection according to minimum standard data criteria (scope, format) that each system has to provide.
- Energy use and power demands shall be reported at the level of the various technical building systems and occupant controlled non-EPB uses (small power, lighting, and process loads).
- The measured values, design specification and product data shall enable a transparent and explicit evaluation for detecting whether a specified performance is met or not. These tests must be carried out in a technical system independent from the BAC (because the BAC data may be wrong) by an independent third party.
- Based on the results of the above evaluation, the inspection should provide guidance on the potential energy savings possible.

2. Continuous monitoring, energy management, and building automation and control (BAC)

REHVA promotes continuous monitoring and the analysis of operational data to operate buildings in a cost-effective way using automated data input. However, the currently proposed requirements (paragraphs 2, points a-c in articles 14-15) mix the different competences and roles of proper operation and of the inspection process testing it. The **requirements as defined now are technically too complex and difficult to implement and to enforce by the regulatory framework**. Problems of the requirements a-c:

- "*(a) continuously monitoring, analysing and adjusting energy usage;*"
  BAC can support this function from a central place, but not implement the complete process. The adjustment is usually done by a system operator, who is largely responsible for the building performance (e.g. by setting schedules, set points and manual operation) and has therefore to be part of the inspections scope.

- "*(b) benchmarking the building's energy efficiency, detecting losses in efficiency of technical building systems, and informing the person responsible for the facilities or technical building management about opportunities for energy efficiency improvement;*"
  BAC and all the connected services are part of the same system and therefore responsible for the performance of the building. BAC can help in detecting losses, however benchmarking a buildings energy efficiency and identifying improvement opportunities requires understanding of wider context beyond simply the building services. An external service should verify the achieved benchmarked performance, referring to wider world benchmarks and possibilities.

  BAC systems are an important means of improving the energy efficiency of buildings, however, the performance of HVAC and BAC systems are highly sensitive to errors in design, construction, and operation. There are numerous examples of BAC systems not working as intended, as they are complex systems whose interaction with the buildings they serve are often not fully understood by their operators.

  Therefore, equally important as the systems themselves is the quality management for testing the systems performance. Third party testing through well-defined regular inspections or continuous monitoring shall be a mandatory requirement for buildings. This can ensure the closing of the gap between designed and actual energy performance.

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REHVA actions under new EPBD

- EPBD review is in the final stage – no input any more needed
- Main changes well communicated by the public draft June 2017

Three main items for REHVA:

1. Mandate to MS to establish minimum ventilation requirements
2. nZEB technical challenge – how to compare with EC official recommendation benchmarks
3. Smartness indicator – a possibility to bring a power dimension in addition to energy to EPBD

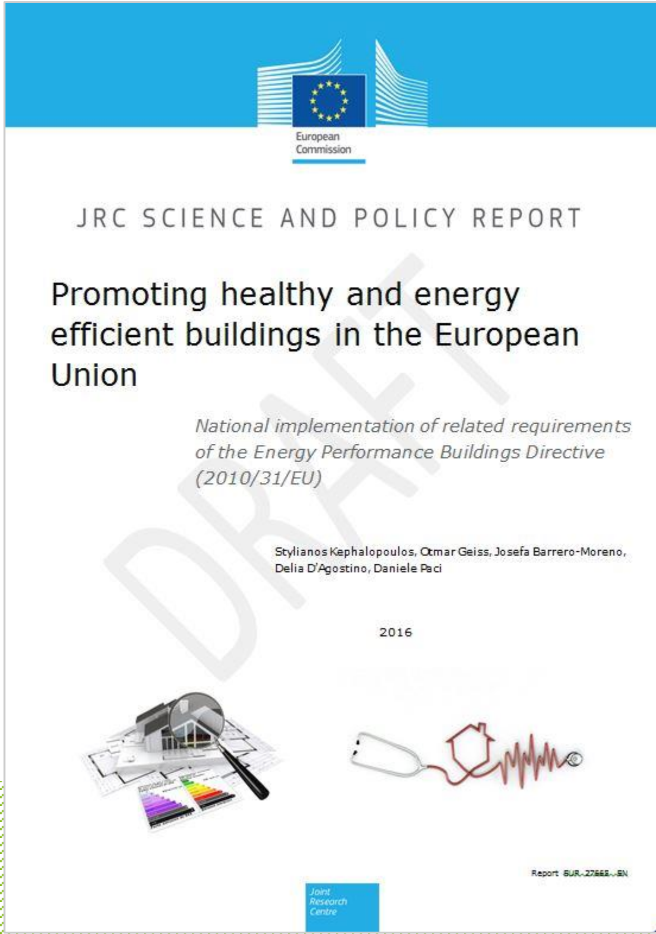
IEQ situation in EU

Indoor Environmental Quality (IEQ) requirements in EU:

- Currently there are no binding ventilation and IEQ requirements at EU level
- From a regulatory point of view this remains under the competencies and responsibilities of the EU Member States

JRC assessment of the implementation status of the EPBD by the EU MS in terms of ventilation and indoor air quality criteria:

- Many inadequate ventilation problems reported from renovation
- New evidence that mechanical HR ventilation systems lead to an overall improvement of the IAQ and reduction of reported comfort and health related problems if properly designed and operated



Example of ventilation requirements (BPIE 2015)

- Ventilation is included in all surveyed EU MS building regulations but **minimum requirements are set only for half of the countries** while for the other half there are only recommended minimum ventilation rates

⇒ Is it possible to design and construct buildings without ventilation in EU?

⇒ No doubt that possible in renovation

Country and Standard Reference	Whole Building Ventilation Rates	Living Room	Bedroom	Kitchen	Bathroom + WC	WC only
Brussels (NBN D 50-001)	3.6 $m^3/(h \cdot m^2)$ floor surface area	Minimum 75 m^3/h (limited to 150 m^3/h	Minimum 25m^3/h (limited to 72m^3/h)	Open kitchen Minimum 75 m^3/h (exhaust)	Minimum 50 m^3/hour (limited to 75 m^3/h	Minimum 25 m^3/h
Denmark (BR10)	Min. 0.3 $l/s \cdot m^2$ (supply)	Min. 0.3 $l/(s \cdot m^2)$ (supply)		20 l/s (exhaust)	15 l/s (exhaust)	10 l/s (exhaust)
France (Arrêté 24.03.82)	10-135 m^3/h (depending on room number and ventilation system)			Continuous: 20 – 45 m^3/h		Minimum 15 m^3/h
Germany (DIN 1946-6)	15-285 m^3/h (details see chapter)			45m^3/h (nominal exhaust flow)	45 m^3/h (nominal exhaust flow)	25 m^3/h (nominal exhaust flow)
Italy (Legislative Decree 192/2005, UNI EN 15251)	Naturally ventilated: 0.3 – 0.6 vol/h	0.011 m^3/s per person for an occupancy level of 0.04 persons/m^2			4 vol/h	
Poland (Art 149 (1) – Journal of Laws 2002 No. 75, item. 690, as amended and PN-B-03430:1983/ Az3:2000)	20 m^3/h for each permanent occupant should be calculated according to the Polish standard but not less than 20 m^3/h	20 -30 m^3/h for each permanent occupant (for public buildings) For flats, it is a summary of flow from all rooms		30 m^3/h to 70 m^3/h without windows	50 m^3/h	30 m^3/h
Sweden (BFS2014:13 – BBR21)	Supply: min 0.35 $l/(s \cdot m^2)$ floor area					
UK (Approved Document F)	13-29 l/s (depending on bedrooms)			13-60 l/s (extract)	8-15 l/s (extract)	6 l/s (extract)
EN 15251	0.35 – 0.49 $l/(s \cdot m^2)$	0.6 – 1.4 $l/(s \cdot m^2)$		14-28 l/s	10-20 l/s	7-14 l/s

Requirement **Recommendation** **European standard**

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EPBD ANNEX 1: adequate ventilation and minimum health and comfort levels

- In the latest EPBD proposal June 27, 2017, adequate ventilation and minimum health and comfort levels are clearly mentioned in Annex 1:
  - “The energy needs for space heating, space cooling, domestic hot water and **adequate ventilation** shall be calculated in order to ensure **minimum health and comfort levels** defined by Member States.”
- → clear mandate to MS to establish minimum ventilation requirements for new buildings and major renovations to implement the directive
- REHVA has already established a task force aiming to develop European Guidebook on residential heat recovery ventilation:
  - ventilation requirements evidently will lead to the implementation of healthy and energy efficient ventilation solutions
  - good technical knowledge and installation skills needed in order to avoid problems caused by design and installation mistakes

Residential heat recovery ventilation Task Force

- Aims to develop European Guidebook on HRV
- Limited to mechanical supply and exhaust HRV
- Targeted to engineers, HVAC consultants and contractors

- Should include all information and calculation bases needed to design, size, install, commission and maintain HR ventilation properly – in order to avoid design and installation mistakes which could destroy the reputation of a dedicated high performance ventilation system
- Time schedule: draft 6/2017, review version 12/2017, printed 3/2018

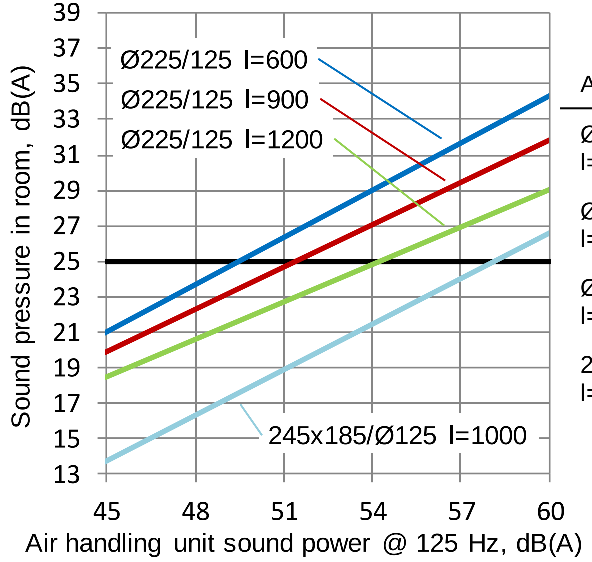
Challenge of silent, clean and draft-free energy efficient HRV

Selection of ventilation units

Pressure drop and noise calculation

Ventilation system layouts

Example: selection of sound attenuator based on the sound power at frequency 125 Hz:



Attenuator	Attenuation, dB 125 Hz	250 Hz
Ø225/125 l=600	6	13
Ø225/125 l=900	6	15
Ø225/125 l=1200	6	20
245x185/Ø125 l=1000	14	19

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How much ventilation is needed?

- No consensus in national regulation and guidelines
- FprEN 16798-1:2016 (EN 15251:2007) and ISO/DIS 17772-1 include new section for airflow rate selection in residences
- Further developed in REHVA GB to be suitable for practical design

	Supply airflowrate L/s	Extract airflowrate L/s	Air velocity[1] m/s
Living rooms[2] >15 m^2	8+0.27 L/(s m^2)		0.10
Bedrooms >15 m^2	14		0.10
Living rooms and bedrooms 11-15 m^2	12		0.10
Bedrooms <11 m^2, 3rd and the following bedrooms in large apartments	8		0.10
WC		10	
Bathroom		15	
Bathroom in one room apartement		10	
Utility room		8	
Wardrobe and storage room		6	
Kitchen[3]		8	
Kitchen[3], one room apartement		6	
Kitchen, cooker hood in operation		25	
Average airflowrate of a whole residence L/(s m^2)	0.42		
Staircase of an apartement building, ACH	0.5		

[1] Maximum air velocity values apply at design airflow rate and supply air temperature in heating season conditions, in boost mode higher velocities may be accepted, see section 2.2.
[2] Transfer air from bedrooms may be reduced, 12 L/s is the minimum value
[3] Airflow rate in the kitchen when cooker hood is not in operation

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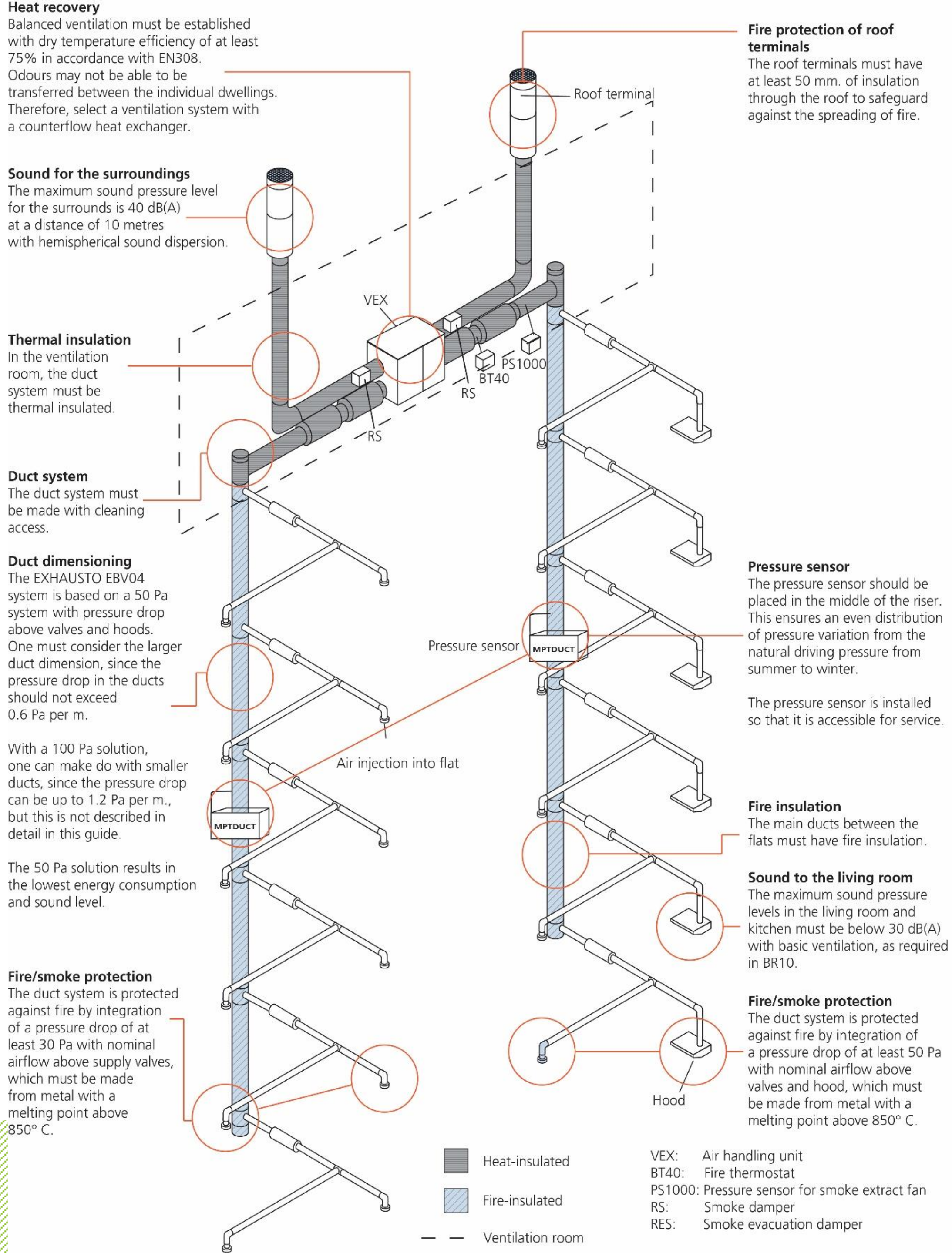
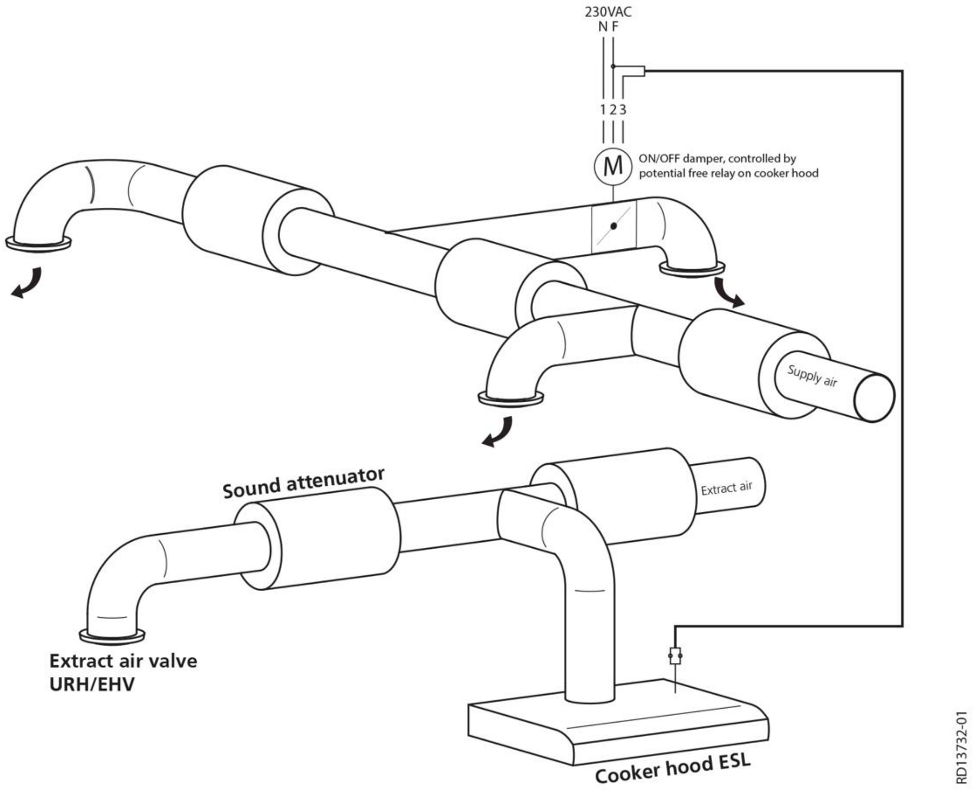
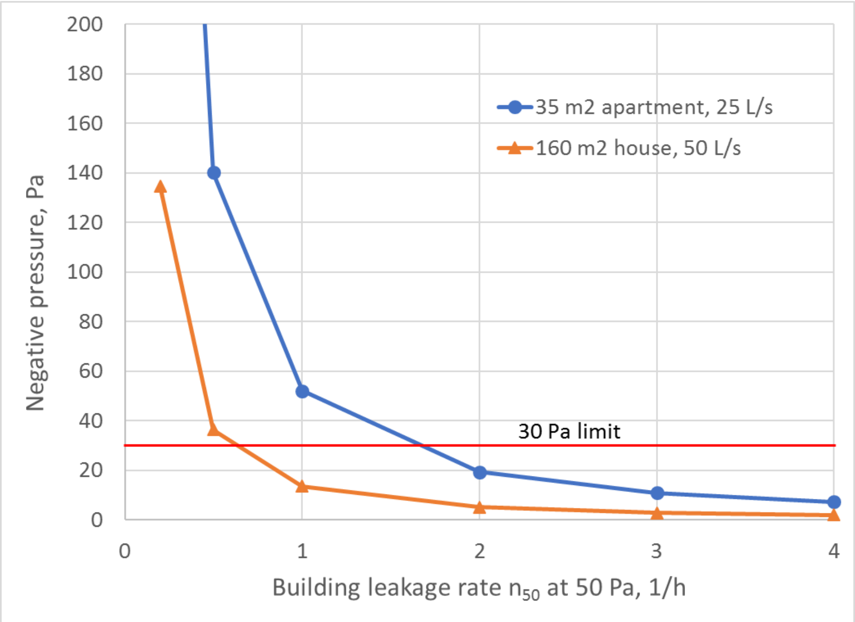
Ventilation systems

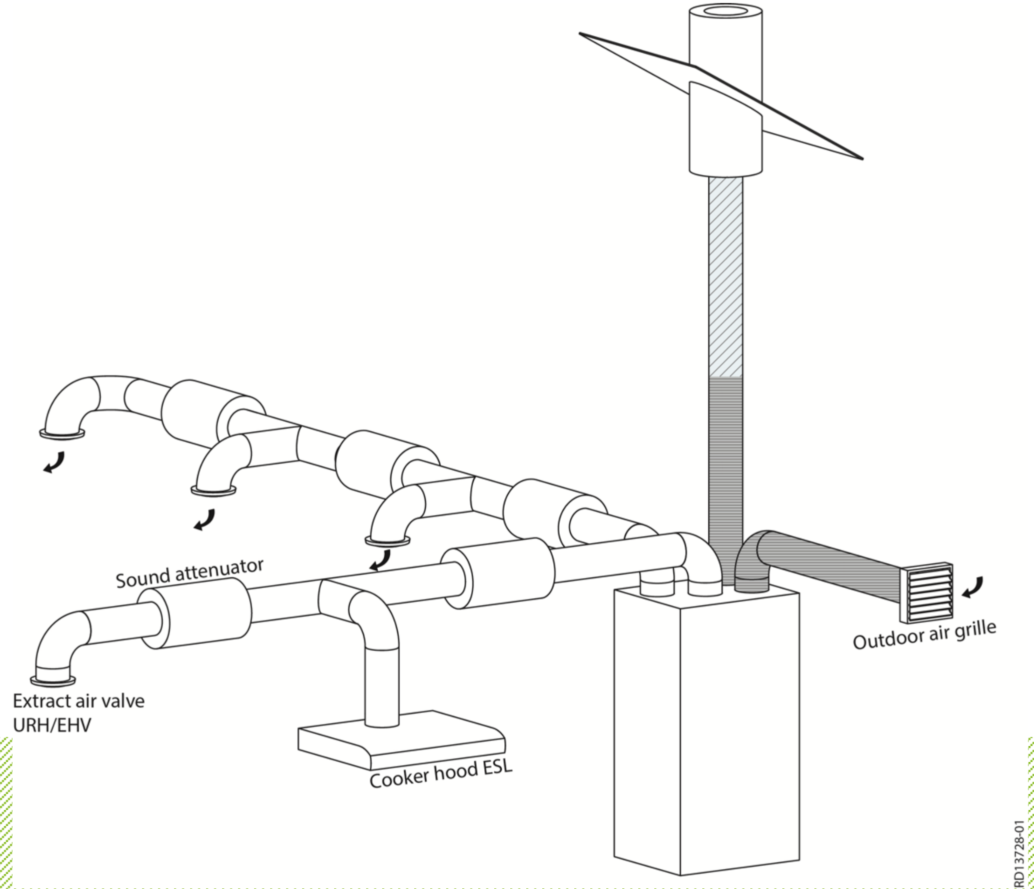
- Main focus to centralized and decentralized ventilation systems
- Some warnings regarding room ventilation units (monoblock), which have been problematic especially in renovation
- Specific solutions for renovation



nZEB = airtight buildings need special solutions for cooker hood and fireplace compensation







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Technical challenge of nZEB performance levels

JRC 2016 data: Energy performance expressed by Member States

Country	Residential Buildings (kWh/m²/y or Energy Class)		Non-Residential Buildings (kWh/m²/y or Energy Class)	
	New	Existing	New	Existing
Austria	160	200	170	250
Belgium	45 (Brussels region) 30 (Flemish region) 60 (Walloon region)	~54	(95–2.5) *(V/S) (Brussels region) 40 (Flemish region) 60 (Walloon region)	~108
Bulgaria	~30–50	~40–60	~30–50	~40–60
Cyprus	100	100	125	125
Czech Republic	75%–80% PE	75%–80% PE	90% PE	90% PE
Germany	40% PE	55% PE	n/a	n/a
Denmark	20	20	25	25
Estonia	50 (detached house)	n/a n/a n/a n/a	100 (office buildings) 130 (hotels, restaurants) 120 (public buildings) 130 (shopping malls)	n/a n/a n/a n/a
	100 (apartment blocks)	n/a n/a n/a	90 (schools) 100 (day care centres) 270 (hospitals)	n/a n/a n/a
France	40–65	80 n/a	70 (offices without AC) 110 (offices with AC)	60% PE n/a
Croatia	33–41	n/a	n/a	n/a
Hungary	50–72	n/a	60–115	n/a
Ireland	45 (Energy load)	75–150	~60% PE	n/a
Italy	Class A1	Class A1	Class A1	Class A1
Latvia	95	95	95	95
Lithuania	Class A++	Class A++	Class A++	Class A++
Luxemburg	Class AAA	n/a	Class AAA	n/a
Malta	40	n/a	60	n/a
Netherlands	0	n/a	0	n/a
Poland	60–75	n/a	45–70–190	n/a
Romania	93–217	n/a	50–192	n/a
Spain	Class A	n/a	Class A	n/a
Sweden	30–75	n/a	30–105	n/a
Slovenia	45–50	70–90	70	100
Slovakia	32 (apartment buildings) 54 (family houses)	n/a n/a	60–96 (offices) 34 (schools)	n/a n/a
UK	~44	n/a	n/a	n/a

nZEB level of energy performance	**Mediterranean** Zone 1: Catania (others: Athens, Larnaca, Luga, Seville, Palermo)	**Oceanic** Zone 4: Paris (others: Amsterdam, Berlin, Brussels, Copenhagen, Dublin, London, Macon, Nancy, Prague, Warszawa)	**Continental** Zone 3: Budapest (others: Bratislava, Ljubljana, Milan, Vienna)	**Nordic** Zone 5: Stockholm (Helsinki, Riga, Stockholm, Gdansk, Tovarene)
	Offices kWh/(m2/y)			
net primary energy	20-30	40-55	40-55	55-70
primary energy use	80-90	85-100	85-100	85-100
on-site RES sources	60	45	45	30
	New single family house kWh/(m2/y)			
net primary energy	0-15	15-30	20-40	40-65
primary energy use	50-65	50-65	50-70	65-90
on-site RES sources	50	35	30	25

nZEB requirements

- The range of values varies remarkably from positive energy buildings up to 270 kWh/m^2/y primary energy:
  - from to 20 kWh/m^2/y to160 kWh/m^2/y in residential buildings, but usually targets aim at 45 kWh/m^2/y or 50 kWh/m^2/y
  - Values from 25 kWh/m^2/y to 270 kWh/m^2/y are reported for non-residential buildings with higher values given for hospitals.
  - Remarkable differences caused mostly due to different energy uses included, but the methodologies/input data have an effect and evidently there are differences in the ambition level
- Evidence that national input data causes more difference than the climate
- Methodologies to be developed to be able to compare national requirements and to benchmark to EC recommendations

Smartness indicator

- Refers to flexibility and other features in order to take part to demand response and contribute to the optimum operation of the energy systems
- In the present form SI has no clear objective and it is not fully clear which problem SI has to solve – EC has the mandate to develop the content
- Possibility to include electric power dimension to EPBD (so far all focus on energy) which will push the use of smart controls and storage solutions

- It has proposed that SI has contribute to **enhanced energy savings** – which is likely correct intention, but wrong wording in too general level, not clearly referring to electric peak power savings (+ cost saving and some small energy losses)

Smartness indicator – new possibilities

- To be meaningful, smartness indicator should aim to reduce electricity peak powers and CO_2 intensity during critical production hours
- Analyses needed to quantify the effects of smartness: how much peak power reduction, how much cost saving, how much extra energy use, CO_2 reduction etc.
- Focus to technical solutions being based on the use of electricity price signal with the scope to building operation + electric vehicle charging – today technology exists but utilization potential is not known
- Possibility to develop a performance based indicator which could be similar to primary energy indicator but in terms of power instead of energy

Conclusions

- Adequate ventilation and minimum health and comfort levels clearly mentioned in the new EPBD proposal – mandate for MS to establish minimum ventilation requirements:
  - ventilation requirements evidently will lead to the implementation of healthy and energy efficient heat recovery ventilation solutions
  - good technical knowledge and installation skills needed in order to avoid problems caused by design and installation mistakes
- Remarkable differences in national nZEB levels call for the assessment of ambition/cost optimality and benchmarking to EC nZEB recommendations
- Smartness indicator offers a new possibility to bring peak power dimension to EPBD and to develop a performance based indicator helping to reduce electricity peak powers as well as CO_2 intensity during critical production hours