REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

eu.bac european building automation controls association

EVIA European Ventilation Industry Association

European Commission

GCP EUROPE
The voice of efficient building engineering services

LIGHTINGEUROPE
THE VOICE OF THE LIGHTING INDUSTRY

Breathing Life into Efficiency: Indoor Environmental Quality (IEQ) as a Cornerstone in Building Policy

Sustainable Energy Day
10 June 2024
14h00-18h00 CEST
@Comet Louis (Brussels)
& livestreamed

11-13 JUNE 2024

EUROPEAN SUSTAINABLE ENERGY WEEK

Net-zero energy solutions for a competitive Europe

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BREATHING LIFE INTO EFFICIENCY: INDOOR ENVIRONMENTAL QUALITY AS A CORNERSTONE IN BUILDING POLICY

Welcome & introduction

← **Valérie LEPRINCE**

Project Director IEQ

Cerema
CLIMATE & REGIONS, THE FUTURE

Keynote “Overview of IEQ and its Importance””

Pawel WARGOCKI →

Professor, Indoor Environment

DTU

REHVA
Federation of European Heating, Ventilation and Air Conditioning Associations

BREATHING LIFE INTO EFFICIENCY: INDOOR ENVIRONMENTAL QUALITY AS A CORNERSTONE IN BUILDING POLICY

Keynote “IEQ in revised EPBD 2024”

Pau GARCIA AUDI

Policy Officer, Unit B3, Buildings and Products

Energy

BREATHING LIFE INTO EFFICIENCY: INDOOR ENVIRONMENTAL QUALITY AS A CORNERSTONE IN BUILDING POLICY

Cerema
CLIMATE & REGIONS, THE FUTURE

Moderated panel discussion






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Closing remarks and link networking coffee break & session 2

European Commission

BREATHING LIFE INTO EFFICIENCY: INDOOR ENVIRONMENTAL QUALITY AS A CORNERSTONE IN BUILDING POLICY

2002 – 23 – 17 – 1
2024 – 84 – 38 – 10

What do these numbers represent?

BREATHING LIFE INTO EFFICIENCY: INDOOR ENVIRONMENTAL QUALITY AS A CORNERSTONE IN BUILDING POLICY

2002 EPBD

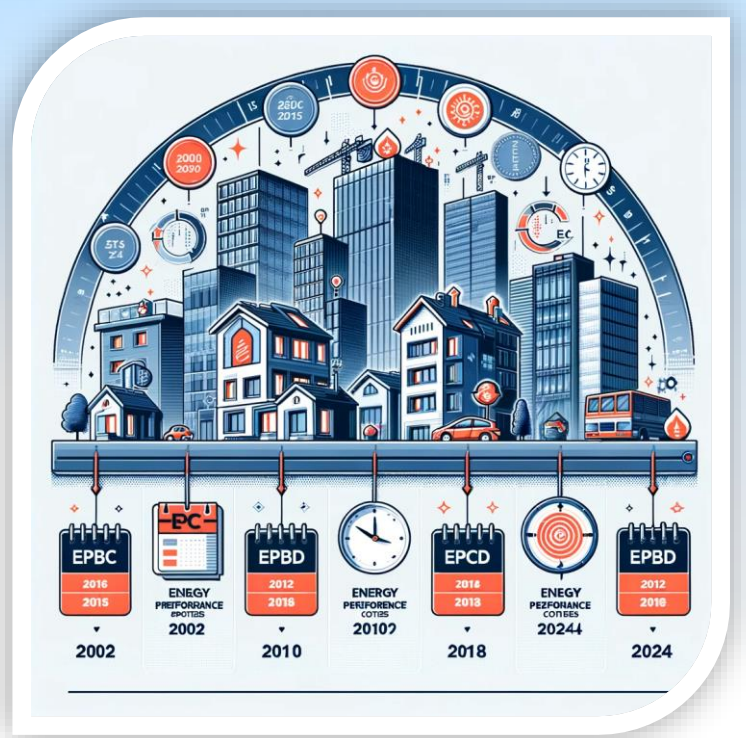
The directive had

- **23 Recitals**
- **17 Articles**
- **1 Annex**

2024 Revised EPBD

The directive has

- **84 Recitals *(3.7 times > 2002)***
- **38 Articles *(2.3 times > 2002)***
- **10 Annexes *(10 times > 2002)***



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European Commission

Pawel Wargocki (pawar@dtu.dk)
International Centre for Indoor Environment and Energy
DTU Sustain, Technical University of Denmark

Overview of IEQ and its importance

Official Journal
of the European Union

EN
L series

2024/1275

8.5.2024

DIRECTIVE (EU) 2024/1275 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 24 April 2024

on the energy performance of buildings

(recast)

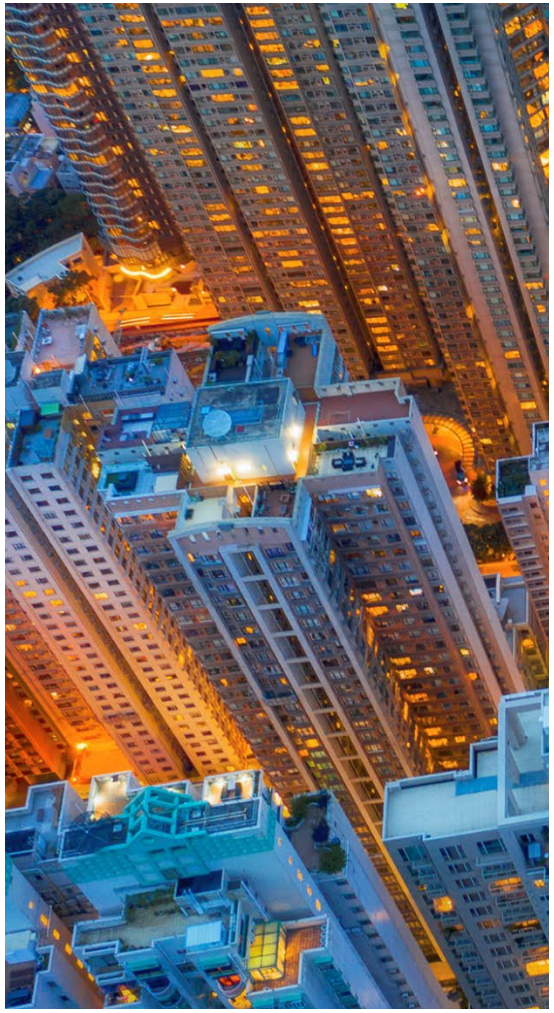
Article 13 Technical building systems

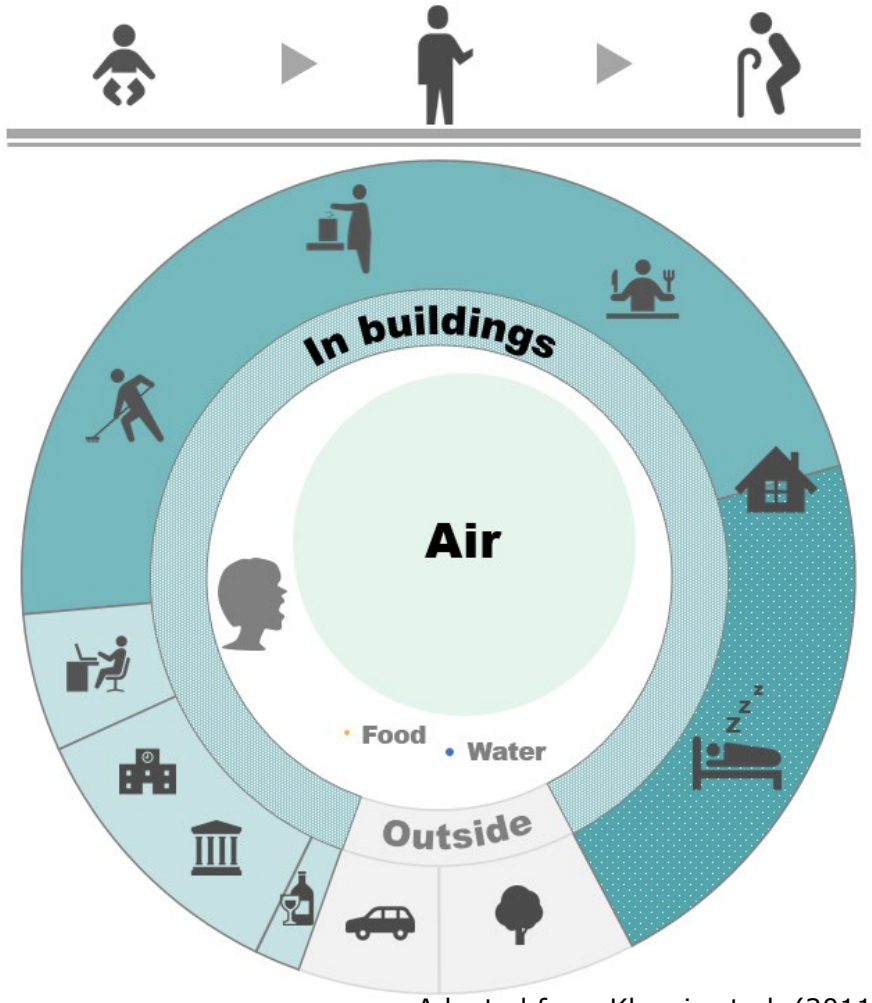
4. Member States shall set requirements for the implementation of in order to maintain a healthy indoor climate. adequate indoor environmental quality standards in buildings

5. 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.

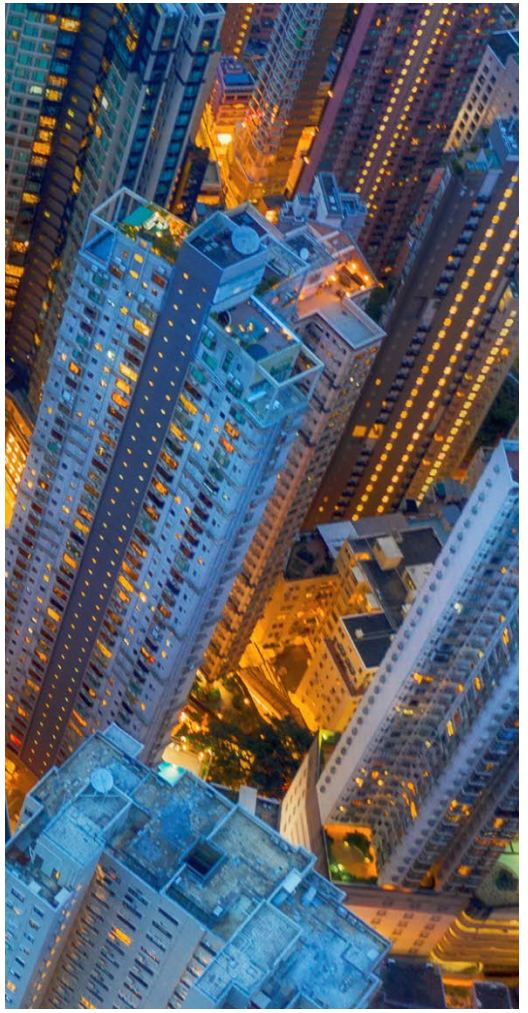
Opening remarks

Current human habitat are buildings
We spent most of our live in buildings…





Adapted from Klepeis et al. (2011)



Source: Klepeis et al. (2011)

Human natural habitat is outdoors
But we stay only 6 years outdoors….

Decoding the ”Da-building” code:

- 79 years (average life time, male EU)

- 69 years (in buildings)
- 54 years (at home)
- 26 years (sleeping)

- ~4 years (commute)

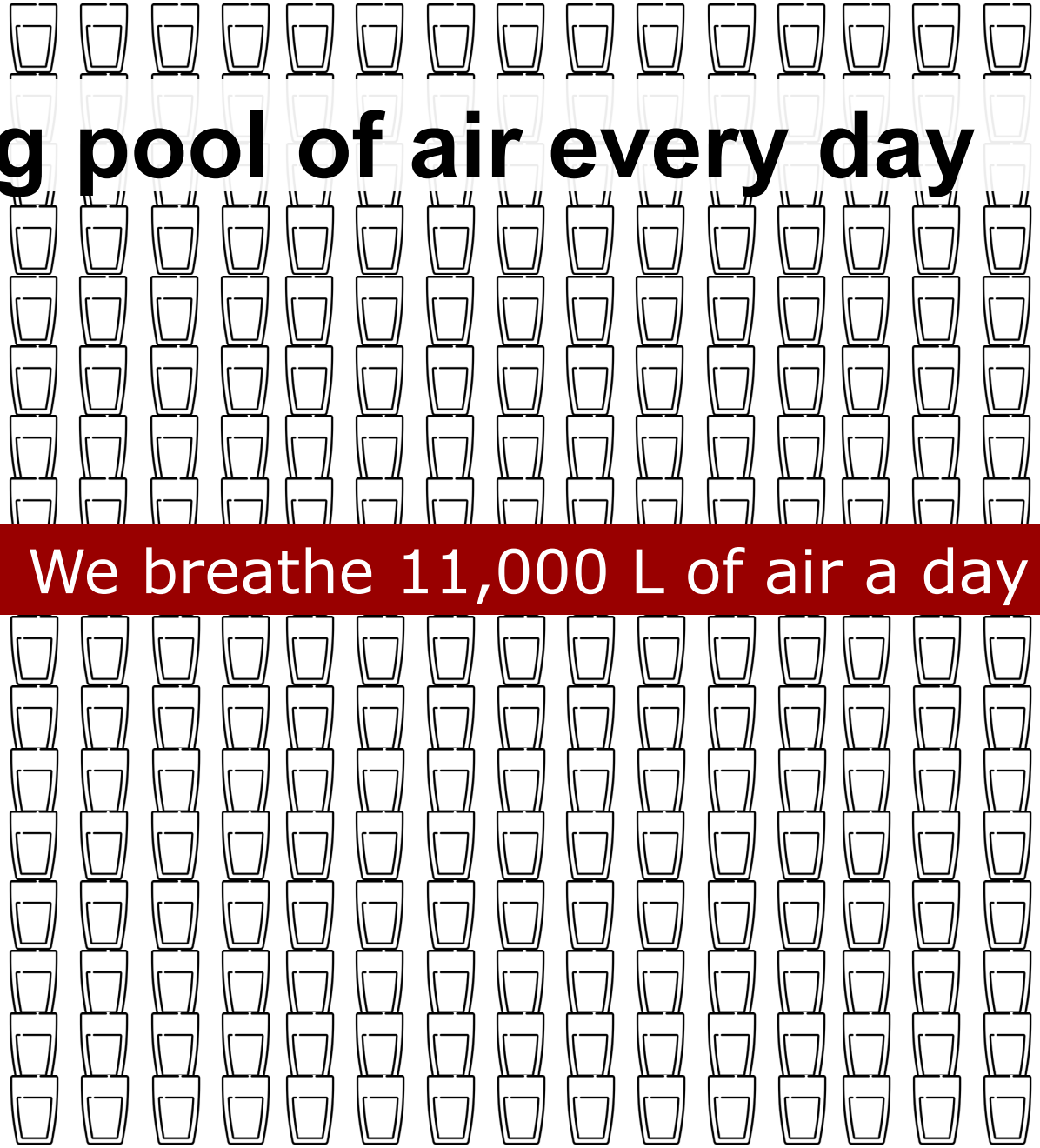
- 6 years (outdoor air)

Source: Pinterest

We inhale a swimming pool of air every day

>85% of time indoors

We drink 2-3 L of water a day



We breathe 11,000 L of air a day

Source: Glass-of-water icons created by Freepik - Flaticon

Main components (domains) characterizing indoor environmental quality (IEQ)

+

Source: Google Pictures

Human behavior

Source: ArchDaily

Contact with nature (biofilia)

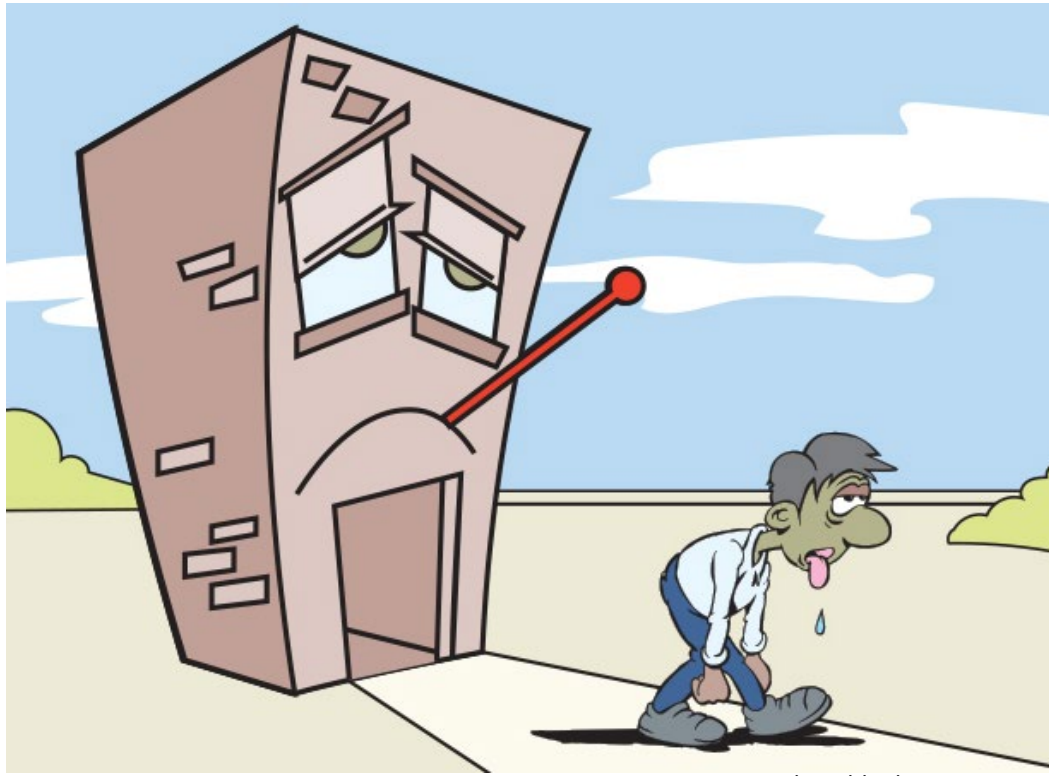
Humans (in buildings) and buildings must be in focus: green + healthy = smart buildings

- Buildings must be climate neutral by minimizing their carbon footprint when constructed, retrofitted and operated
- Buildings must ensure conditions that do not create the risks for health and promote health and healthy behaviors of their occupants (are healthy)

Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs

The goal is all buildings being healthy

- A healthy building should not compromise the basic human requirements of every building occupant and foster high quality of life, good health, optimal physical and mental activity, and sleep quality



Source: thegoldenhammer.net

What do we know about IEQ?

Documented effects of components characterizing a healthy building

Sleep/circadian rhythm

Health and comfort (well-being)

Cognitive performance

Mood

Comfort (well-being)

Cognitive performance

Sleep

Perceived health, health and comfort

Cognitive performance

Sleep

Comfort (well-being)

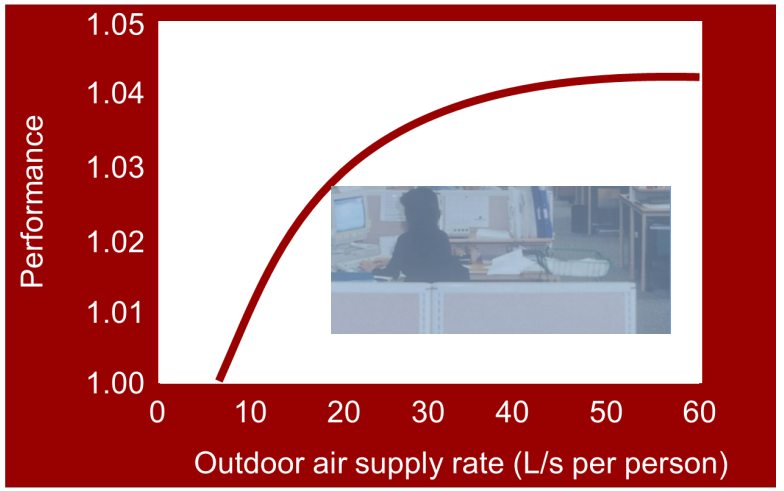
Cognitive performance

Mood and disturbance

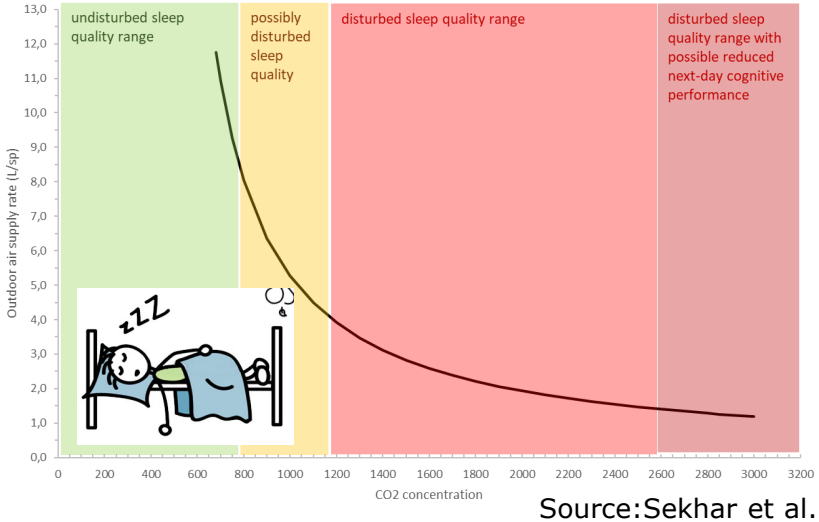
Source: Many authors

Environment in buildings and effects on work, learning and sleep

- Reduced work performance, expected loss is at least up to 5%
- Increased absenteeism and presenteeism
- Reduced learning of children, expected loss of up to 10-15%
- Brand new data: Disturbed sleep quality, poor sleep quality => reduced health, cognitive performance



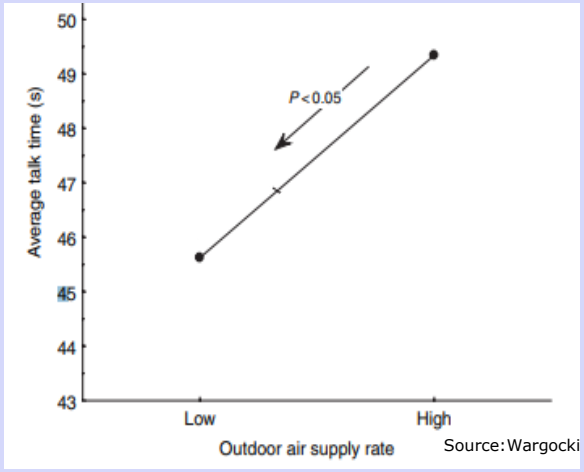
Source:Seppanen et al. (2006)



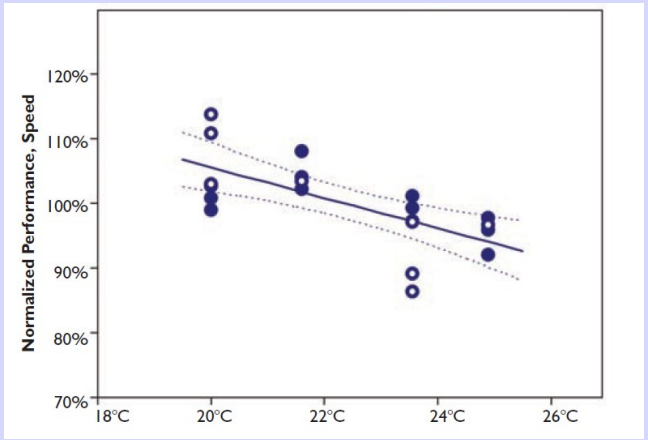
Source:Sekhar et al. (2020)

The effects are similar across climates and regions

Temperate climate

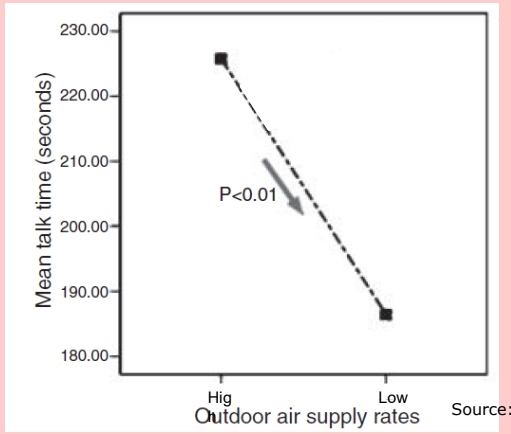


Source: Wargocki and Wyon (2004)

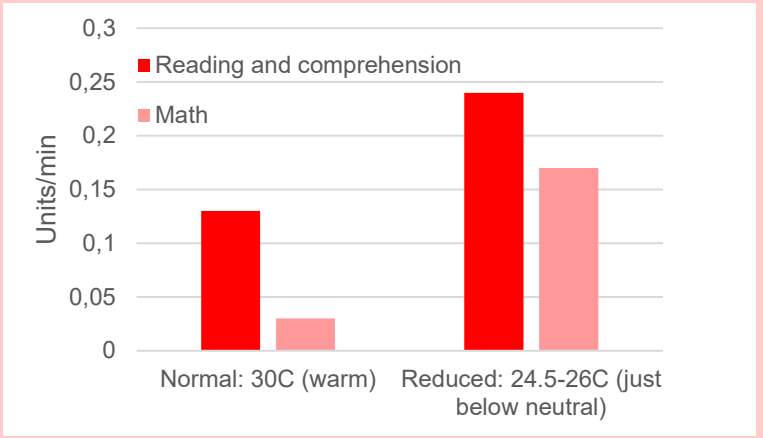


Source: Wargocki and Wyon (2007)

Tropical climate



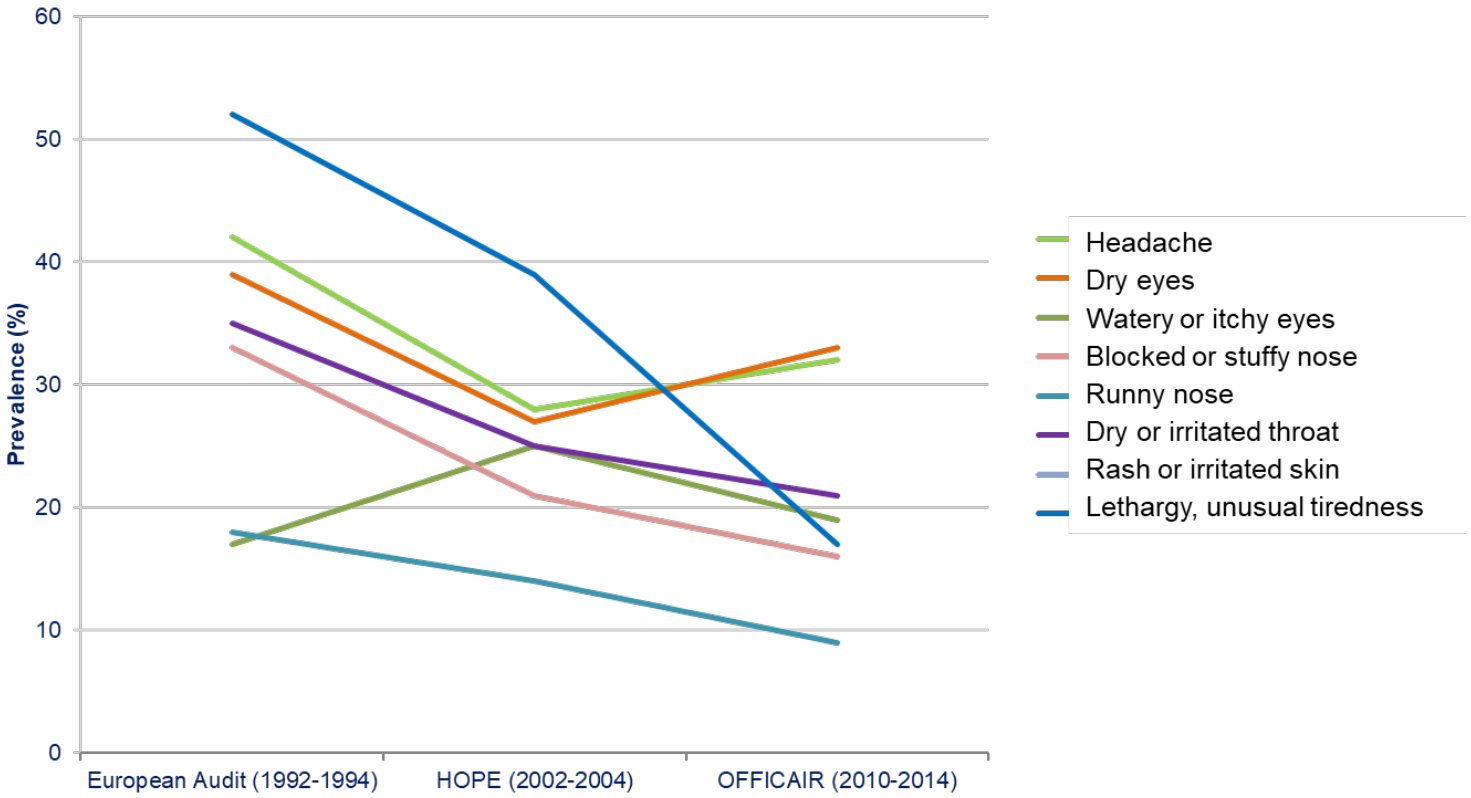
Source: Tham (2004)



Source: Porras-Salazar et al. (2018)

IEQ still not satisfactory

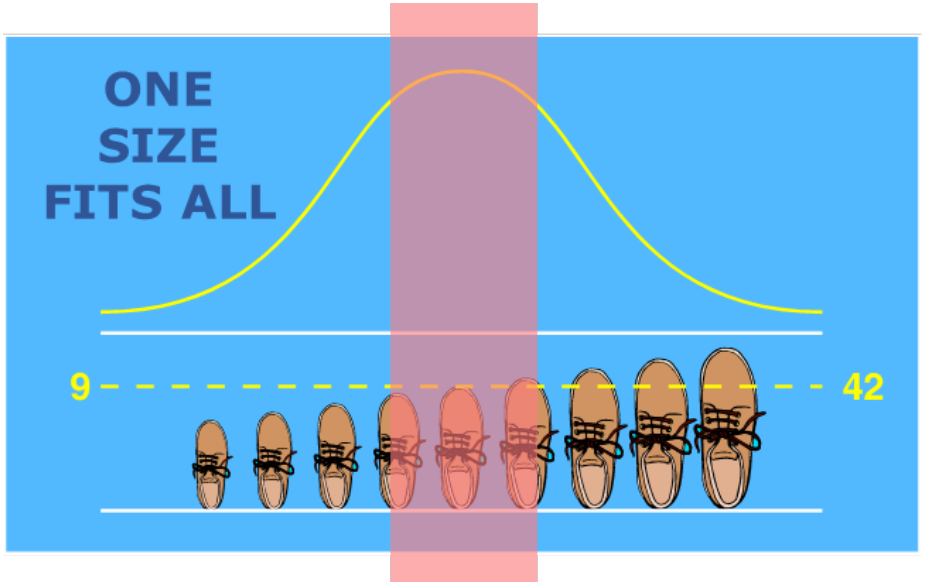
Buildings (even the newer ones) do not perform satisfactorily with respect to IEQ albeit they comply with the current codes and standards



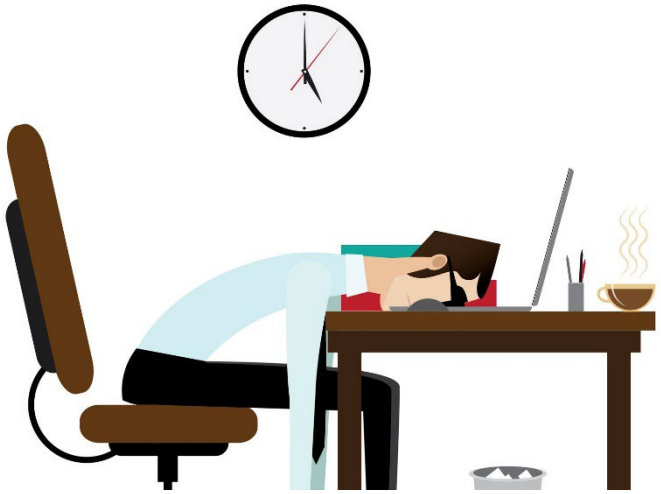
Source: Courtesy of Corinne Mandin; Bluyssen et al. (2016)

Requirements are not sufficiently ambitious? Limiting innovation and advanced development

- Overdependence on the existing rather crude technological solutions and minimum standards.
- Based on population data thus addressing needs for an average person and neglecting individual preferences, diversity, vulnerability, differences, etc.
- Comfort (satisfaction) is the main design criteria, other outcomes not addressed sufficiently
- Addressing one aspect of IEQ not a combined effect
- There no tools to secure high IEQ at the design, operation and maintence phase



IEQ somewhat disregarded/overlooked…costly? (can we adapt and tolerate?)



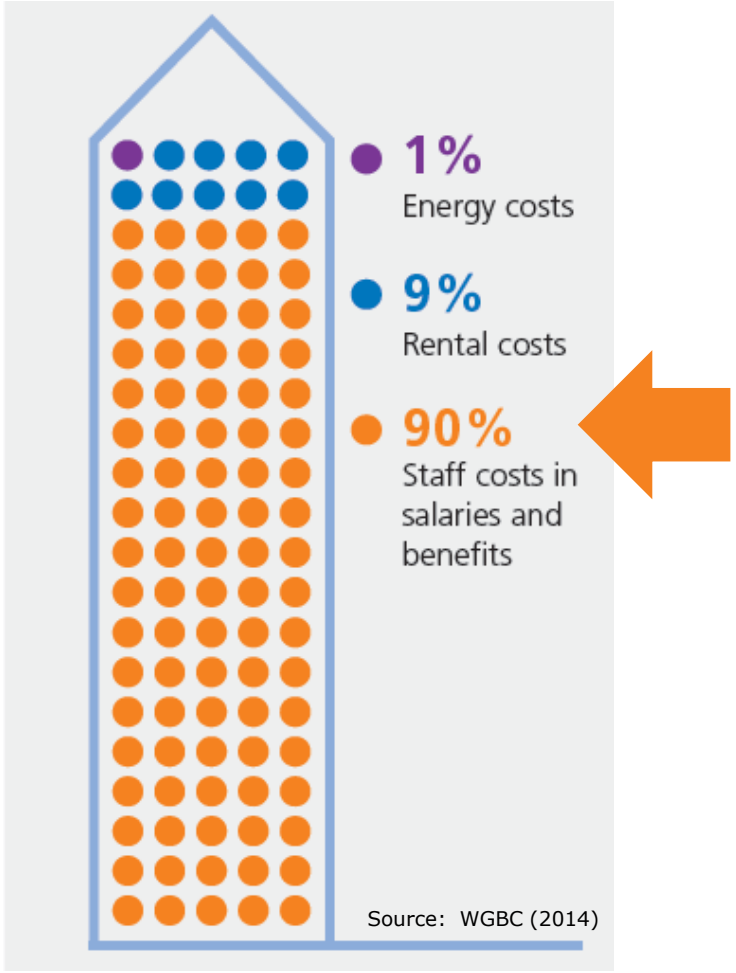
Sources: Biznes.Interia; Fakt.pl; Freepik

Is IEQ truly costly?

Building occupants are major costs => Considerable economic implications, work, health, sleep

- Modest gains in work performance can deliver significant financial benefits – even 1% increase in productivity is cost-effective
- Pay-back times are usually <1 (max. 2) years

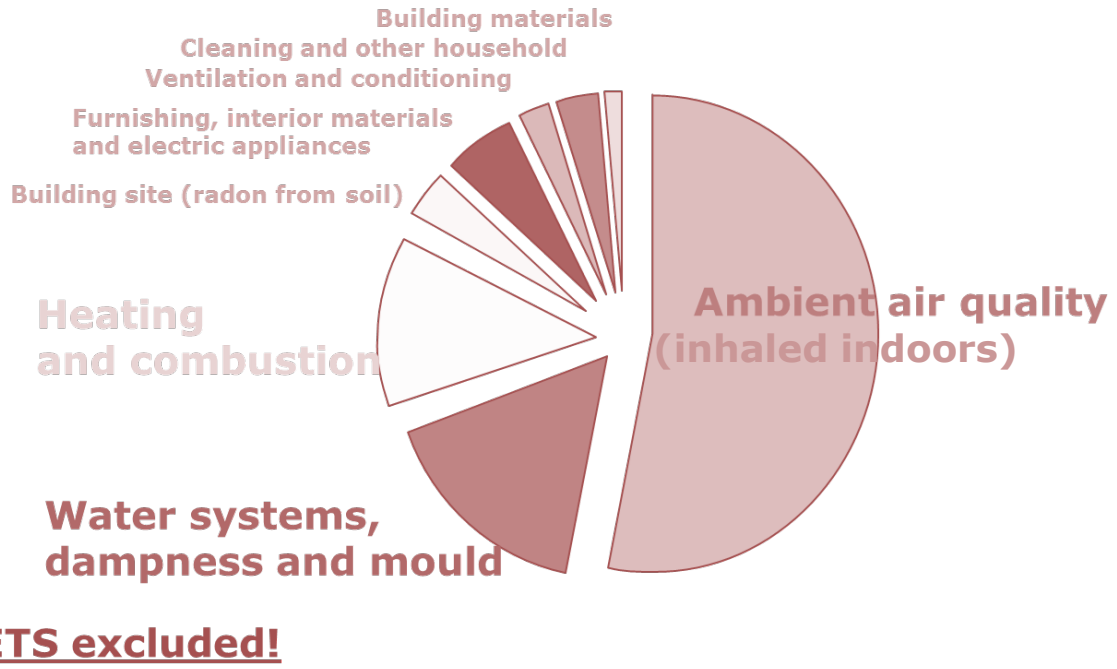
- Crude estimate: Too short sleep (<7 hours) causes 3.7-6 working days lost per year



Costs for disregarding health are also major

- Exposure in buildings estimated in EU to cause >2 mil healthy-life years lost due to poor indoor air quality (IAQ) (ca. €200 billion annually)
- This effects is comparable with, e.g. road traffic injuries, cost similar to GDP of Cyprus
- 200 million in Europe live with allergies, asthma and COPD

- COVID-19 costs in Denmark were 30,000 healthy life years in Denmark (only) partly attributable to poor IAQ (€1 trillion/mo globally)



ETS excluded!

Source: ENVIE (2009)

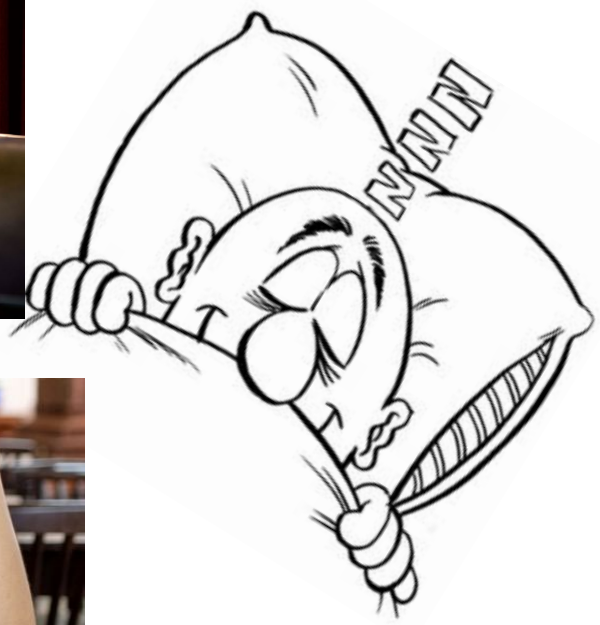
IEQ is in fact a low-hanging fruit

The way forward

Resilience in building design and operation

Overheating
Infection control
Wild fires
Ambient air pollution
Any other unexpected event

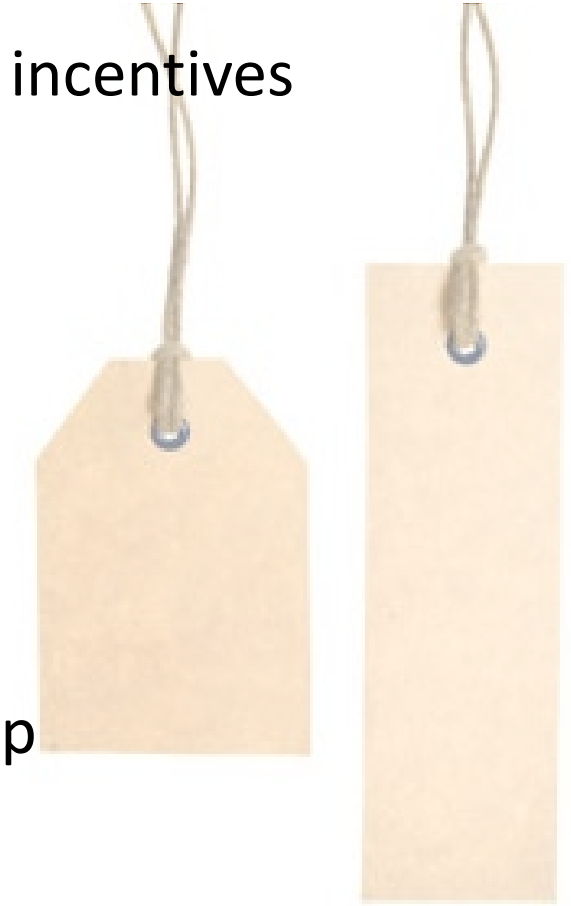
Flexibility in building design and operation



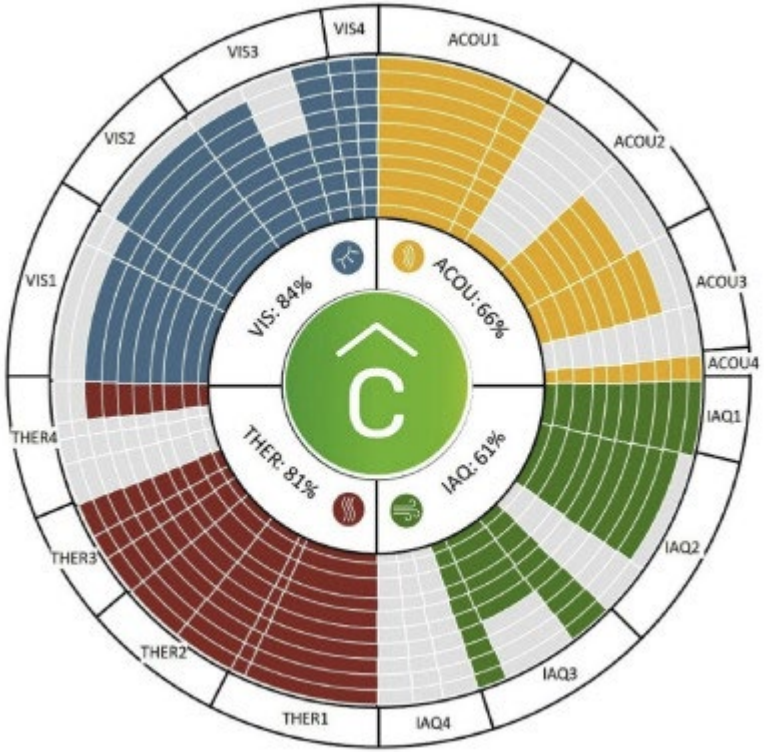
Address (when needed and for whom) health – comfort – performance – sleep

Monitoring and documentation is of an essence

- Useful data for all building stakeholders and additional incentives for improvement of IEQ
- Create benchmark, reference, building data-base
- Monitor performance – compliance and maintenance
- Input to sustainable investments, and technological advancements
- Input to control and AI
- Input to energy simulation and reduce performance gap
- Input to economic calculations
- Demonstrate invisible - occupants feel secure (no risks)
- Raising awareness

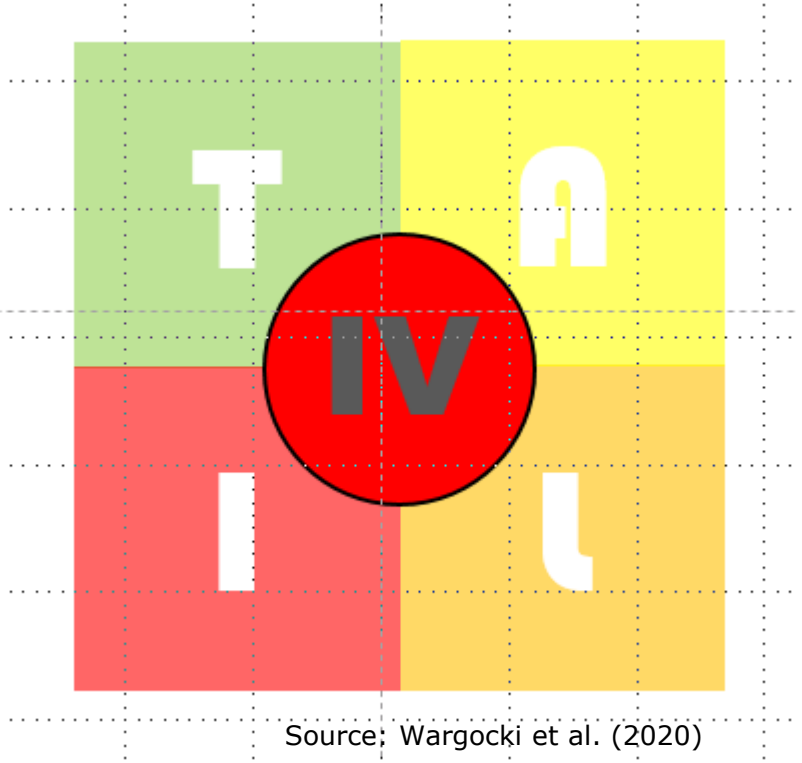


Proposed IEQ rating schemes but not in general use



Source: Larsen et al. (2020)

IEQ-Compass
(asset rating)



Source: Wargocki et al. (2020)

TAIL
(performance rating)

A common language for assessing and reporting on the sustainability performance of buildings

Source: European Commission

Health performance indicators

- Developing Health Performance Indicators using biomarkers and monitoring total exposure for detecting the underlying health risks and implications for cognitive performance and modifiers of these indicators (e.g. stress).

Courtesy of Joon-Ho Choi

It is high time for a change

From pathogenesis to salutogenesis (buildings promoting health and not only avoiding risks)

For example:

- *creating positive sensations*
- *fulfilling preferences and allowing active adaptation*
- *enhancing health resilience and immune response*

Pawel Wargocki (pawar@dtu.dk)
International Centre for Indoor Environment and Energy
DTU Sustain, Technical University of Denmark

Thank you

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Keynote “IEQ in revised EPBD 2024”

Pau GARCIA AUDI

Policy Officer, Unit B3, Buildings and Products

European Commission
Energy

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European Commission

Delivering on the European Green Deal and Fit for 55

Energy Performance of Buildings Directive (EPBD) recast

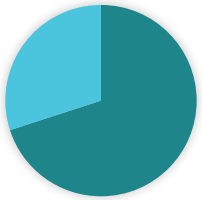
(2024/1275)

European Commission – DG ENERGY
Unit B3 - Buildings and Products

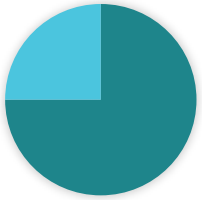
EU building stock

EU building sector is one of the **largest energy consumers** (aprox 42%) in Europe, responsible for **more than one third of the energy-related emissions**.

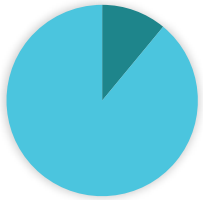
About **24 billion m2** permanently occupied floor area, more than **70 % residential**

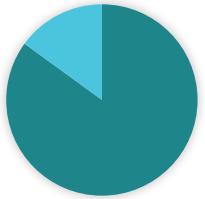


… **75 %** of the building stock **has poor energy performance** …

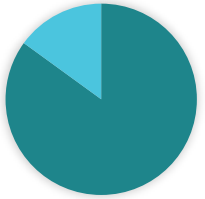


Aprox. **11%/yr** of existing buildings undergo some level of **renovation,** while only about **1%/yr concerns deeper energy renovation**





About **85 %** of existing EU dwellings were **built before 2000**, of which …

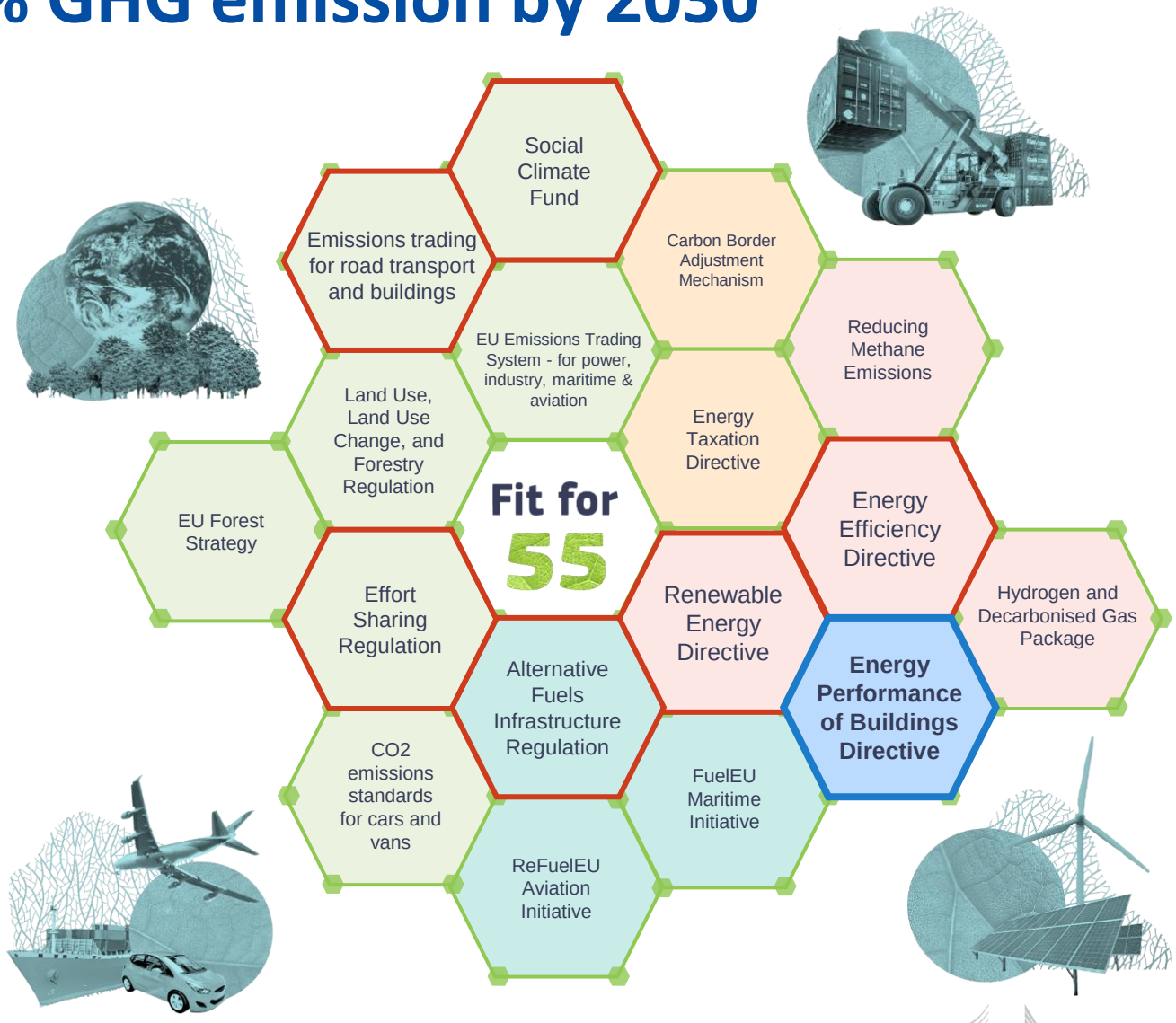


… **more than 85 %** of current stock will **still be in place in 2050**

European Commission

“Fit for 55” package - 55% GHG emission by 2030

EPBD recast = effective delivery mechanism for the buildings sector



https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541

European Commission

EU legislation on energy and buildings

1970s — Oil crisis

2002 — EPBD 2002-91-EC

Minimum performance requirements (2004)

2009 — RES Directive 2009/28/EC

2010 — EPBD 2010/31/EU – recast

2012 — EE Directive 2012/27/EU

2018 — **EPBD (EU) 2018/844 – amending**

RES Directive – amending + EE Directive – amending

Nearly Zero Energy Buildings (2020)

2021 — EU Green Taxonomy

2023 — RES Directive – amending + EE Directive – recast

2024 — EPBD recast

Zero Emission Buildings (2030)

Also:

- Ecodesign
- Ecodesign for Sustainable Product Regulation (ESPR)
- Energy labelling
- Level(s)
- State Aid (GBER)

European Commission

Focus areas of the recast EPBD

Renovation

- Minimum Energy Performance Standards
- National trajectories for the progressive renovation of the residential building stock
- National Building Renovation Plans

Decarbonisation

- Introduction of zero-emission buildings as standard for new buildings
- Solar deployment in buildings
- Calculation of whole life cycle carbon
- Phasing out incentives for fossil fuels and new legal basis for national bans

Enabling framework

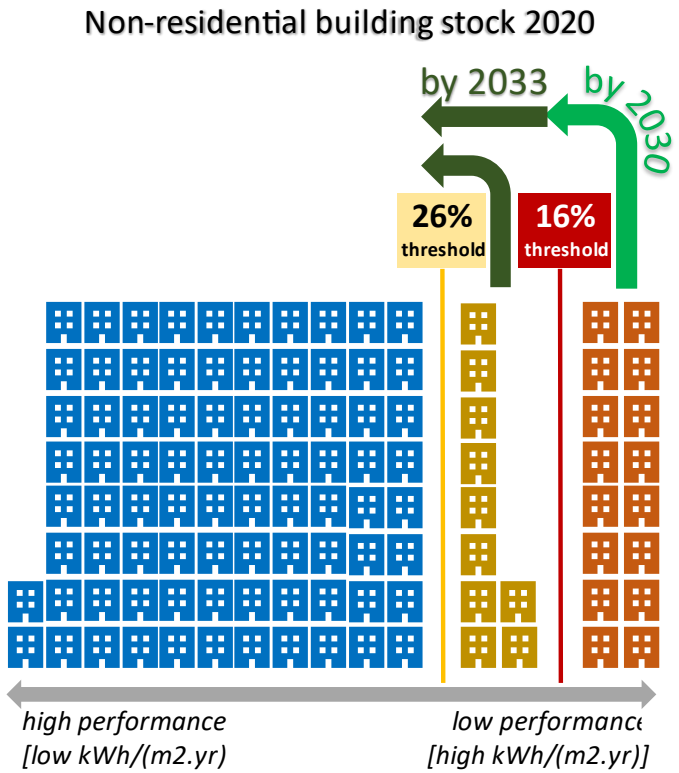
- Strengthened Energy Performance Certificates
- Renovation passports
- Sustainable finance & energy poverty
- One-stop-shops
- Deep renovation standard
- National energy performance databases

Modernisation & system integration

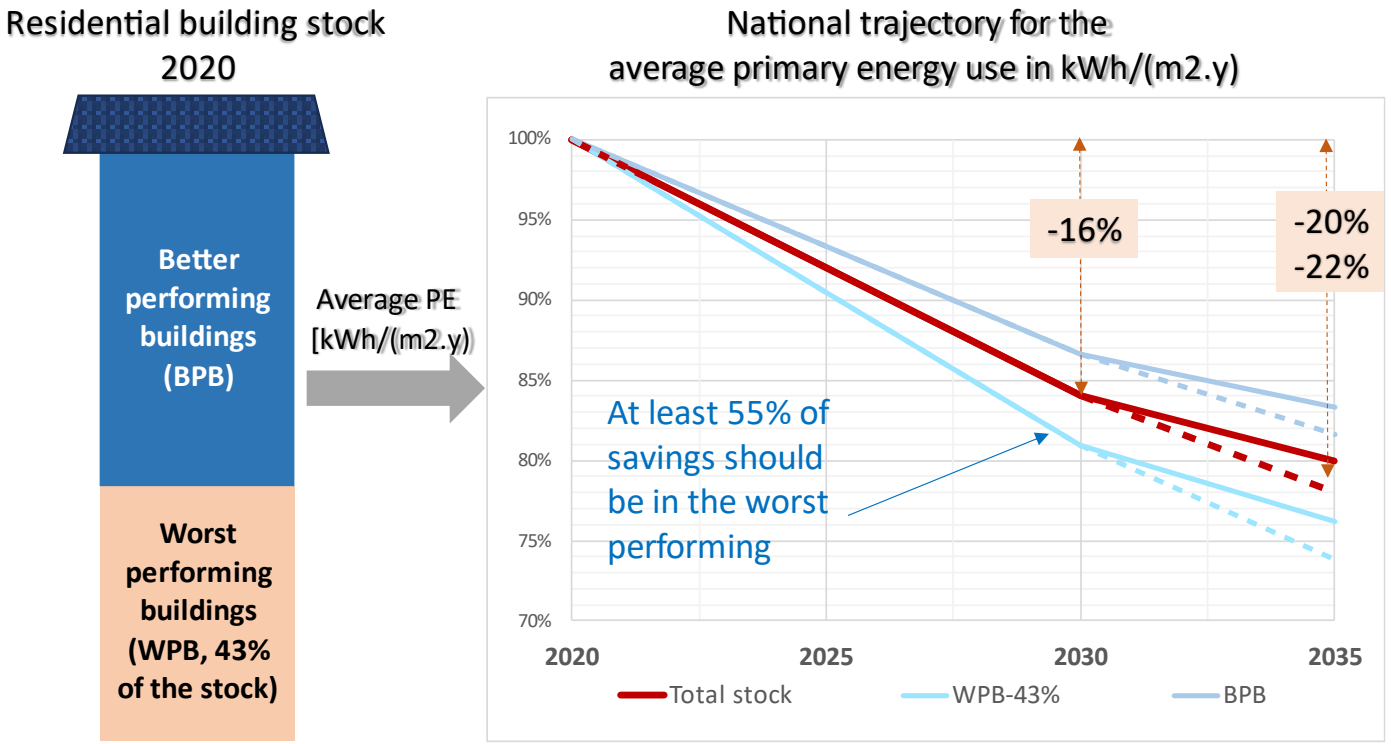
- Infrastructure for sustainable mobility
- Smart Readiness Indicator
- Indoor air quality: ventilation and other technical building systems
- Digitisation, data access and exchange

MEPS for non-residential buildings and primary energy use trajectory for the residential building stock (Article 9)

Non-residential: Minimum Energy Performance Standards (MEPS)



Residential: trajectory to reduce the average primary energy use



Exemptions allowed both for non-residential and residential
(for protected buildings, temporary use, places of worship, etc.)

European Commission

Zero-emission buildings (Articles 7, 11, Annex III)

- **All new buildings to be zero-emission buildings (ZEBs):**
  - From 2028 public buildings owned by public bodies
  - From 2030 all new buildings
- **ZEB will require:**
  - **Zero on-site emissions from fossil fuels**
  - **A very low amount of energy with a view to cost-optimal level but at least (NZEB -10%)**
  - Supplied by:
    - **renewables from onsite, nearby, renewable energy communities**
    - **energy efficient DH&C**
    - **energy from carbon-free sources**
  - Life cycle GWP calculation (from 2028 for new bdgs >1000m2 useful floor area, from 2030 for all new buildings) and disclosure through EPC
  - Indoor Environmental Quality requirements (monitoring and control)

European Commission

Fossil fuel use in buildings – Gradual phase-out
Solar energy in buildings – Gradual phase-in

- **Fossil fuel in buildings**
  - From 1 January 2025: **no more financial incentives for stand-alone boilers powered by fossil fuels (Article 17 (15))**
  - Legal basis for Member States to set requirements
  - Plan policies and measures with a view to a complete phase-out of boilers powered by fossil fuels by 2040 through the national Building Renovation Plans (Annex II)

- **Solar energy in buildings:**
  - New buildings are designed to optimize their solar energy generation potential
  - Gradual deployment of suitable solar energy installations on new buildings
  - Gradual deployment of suitable solar energy installations on existing buildings (linked to trigger points)

Other key provisions & strengthened enabling framework (1)

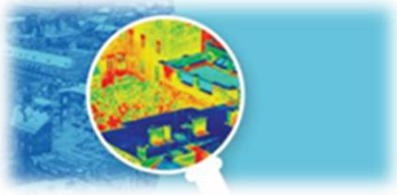
- **Definition of Indoor Environmental Quality** (Article 2) to replace Long Term Renovation Strategies (LTRS)
- IEQ to be **addressed in new and renovated buildings**
- MS to set up **requirements for the implementation of adequate IEQ standards** in buildings
- Measuring & control devices for **monitoring and regulation of indoor air quality**:
  - mandatory in new and renovated non-residential buildings
  - voluntary in residential buildings
- Inclusion of IEQ monitoring among the **mandatory capabilities of BACS** in large non-residential buildings
- **Recommendations for the cost-effective improvement of IEQ** to be included in the EPCs + **voluntary indicators**

Other key provisions & strengthened enabling framework (2)

- **National Building Renovation Plans** (Article 3) to replace Long Term Renovation Strategies (LTRS)
  - **Common template**
  - **Aligned** with National Energy and Climate Plans (NECPs) cycles
- **Sustainable mobility** (Article 14): **Strengthened requirements on the number of recharging points for electric vehicles**
  - **For non-residential buildings** (new buildings and buildings undergoing major renovation):
    - **> 5 car parking spaces:** installation of at least 1 recharging point for every 5 car parking spaces (1 for 2 in office buildings) **and** pre-cabling for at least 50 % of car parking spaces and ducting
    - **> 20 car parking spaces: before 2027,** installation of at least 1 recharging point for every 10 car parking spaces **or** of ducting for at least 50 % of car parking spaces
  - **For residential buildings** (new buildings and buildings undergoing major renovation) > 3 parking spaces:
    - Installation of at least 1 recharging point (new buildings) **and** pre-cabling for at least 50 % of car parking spaces and ducting (new and renovated buildings)
  - Enable **smart charging** and, where appropriate, **bi-directional charging**
  - Sufficient number of **parking spaces for bicycles**, including cargo bikes

Other key provisions & strengthened enabling framework (3)

- **Energy Performance Certificates (EPC)** (Articles 19, 20, Annex V)
  - Energy performance **classes from A to G**
  - **Common template** with energy, GHG indicators and IEQ indicators
  - **More trigger points** (incl. major renovation) for issuing and accessing EPCs
  - Strengthened quality framework
- **Building Renovation Passports** (Article 12)
  - Scheme **in every Member State** to **guide building owners** in their **staged energy renovations**
- **Smart Readiness Indicator** (Article 12)
  - Test phase + Possible introduction of the scheme for non-residential buildings (based on test phase)



- **National databases on energy performance of buildings & Data exchange**
  - MS to set up **databases on energy performance of buildings** and report to Building Stock Observatory (Article 22)
  - MS to ensure that building owners, tenants and managers can have direct and free-of-charge access to their building systems data (Article 16)

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Other key provisions & strengthened enabling framework (4)

Financing, support measures and one-stop-shops (Article 17 and 18)

- Clear obligation for Member States to **provide appropriate financing and support** measures and **stimulate private investments**, in line with building renovation plans and 2050 goals
- Financial measures to offer **higher support** to **vulnerable households** and **deeper renovations**
- Member States to provide **safeguards for tenants** and to aim to **distribute the benefits for both owners and tenants** when providing financial incentives
- COM to adopt **delegated act** providing a comprehensive portfolio framework **for voluntary use by financial institutions**, **to increase financing volumes provided for energy performance renovations.**

- Member States to ensure that **EPCs and renovation passports are affordable**

- Member States to establish dedicated **one-stop-shops for energy performance of buildings**

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Timeline of the recast EPBD process

29 May 2026	Transposition date (24 months after EPBD entry into force)
8 May 2024	**Publication in Official Journal - entry into force: 28 May 2024**
12 April 2024	**Formal adoption by Council**
12 March 2024	**Adoption in the EU Parliament plenary**
7 Dec. 2023	**4th political trilogue: provisional agreement reached**
March 2023	European Parliament's position on the EPBD revision
October 2022	Council General Approach on the EPBD revision
15 Dec. 2021	**EPBD proposal adopted by COM**

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Next steps

Next steps – Guidance

- 17-18 April 2024 – Concerted Action
- 6 EPB Committees: **16 May**, June, July, September, October and November
- 1st draft guidance shared with MS by summer 2024
- Draft guidance completed by end of 2024
- Guidance publication in Q1-Q2 2025*

Next steps – Delegated Acts

- 8 Delegated acts identified in the EPBD recast
- Deadlines between mid 2025 and 2027
- Start of technical work with MS in Q3 2024

Guidance on financial incentives for standalone fossil fuel boilers by **Q4 2024 (earlier than others)*

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Thank you!

BREATHING LIFE INTO EFFICIENCY: INDOOR ENVIRONMENTAL QUALITY AS A CORNERSTONE IN BUILDING POLICY

Cerema
CLIMATE & REGIONS, THE FUTURE

Moderated panel discussion






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Introductory statement

Loïc DELORME

EU Government Affairs Manager

Schneider Electric

eu.bac european building automation controls association

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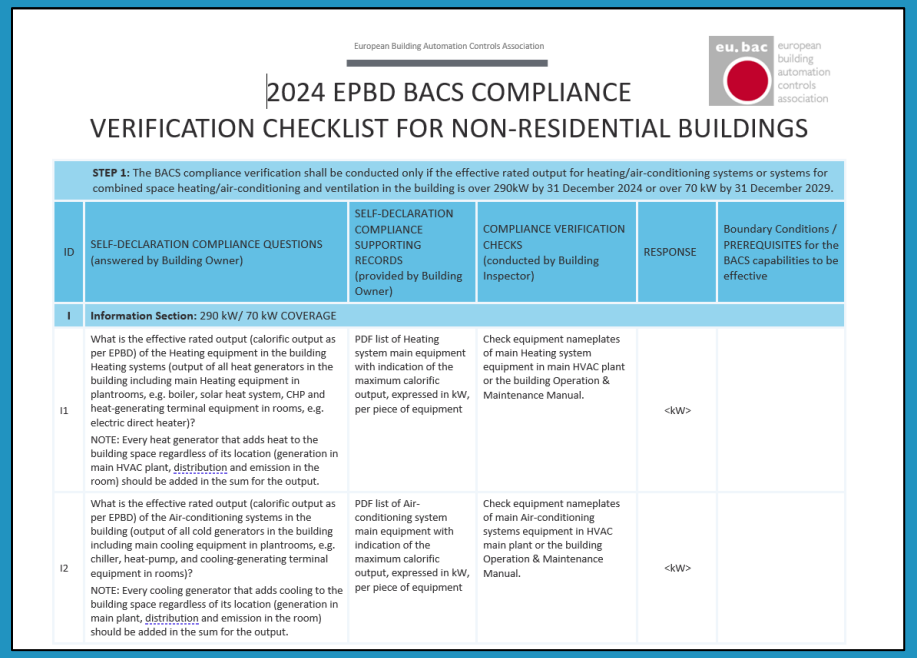
IEQ monitoring using BACS in non-residential (Art. 13, Par. 9-10)

BY 2025 **EFFECTIVE RATED OUTPUT >290 kW**

BY 2030 **EFFECTIVE RATED OUTPUT >70 kW**



European Building Automation Controls Association

2024 EPBD BACS COMPLIANCE VERIFICATION CHECKLIST FOR NON-RESIDENTIAL BUILDINGS

STEP 1: The BACS compliance verification shall be conducted only if the effective rated output for heating/air-conditioning systems or systems for combined space heating/air-conditioning and ventilation in the building is over 290kW by 31 December 2024 or over 70 kW by 31 December 2029.

ID	SELF-DECLARATION COMPLIANCE QUESTIONS (answered by Building Owner)	SELF-DECLARATION COMPLIANCE SUPPORTING RECORDS (provided by Building Owner)	COMPLIANCE VERIFICATION CHECKS (conducted by Building Inspector)	RESPONSE	Boundary Conditions / PREREQUISITES for the BACS capabilities to be effective
I	**Information Section:** 290 kW/ 70 kW COVERAGE				
I1	What is the effective rated output (calorific output as per EPBD) of the Heating equipment in the building Heating systems (output of all heat generators in the building including main Heating equipment in plantrooms, e.g. boiler, solar heat system, CHP and heat-generating terminal equipment in rooms, e.g. electric direct heater)? NOTE: Every heat generator that adds heat to the building space regardless of its location (generation in main HVAC plant, distribution and emission in the room) should be added in the sum for the output.	PDF list of Heating system main equipment with indication of the maximum calorific output, expressed in kW, per piece of equipment	Check equipment nameplates of main Heating system equipment in main HVAC plant or the building Operation & Maintenance Manual.	<kW>	
I2	What is the effective rated output (calorific output as per EPBD) of the Air-conditioning systems in the building (output of all cold generators in the building including main cooling equipment in plantrooms, e.g. chiller, heat-pump, and cooling-generating terminal equipment in rooms)? NOTE: Every cooling generator that adds cooling to the building space regardless of its location (generation in main plant, distribution and emission in the room) should be added in the sum for the output.	PDF list of Air-conditioning system main equipment with indication of the maximum calorific output, expressed in kW, per piece of equipment	Check equipment nameplates of main Air-conditioning systems equipment in HVAC main plant or the building Operation & Maintenance Manual.	<kW>	

CAPABILITIES:

a) continuously monitoring, logging, analysing and allowing for adjusting energy usage;

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;

c) allowing communication with connected technical building systems and other appliances inside the building, and being interoperable with technical building systems across different types of proprietary technologies, devices and manufacturers.

d) by 29 May 2026 monitoring of indoor environmental quality.

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Jelle LAVERGE

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FACULTY OF ENGINEERING AND ARCHITECTURE

DEPARTMENT OF ARCHITECTURE AND URBAN PLANNING
BUILDING PHYSICS, CONSTRUCTION AND SERVICES RESEARCH GROUP

EUSEW SUSTAINABLE ENERGY DAY 2024: PANEL 1: IEQ INTRO SLIDE

While we breathe, we hope - Barak Obama

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“Turn left at the next traffic lights, then take the fourth street to the right, go right ahead at the first roundabout, turn to the right at the second roundabout and keep the left lane, then turn ……..”

Spekkink, D. 2005. Key note presentation on PeBBu, CIB Conference, Helsinki, 2005

“To the airport!”

Spekkink, D. 2005. Key note presentation on PeBBu, CIB Conference, Helsinki, 2005

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Introductory statement

Elena SCARONI

Secretary General

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Introductory slide on IEQ

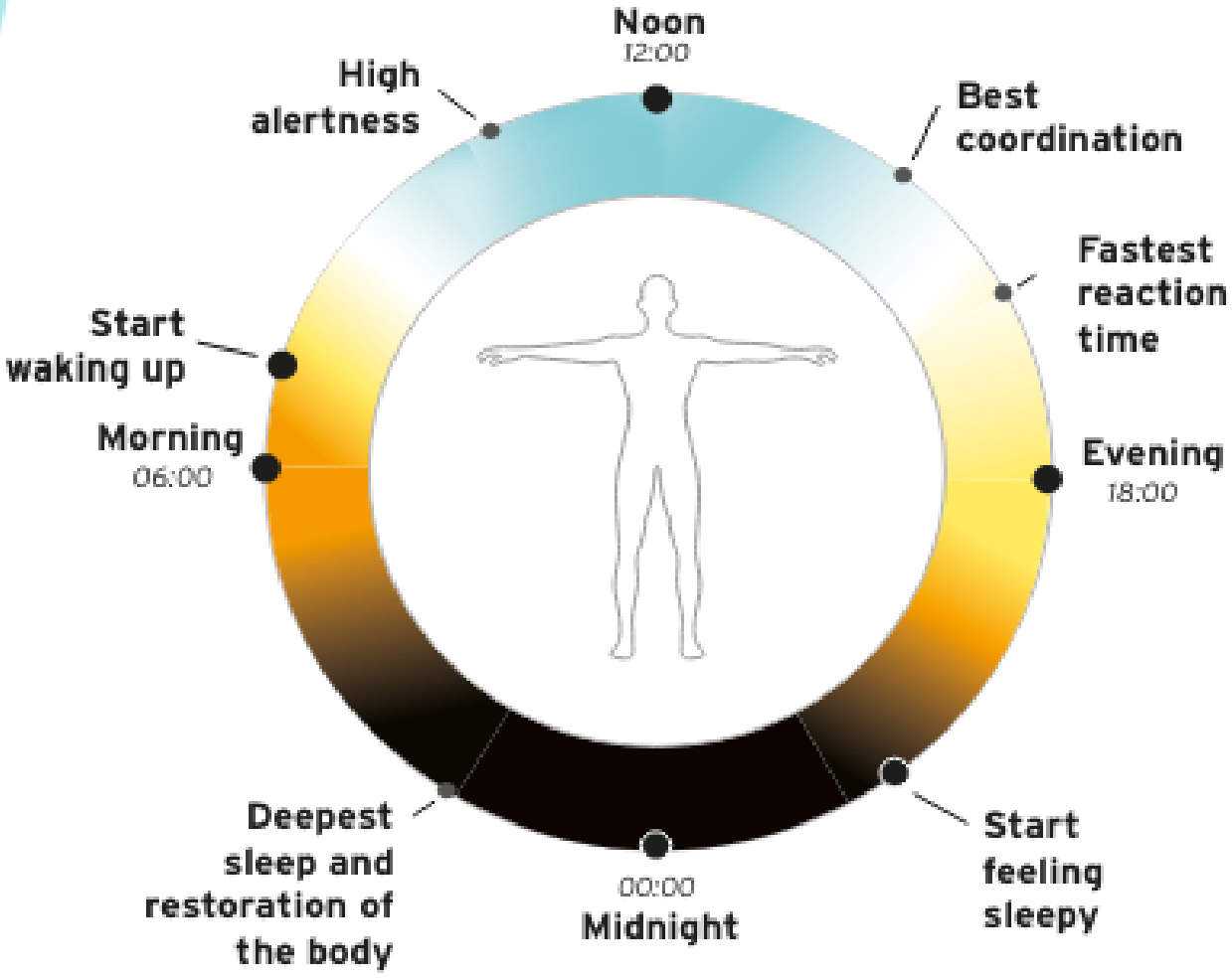
First panel discussion

Elena Scaroni
Secretary General

We need light and darkness

There is a period of the day when we are active and a period when we are sleeping

Light is the most important timer for our internal clock



Light has an effect on

Vision
Sight, safety and orientation

Body
Alertness, cognitive performance and sleep/wake cycle

Emotion
Mood, energize and relaxation

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THANK YOU

Elena Scaroni

Secretary General

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Introductory statement

Adam TAYLOR

IAQ Chairperson

GCP EUROPE

The voice of €fficient building engineering services

ADAM TAYLOR B.ENG I.ENG MCIBSE

IAQ CHAIRPERSON FOR BESA & GCP EUROPE

- Indoor Air Quality, ventilation and thermal comfort specialist

- Day Job -
- Assessment
- Remediation
- Maintenance

- Healthy Buildings Healthy Building Standards - development & deployment

- Balancing the needs of IAQ and Energy – “Buildings are built for people, not just for saving energy”

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Closing remarks and link networking coffee break & session 2

Valérie LEPRINCE

Project Director IEQ

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Blagodarjá!
Hvala!
Děkuji!
Tak!
Dank je!
Thank you!

Aitäh!
Kiitos!
Merci!
Danke!
Efcharisto!
Köszönöm!

Go raibh maith agat!
Grazie!
Paldies!
Ačiū!
Grazzi!
Dziękuję!

Obrigado!
Mulțumesc!
Ďakujem!
Hvala!
Gracias!
Tack!

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