



REHVA seminar Light + Building 2018, Frankfurt:

# Indoor Environmental Quality & the EPBD recast

**Dr. Eng. Atze Boerstra, REHVA vice-president**

# Where I(we) come from...



# Solution ±1900: Housing Act!

Requirements in relation to:

- Plumbing
- Fresh water supply
- Daylighting
- Ventilation
- Mould & moisture
- Heating



**NEW**

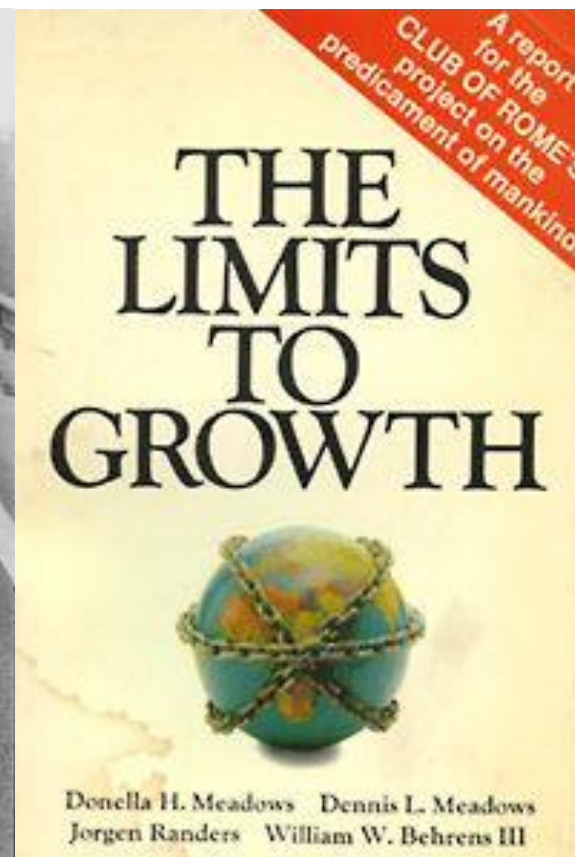
**FOCUS ON HEALTH AND COMFORT, NOT ON ENERGY USE!**



# Resulting in...

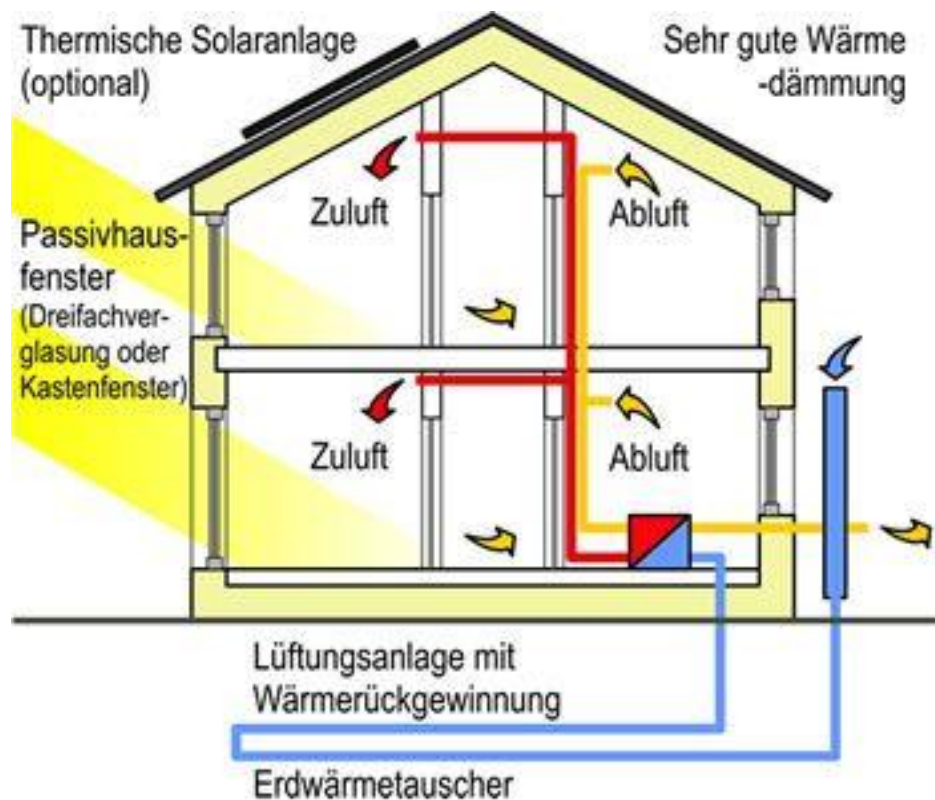


# Then the 70's came...





# Which lead to...



# NEW



# That in turn lead to... (??)

## Asthma could be worsened by energy-efficient homes, warns study

Lack of ventilation caused by better insulation could create spike in indoor pollutants, research warns



NEWSLETTER | SUBSCRIBE

CO.DESIGN

CITIES | GRAPHICS | INNOVATION BY DESIGN | INTERACTIVE

09.15.17 | 7:30 AM

### Are "Green" Buildings Killing Us?

They might be energy efficient, but that doesn't mean they're free of toxic chemicals.

An isometric illustration of a city skyline. The buildings are rendered in various shades of green and brown, creating a sense of depth and perspective. The style is modern and architectural.

the number of people suffering from asthma by 2050.

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### Are energy efficient homes making us ILL? Toxic mould caused by poor air circulation could trigger 'sick building syndrome'

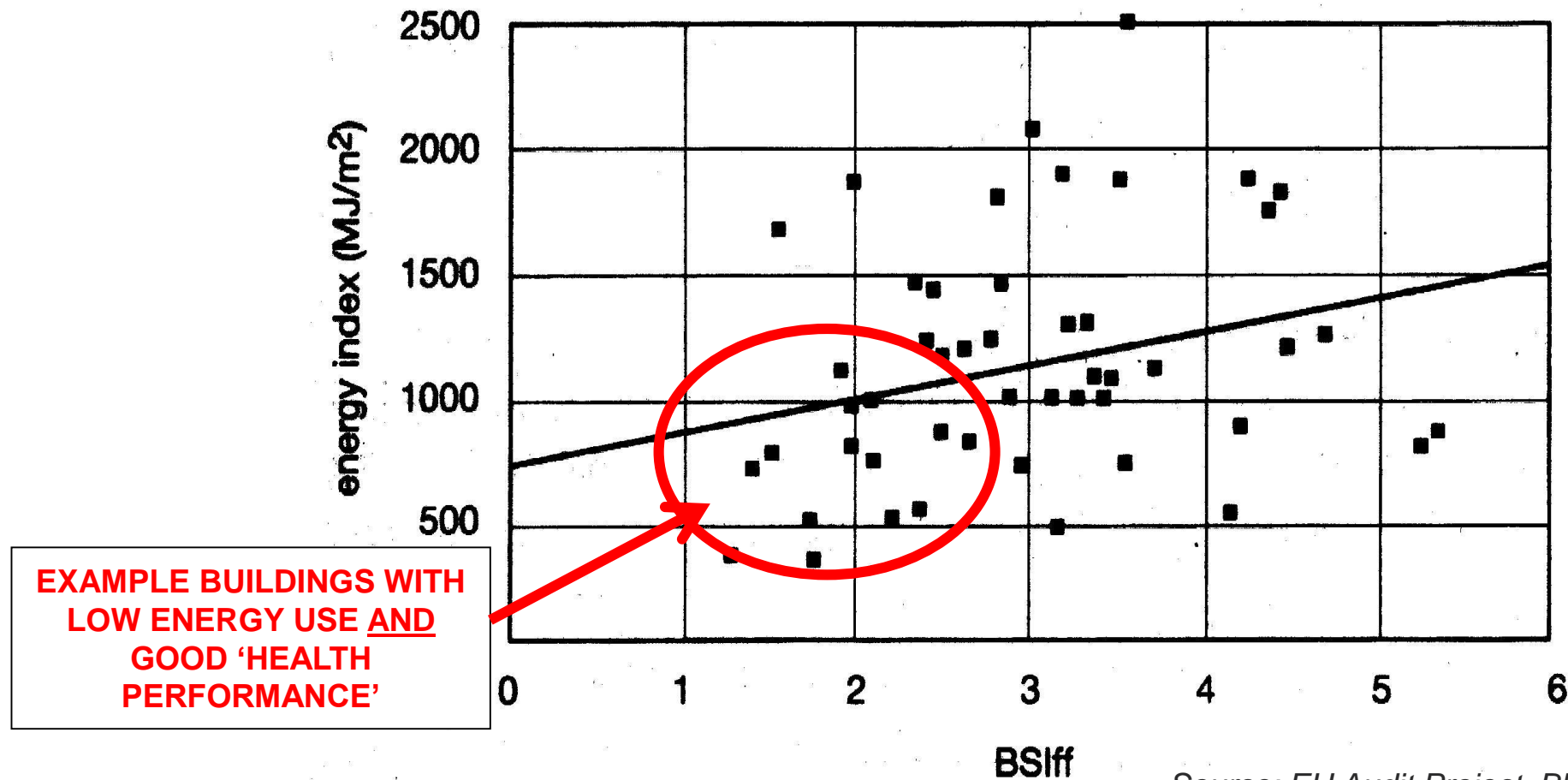
NEW

# Health/comfort risks energy efficient homes

- IAQ / inadequate ventilation
- Mould & moisture issues (esp. renovations)
- Overheating
- Personal control over temperature (esp. winter)
- Inadequate daylighting
- Noise from installations
- ....



# Energy efficient & healthy CAN go together



Source: EU Audit Project, Bluyssen et al, 1995

# Let's tune in with large body of knowledge on Indoor Environmental Quality & Health!

10



REHVA 13<sup>th</sup> HVAC World Congress  
26 - 29 May, Bucharest

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RETHINKING COMFORT

*Indoor Air* 2011  
www.blackwellpublishing.com/ina  
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INDOOR AIR  
doi:10.1111/j.1600-0668.2010.00703.x

## Commemorating 20 Years of *Indoor Air*

### Ventilation rates and health: multidisciplinary review of the scientific literature

**Abstract** The scientific literature through 2005 on the effects of ventilation rates on health in indoor environments has been reviewed by a multidisciplinary group. The group judged 27 papers published in peer-reviewed scientific journals as providing sufficient information on both ventilation rates and health effects to inform the relationship. Consistency was found across multiple investigations and different epidemiologic designs for different populations. Multiple health endpoints show similar relationships with ventilation rate. There is biological plausibility for an association of health outcomes with ventilation rates, although the literature does not provide clear evidence on particular agent(s) for the effects. Higher ventilation rates in offices, up to about 25 l/s per person, are associated with reduced prevalence of sick building syndrome (SBS) symptoms. The limited available data suggest that inflammation, respiratory infections, asthma symptoms and short-term sick leave increase with lower ventilation rates. Home ventilation rates above 0.5 air changes per hour ( $\text{h}^{-1}$ ) have been associated with a reduced risk of allergic manifestations among children in a Nordic climate. The need remains for more studies of the relationship between ventilation rates and health, especially in diverse climates, in locations with polluted outdoor air and in buildings other than offices.

**J. Sundell<sup>1,2,\*</sup>, H. Levin<sup>3,\*</sup>,  
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12<sup>th</sup> REHVA World Congress

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22-25 May | Aalborg | Denmark



# EPBD recast

*‘The (energy performance) requirements shall be general indoor climate requirements in order to avoid possible health issues such as inadequate ventilation, as local conditions may vary according to building function and the age of the building’*

EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

DRAFT  
prEN 16798-1

May 2015

ICS 91.120.10; 91.140.01

Will supersede EN 15251:2007

English Version

Energy performance of buildings - Part 1: Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics - Module M1-6

Performance énergétique des bâtiments - Partie 1 : Critères d'ambiance intérieure pour la conception et l'évaluation de la performance énergétique des bâtiments couvrant la qualité de l'air intérieur, l'ambiance thermique, l'éclairage et l'acoustique - Module M1-6

Energieeffizienz von Gebäuden - Teil 1: Eingangsparameter für das Raumklima zur Auslegung und Bewertung der Energieeffizienz von Gebäuden Raumluftqualität, Temperatur, Licht und Akustik - Modul M1-61)

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 156.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CEN in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

**Warning** : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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

states the principles of EPBD aiming both at the improvement of energy efficiency with cost optimal minimum requirements, as well as at the improvement of indoor environmental quality. REHVA welcomes the binding 30% energy efficiency target and is confident that the building sector can and should contribute more to achieving highly ambitious nZEB targets for new buildings, **the EPBD must put in place measures to address the refurbishment of the existing building stock, including the replacement and modernisation of building systems that waste energy and don't deliver good indoor environmental quality. The revised EPBD shall better tackle this challenge and aim at strengthening the energy performance of buildings.**

**For better indoor environmental quality and energy efficiency at the same time**

profit projects. To achieve this, REHVA advocates for indoor environmental quality targets in the EPBD. REHVA welcomes that Annex I of the legislative proposal sets minimum environment quality levels. However, to provide and maintain good indoor environmental quality, IEQ aspects should be further strengthened in the directive.

It should set a clear mandate for Member States to **define indoor environmental quality parameters that are monitored and reported in a harmonised way** in building regulations

part of the inspection of heating and cooling systems, and continuously



# EN 16798-1 (before: EN 15251)

Performance requirements (category A/B/C) for:

- Indoor Air Quality / ventilation
- Thermal environment / heating & cooling
- Light / lighting & daylight penetration
- Noise / spec. installation noise

Seperate requirements for residential and non-residential buildings

# EN 16798-1: some IAQ requirements

**Table B2.1.2-1 Design ventilation rates for non-adapted persons for diluting emissions (bioeffluents) from people for different categories**

Category	Expected Percentage Dissatisfied	Airflow per non-adapted person
I	15	
II	20	
III	30	
IV	40	

**Table B2.1.3-1. Default design CO<sub>2</sub> concentrations above outdoor concentration assuming a standard CO<sub>2</sub> emission of 20 L/(h per person).**

Category	Corresponding CO <sub>2</sub> concentration above outdoors in PPM for non-adapted persons
I	550 (10)
II	800 (7)
III	1350 (4)
IV	1350 (4)

# EN 16798-1: some IAQ requirements II

**Table B2.2-1 Example of recommended design criteria for the humidity in occupied spaces if humidification or dehumidification systems are installed**

Type of building/space	Category	Design humidity relative for dehumidification, %	Design humidity relative for humidification, %
Spaces where humidity criteria are set by human occupancy. Special spaces (museums, churches etc.) may require other limits	I	50	30
	II	60	25
	III	70	20

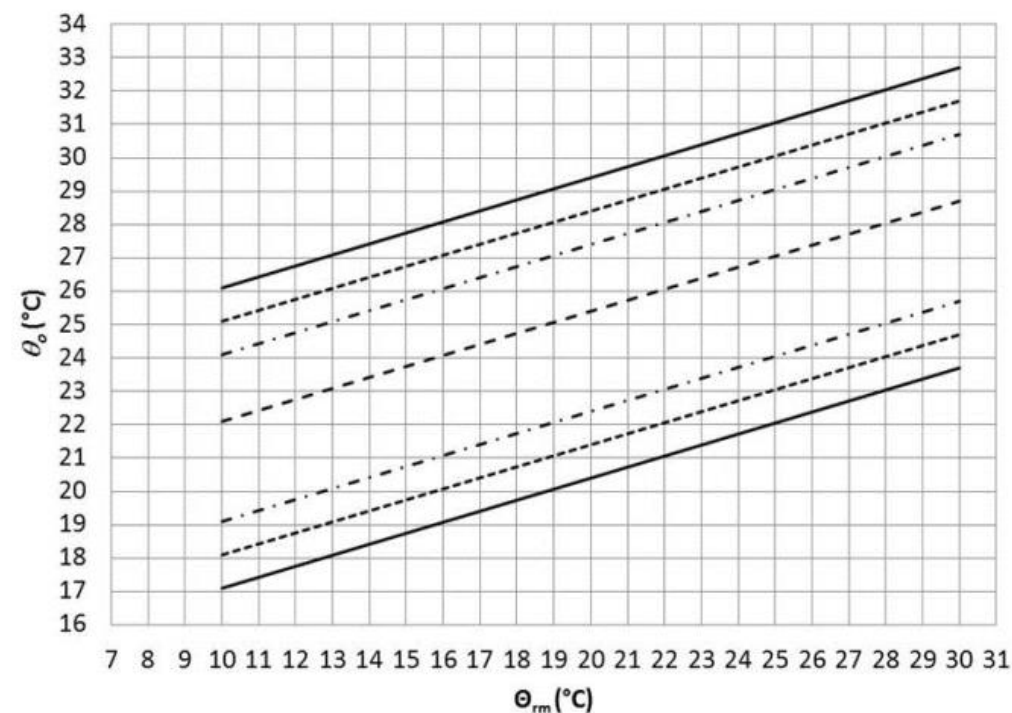
Besides it is recommended to limit the absolute humidity to 12g/kg



# EN 16798-1: some thermal requirements

Table B.1-4 — Temperature ranges for hourly calculation of cooling and heating energy in three categories of indoor environment.

Type of building or space	Category	Temperature range for heating, °C	Temperature range for cooling, °C
		Clothing ~ 1,0 clo	Clothing ~ 0,5 clo
Residential buildings, living spaces (bed room's, kitchens, living rooms etc.)  Sedentary activity ~1,2 met	I	21,0 -25,0	23,5 - 25,5
	II	<b>20,0-25,0</b>	<b>23,0 - 26,0</b>
	III	18,0- 25,0	22,0 - 27,0
	IV	17,0-25,0	21,0 – 28,0
Residential buildings, other spaces (utility rooms, storages etc.)  Standing-walking activity ~1,5 met	I	18,0-25,0	
	II	<b>16,0-25,0</b>	
	III	14,0-25,0	
Offices and spaces with similar activity (single offices, open plan offices, conference rooms, auditoria, cafeteria, restaurants, class rooms,  Sedentary activity ~1,2 met	I	21,0 – 23,0	23,5 - 25,5
	II	<b>20,0 – 24,0</b>	<b>23,0 - 26,0</b>
	III	19,0 – 25,0	22,0 - 27,0
	IV	17,0-25,0	21,0 – 28,0



# EN 16798-1: some light requirements

Table B4-1 Examples of criteria for some buildings and spaces according to EN 12464.

Ref. no. acc. to EN 12464-1:2011	Type of area, task or activity	$\bar{E}_m$ lx	$UGR_L$ —	$U_o$ —	$R_a$ —	Specific requirements
5.26.2	Offices - Writing, typing, reading, data processing, -	500	19	0,60	80	DSE-work, see 4.9
5.26.5	Conference and meeting rooms					
5.36.1-5.36.3	Educational buildings - Classrooms, tutorial rooms, Classroom for evening classes and adults education, Auditorium, lecture halls	500	19	0		
5.36.24	Educational premises – Educational buildings - Sports halls, gymnasiums, swimming pools	300	22	0		

Table B4-2 — Daylight availability classification as a function of the daylight factor  $D_{Ca,j}$  of the raw building envelop opening and  $D_{SNA}$  15193

Vertical Facades Daylight factor $D_{Ca,j}$	Roof lights Daylight factor $D_{SNA}$	Classification of daylight availability
$D_{Ca,j} \geq 6 \%$	$7 \% < D_{SNA}^a$	Strong
$6 \% > D_{Ca,j} \geq 4 \%$	$7 \% > D_{SNA} \geq 4 \%$	Medium
$4 \% > D_{Ca,j} \geq 2 \%$	$4 \% > D_{SNA} \geq 2 \%$	Low
$D_{Ca,j} < 2 \%$	$2 \% > D_{SNA} \geq 0 \%$	None
<sup>a</sup> Values of $D_{SNA} > 10 \%$ should be avoided due to danger of overheating		

# EN 16798-1: some noise requirements

**Table B5-1 Examples of design Equivalent Continuous Sound Level,  $L_{eq, nT,A}$  [dB(A)] for continuous sources**

Building	Type of space	Equivalent Continuous Sound Level $L_{eq, nT,A}$ [dB(A)]		
		I	II	III
Residential	Living-room	≤30	≤35	≤40
	Bedrooms	≤25	≤30	≤35
Places of assembly	Auditoriums	≤24	≤28	≤32
	Libraries	≤25	≤30	≤35
	Cinemas	≤24	≤28	≤32
	Museums	≤28	≤32	≤36
Commercial	Retail Stores	≤35	≤40	≤45
	Department stores, Supermarkets	≤40	≤45	≤50
Hospitals	Bedrooms	≤25	≤30	≤35
	Wards	≤32	≤36	≤40
	Operating theatres	≤35	≤40	≤45
Hotels	Hotel rooms	≤25	≤30	≤35
	Reception, Lobbies	≤30	≤35	≤40
Offices	Small offices	≤30	≤35	≤40
	Landscaped offices	≤35	≤40	≤45
	Conference rooms	≤30	≤35	≤40



# Latest news...

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AUF DEUTSCH

**FOCUS**

## Household air pollution, the forgotten health hazard



"The WHO estimates that 4.3 million people a year die from exposure to household air pollution globally, of which almost 120,000 are in the WHO European region," Leen Meulenberg, the WHO's representative to the EU, told EUobserver (Photo: iStock)

By **MICHELLE PERRETT**  
BRUSSELS, 1. NOV, 08:19



**FEATURE**

### Sedentary pandemic threatens EU health

27. OCT, 08:57



**EFA Patients**  
@EFA\_Patients

Volgen

We have the right to breathe [#cleanair](#) EVERYWHERE! We hope @EP\_Industry will vote for an [#IAQCertificate](#) in [#EPBD](#) [twitter.com/euobs/status/9 ...](https://twitter.com/euobs/status/9...)

**EUobserver** @euobs

[Focus] Indoor air quality on #EU building agenda for first time  
[euobserver.com/health/139297](https://euobserver.com/health/139297)

04:27 - 6 okt. 2017

3 retweets 4 vind-ik-leuks



3



4



**EUobserver**  
@euobs

Volgen

[Focus] Indoor #AirQuality to be debated by #EU parliament and could become binding criteria.  
[#EUWeekInReview](#)



**[Focus] Indoor air quality on EU building agenda for first time**

MEPs will debate amendments to new EU building regulations next week, intended to improve energy efficiency but which could also see indoor air quality become a ma...

[euobserver.com](https://euobserver.com)

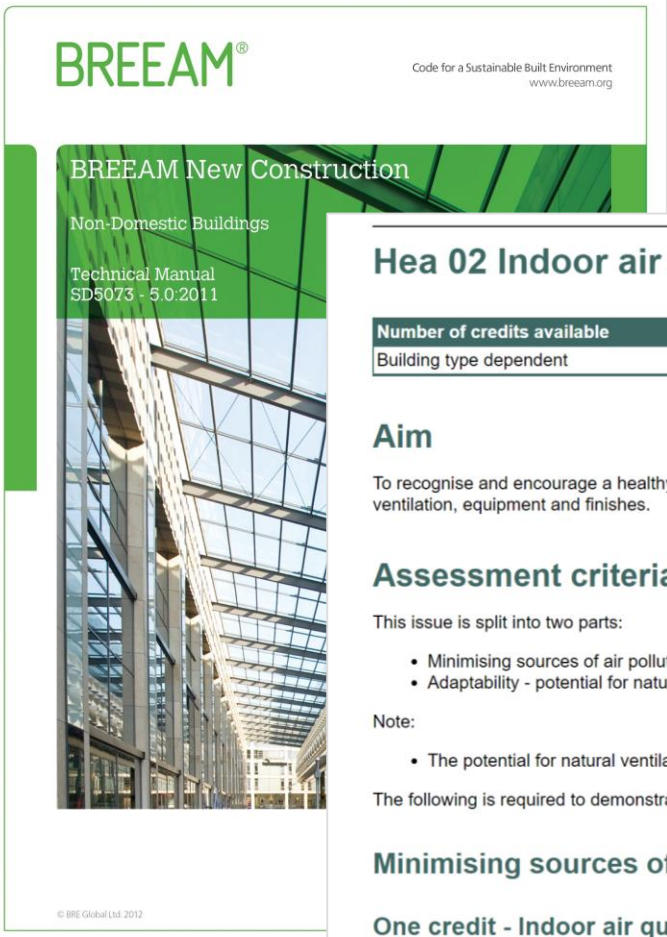
06:30 - 8 okt. 2017

# Forget about (just) nZEB....



WHAT WE NEED IS INTEGRAL APPROACH, ALSO TAKING  
INTO ACCOUNT FACT THAT PEOPLE WANT/NEED/EXPECT  
HEALTH AND COMFORT IN BUILDINGS

# HEA aspects



**BREEAM®**  
Code for a Sustainable Built Environment  
www.breem.org

**BREEAM New Construction**  
Non-Domestic Buildings  
Technical Manual  
SD5073 - 5.0.2011

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## Hea 02 Indoor air quality

Number of credits available	Minimum standards
Building type dependent	No

### Aim

To recognise and encourage a healthy internal environment through the specification and installation of appropriate ventilation, equipment and finishes.

### Assessment criteria

This issue is split into two parts:

- Minimising sources of air pollution (4 credits)
- Adaptability - potential for natural ventilation (1 credit)

Note:

- The potential for natural ventilation credit does not apply to buildings on a prison development.

The following is required to demonstrate compliance:

### Minimising sources of air pollution

#### One credit - Indoor air quality (IAQ) plan

1. An indoor air quality plan has been produced, with the objective of facilitating a process that leads to design, specification and installation decisions and actions that minimise indoor air pollution during occupation of the building. The indoor air quality plan must consider the following:
  - a. Removal of contaminant sources
  - b. Dilution and control of contaminant sources
  - c. Procedures for pre-occupancy flush out
  - d. Third party testing and analysis
  - e. Maintaining indoor air quality in-use





HEA + nZEB =



# More information...

## Editorial



## Towards HEAnZEBs!

Recently, I was invited by a group of civil servants engaged in the update of the current Dutch EPB regulation based on the expected EPBD revision. My contact person asked me, beforehand, to focus my presentation on health and comfort of building occupants in nearly Zero Energy Buildings (nZEBs).

I started my presentation saying: 'I'm worried about this and I truly believe that it is high time that you start worrying about this too.' That maybe wasn't what they wanted to hear, but they asked for my honest and professional opinion which I was happy to share.

Which are my worries? Since the Paris Agreement, everybody seems to be interested in nothing but the energy performance of both existing and new buildings. I do see the need to fight global warming and drastically cut back on CO<sub>2</sub> emissions. There is no time to lose. However, during the last couple of years I have seen (and investigated) a lot of transformed and new buildings, (re)designed with an energy agenda that had unwanted and serious side effects.

For example, some problems that I have come upon in class A (A+) energy performing dwellings, schools and offices include: overheating in summer, underventilation in winter, severely limited daylight penetration, too noisy HVAC systems and overcomplicated climate controls. These are important issues, as a suboptimal Indoor Environmental Quality (IEQ) will affect the

designed to improve the energy performance of (new or existing) buildings should consider indoor climate conditions in order to avoid possible negative effects 'such as inadequate ventilation'. It, furthermore, states that aspects like indoor air quality, adequate natural light and shading should be taken into account when (re)designing energy-efficient buildings.

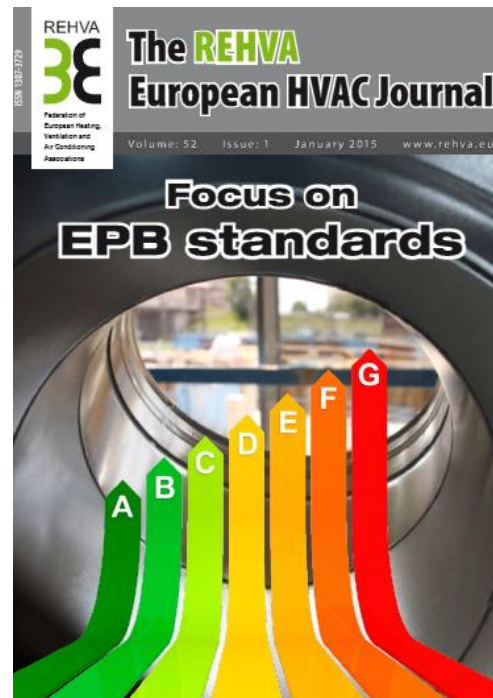
The good news is that countries that want to ensure that the Indoor Environmental Quality of our future nearly Zero Energy Buildings is adequate can now find examples of IEQ performance criteria in FprEN 16798-1 (the upgraded version of EN 15251). This CEN standard presents requirements that can be used when one wants to avoid problems with overheating, underventilation, installation noise, etc.

Several articles in this special issue of REHVA Journal support the hypothesis that the health and comfort performance of buildings is as important as the energy performance. Authors from Europe, South-America, China and India explain that aspects like fine particle exposure, personal control options and sensor technology aimed at local IEQ improvement should be addressed too.

I ended my presentation with the Dutch EPBD recast group saying that, in my opinion, we should start to systematically create buildings that are *both* healthy and

*REHVA journal 3/2017,*  
*[www.rehva.eu](http://www.rehva.eu)*

For more general information about EPBD recast,  
see: [www.rehva.eu](http://www.rehva.eu) & [www.EPB.center](http://www.EPB.center)



<http://www.rehva.eu/publications-and-resources/rehva-journal>