



# HEALTHY BUILDINGS FOR ALL

Putting people's health and well-being  
at the centre of the EU built environment



# Indoor Environmental Quality

Putting people's health and well-being at the center of building construction, renovation and operation.

The informal Indoor Environmental Quality (IEQ) Gathering brings together eight European industry associations, representing companies involved in technical building systems and their maintenance. Our objective is to collectively promote healthy buildings with an adequate level of indoor environmental quality.

- ▶ **AREA** - European Association of refrigeration, air-conditioning and heat pumps contractors
- ▶ **EHPA** - European Heat Pump Association
- ▶ **EPEE** - European Partnership for Energy and the Environment
- ▶ **eu.bac** - European Building Automation and Controls Association
- ▶ **EUROVENT** - European Industry Association for Indoor Climate, Process Cooling, and Food Cold Chain Technologies
- ▶ **EVIA** - European Ventilation Industry Association
- ▶ **GCP Europe** - European association for building engineering services
- ▶ **LightingEurope** - voice of the lighting industry

Healthy Buildings are buildings, in which the indoor environment is healthy for people to live in and carry out their activities. Good air quality, a lighting design adapted to the needs of the occupants, sufficient access to daylight and views and an adequate ventilation are important for creating a healthy indoor environment. Thermal comfort, indoor air quality, moisture, dust and pests, water quality, noise, as well as safety and security are also considered as aspects that must be considered in the context of any healthy building.

The World Health Organisation (WHO) estimates that people spend approximately 90% of their time indoors in residential and non-residential buildings and that 26 million European children are living in unhealthy homes<sup>1</sup>.

Renovation will be at the heart of the European Green Deal and has been identified as a key driver for the European social and economic recovery post-COVID-19. The yearly average renovation rates of the building stock across the EU Member States varies from 0.4 to 1.2%<sup>2</sup>. If Europe is to fulfil its 2050 climate and energy goals, this rate will need to at least double to 3% per year. With 97% of EU buildings in need of renovation, we believe that this represents a golden opportunity to boost both energy efficiency and indoor environmental quality: by making the most of a good indoor air quality, human-centric lighting, acoustic and thermal comfort, and control and automation systems, we will improve the health and well-being of occupants and deliver productivity gains.

Furthermore, energy-efficient and healthy buildings also generate savings by reducing public health costs. The WHO estimates that each Euro spent on building renovation saves €0.42 in public health expenditure!

<sup>1</sup> WHO Regional Office for Europe, OECD (2015). Economic cost of the health impact of air pollution in Europe: Clean air, health and wealth. Copenhagen: WHO Regional Office for Europe

<sup>2</sup> [https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC\\_1&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:b828d165-1c22-11ea-8c1f-01aa75ed71a1.0002.02/DOC_1&format=PDF)



## Our Recommendations

### **👍 Set harmonised mandatory minimum requirements for indoor environmental quality and for accelerating the replacement of old systems.**

These requirements would be met through the implementation of state-of-the-art technologies in the fields of ventilation, cooling, heating, daylight and electric lighting, air-conditioning, dehumidification, plumbing, and building automation and controls.

### **👍 Set requirements to ensure the deployment of smart technologies for healthy buildings and the smart readiness indicator (SRI).**

The SRI should consider health aspects on an equal footing with other factors such as, for instance, energy savings and energy demand flexibility to fully reflect the importance of indoor environmental quality.

### **👍 Ensure that access to public financing is subject to additional conditionality so that renovations also improve the smartness of buildings and their indoor environmental quality.**

In addition, financing schemes should be encouraged to incentivise the installation of the most efficient technical building systems from a holistic energy, IEQ and smartness perspective, whilst ensuring that renovations remain economically accessible to all socio-economic categories.

### **👍 Include indoor environmental quality requirements in Green Public Procurement.**

A reference to Indoor Environmental Quality should be included in Green Public Procurement guidelines and should be a prerequisite for bids on the renovation of public buildings, administrations, hospitals and schools.

### **👍 Include indoor environmental quality indicators in the EU Building Stock Observatory.**

The EU Building Stock Observatory<sup>3</sup>, established as part of the 2016 Clean Energy for All Europeans Package, covers a range of indicators on the performance of the building stock. However, indoor environmental quality indicators have not yet been included, although they would represent a precious source of information to further drive the renovation of buildings across Europe. These indicators should include parameters on all the factors contributing to indoor environmental quality, such as automation, ventilation, electric lighting, daylight and views, indoor air quality, thermal comfort, moisture, dust and pests, water quality, noise, and safety and security.

<sup>3</sup> [https://ec.europa.eu/energy/eu-buildings-database\\_en](https://ec.europa.eu/energy/eu-buildings-database_en)

### **👍 Set or improve mandatory requirements for the regular inspections and continuous commissioning, monitoring and control functionalities of technical building systems.**

Technical building systems can be used to facilitate inspections, improve the regularity of maintenance, and provide for monitoring and control thereby maintaining the required levels of energy efficiency and indoor environmental quality through time. Also, a dedicated tool, such as building renovation passports, could in addition to monitoring renovation depth and energy performance, be used to assess indoor environmental quality. Such a tool could also be used to improve the regularity of maintenance, thereby helping to maintain the required levels of energy efficiency and indoor environmental quality over time.

### **👍 Incentivise training and certification schemes for building professionals, such as designers and installers.**

The design, deployment and maintenance of the technologies needed to achieve and maintain an adequate indoor environmental quality require advanced design and smooth integration. The professionals in charge are predominantly employed by small and medium-sized enterprises (SME), that are currently trying to meet growing demand for their services with a limited, often inadequately skilled, and ageing workforce. Actions are therefore needed to incentivise technical education, apprenticeships, as well as up- and re-skilling.

### **👍 Ensure the enforcement of Member States' Long-term Renovation Strategies (LTRSs).**

Post occupancy evaluations of buildings by qualified assessors would provide a source of information to monitor the state of the building stock, inform policy makers and improve best practices.

## Annex

*The informal Indoor Environmental Quality (IEQ) Gathering brings together eight European industry associations, representing companies involved in technical building systems and their maintenance. This Annex provides additional information with regards to the specificities and added value of each of our sectors in improving indoor environmental quality.*

### Lighting in a Healthy Building

Depending upon the scenario, lighting accounts for around 20 % of the total cost-effective energy savings potential in non-residential buildings towards 2030. Properly designed and well-coordinated lighting systems are one of the most cost-efficient ways to reduce energy consumption and CO<sub>2</sub>-emissions. But, by leveraging the power of Human Centric Lighting and technical building systems, we can also improve inhabitants' health, well-being and productivity<sup>4</sup>.

Although traditional electric lighting does wonders in terms of the visual, it simply lacks the non-visual benefits of natural light, caused by dynamics in intensity and colour of the light throughout the day. This is where **Human Centric Lighting (HCL)** comes in. Using daylight as the baseline for quality lighting, HCL brings the benefits of natural light inside. More specifically, **HCL supports the health, well-being, and performance of humans by combining the visual, biological and emotional benefits of light**<sup>5</sup>.

HCL provides the right light, at the right place and the right time for the activities we carry out every day. That is why a wide range of users can benefit from HCL<sup>6</sup>, including patients, residents, and staff in hospitals and nursing homes; students and teachers in schools; employees in offices; workers in manufacturing sites; and residents in their private homes. Furthermore, recent scientific developments indicate that the benefits of HCL vary depending on the application.

These benefits include:

- ▶ **Visual:** good visibility, visual comfort, safety, orientation
- ▶ **Biological:** alertness, concentration, cognitive performance, stable sleep-wake cycle
- ▶ **Emotional:** improved mood, energise, relaxation, impulse control

Within the HCL design process, lighting should address the core issues of safety, task requirements and occupant needs in a coherent and integrated manner. Within the framework of a Healthy Building, this means ensuring that the HCL system is:

- ▶ **Dynamic:** that the light can vary in level and, at the very least, be 'dimnable' (lower light levels) and, preferably, also 'boostable' (higher light levels);
- ▶ **Tuneable:** light can vary in spectrum; and
- ▶ Includes **default lighting control setting:** personal control should be available so the user can influence the light settings.

<sup>4</sup> [https://www.lightingeurope.org/images/HCL/14\\_LE\\_HCL2017.pdf](https://www.lightingeurope.org/images/HCL/14_LE_HCL2017.pdf)

<sup>5</sup> [https://www.lightingeurope.org/images/publications/position-papers/LightingEurope\\_and\\_IALD\\_Position\\_Paper\\_on\\_Human\\_Centric\\_Lighting\\_-\\_February\\_2017-modified\\_version-v2.pdf](https://www.lightingeurope.org/images/publications/position-papers/LightingEurope_and_IALD_Position_Paper_on_Human_Centric_Lighting_-_February_2017-modified_version-v2.pdf)

<sup>6</sup> <https://www.valueoflighting.eu/>



The introduction of LED light sources has revolutionised the lighting industry and opened the door to many exciting new HCL-related opportunities not possible with previous technologies. For example, Intelligent Lighting Systems make indoor environments more attractive and functional, allowing users to dynamically adapt light to their specific needs. LED lights also allow for increased energy efficiency and savings, especially when used within a well-planned HCL system.

## Ventilation in a Healthy Building

Improving Indoor Air Quality (IAQ) requires a multifaceted approach that not only bans the most obvious pollutants, such as smoke and certain chemicals, but also requires the implementation of other important measures since part of the indoor pollution is inherent to the presence of people in buildings. A badly ventilated building is an ill building, and this will inevitably lead to ill occupants.

Therefore, ensuring the implementation of well-functioning ventilation systems in new and renovated buildings, to help guarantee an adequate IAQ, is also a critical step to optimise the energy consumption of buildings.

Indeed, they ensure:

- ▶ necessary air renewal while limiting thermal losses to the minimum,
- ▶ and, in addition, can recover the heat or coolness of the outgoing air to preheat or precool the incoming, thus optimising the heating and cooling needs of the building.

Thus, ventilation is an unescapable equipment to ensure buildings fully contribute to attaining a carbon-neutral economy by 2050 and at the same time preserve the health of people living more than ever in insulated and air-tight environments.

European legislative provisions should then be introduced asking Member States to implement both:

- ▶ **mandatory inspections of stand-alone ventilation systems**, to ensure their optimal performance,
- ▶ **IAQ regulatory minimum requirements.**

This will enable the major health impacts of poor indoor air to be addressed, which, according to the WHO estimates, leads to the premature death of 120 000 Europeans every year translating into an annual cost to society of 260 billion euros<sup>7</sup>.

The installation of the latest state-of-the-art, energy efficient, ventilation units in new and renovated buildings brings the added benefit of contributing to tapping into the huge energy savings potential of buildings. Consumers can thus save money on their energy bills, whilst also safeguarding their health!

<sup>7</sup> [http://www.euro.who.int/en/media-centre/sections/press-releases/2015/04/air-pollution-costs-european-economies-us\\$-1.6-trillion-a-year-in-diseases-and-deaths.-new-who-study-says](http://www.euro.who.int/en/media-centre/sections/press-releases/2015/04/air-pollution-costs-european-economies-us$-1.6-trillion-a-year-in-diseases-and-deaths.-new-who-study-says)

## Heating and Cooling in a Healthy Building

The Heating, Ventilation, and Air-Conditioning (HVAC) equipment plays an important role for the health, well-being and productivity of building occupants by improving IEQ and contributing to the overall comfort conditions.

- ▶ In residential buildings, heating and cooling systems provide a range of comfortable indoor temperature thus avoiding the exposure risks to heat/cold thermal stress and their potential serious health consequences (during heat waves). Furthermore, studies have shown that cooling can improve productivity<sup>8</sup> and creativity<sup>9</sup> in working environment.

The HVAC sector is responsible for almost half of Europe's final energy consumption, out of which around 80% are still based on fossil fuels, especially in heating. This big share can be radically reduced with short term effect, as sustainable heating and cooling technologies are readily available to be broadly deployed, most importantly in energy renovations of buildings.

- ▶ Moving out of fossil fuels and decarbonising the heating and cooling sector will further contribute to outdoor and indoor environmental quality.
- ▶ Policy makers should therefore consider IEQ next to outdoor air quality as an important factor for the health and productivity of European citizens.

HVAC installations help guarantee a reliable circulation of fresh air in indoor spaces by supplying outside air and boosting air exchange rates. Built-in filters, ionization and streaming technologies in HVAC equipment also help catch particles and reduce their transmission. In addition to improving comfort and work conditions, innovative temperature and humidity control of heating and cooling systems helps in avoiding the risks of condensation potential and microbiological growth and influence the transmissibility of infectious agents reducing therefore the development of respiratory issues.

- ▶ Highest standards of indoor air quality and indoor thermal comfort, provided by efficient, state-of-the-art heating, cooling and ventilation installations are essential to ensure the health and productivity of building users and increase their work and learning performance.

<sup>8</sup> <https://indoor.lbl.gov/sites/all/files/lbni-60946.pdf>

<sup>9</sup> <https://www.shrm.org/hr-today/news/hr-news/pages/toohottoocold.aspx>

## Sanitary, Plumbing, Ventilation, Heating, Cooling, Air Conditioning, Heat Pumps, Lighting Installation and Operation for a Healthy Building

Installations are the basis for a healthy environment and well-being for occupants in private and public living areas. RACHP, HVAC, plumbing and lighting installers and operators of buildings' services are pivotal to ensure a high indoor environmental quality is maintained inside buildings. The role of installers does not end with the installation as the activities are part of a whole cycle: design, installation, maintenance (including repair and refurbishment) and removal of the systems and equipment at the end of their life.

IEQ benefits delivered by installers include:

- ▶ hygienic requirements guaranteeing quality of water, and of sanitary and plumbing systems
- ▶ thermal comfort in a controlled environment thanks to heating, cooling and air conditioning
- ▶ control of air exchange through ventilation ensuring quality of the air inhaled by occupants

IEQ benefits delivered by installers include:

- ▶ **professional planning and design**
- ▶ **high level of competences** through training and certifications allowing to take responsible and informed decisions on the type of systems to be used as well as to guarantee high level of technical installations to be performed
- ▶ **regular maintenance of the building services**

## Building Automation and Control in a Healthy Building

Building Automation and Control Systems (BACS) are usually in the spotlight for their key contribution to achieve energy savings and decarbonise buildings (appropriate implementation of the revised EPBD BACS measures would deliver savings corresponding to 14% of the total building energy consumption, with 42 Mt CO<sub>2</sub> annual savings and €36 billion energy bill savings triggered<sup>10</sup>).

Thanks to the same functionalities that are able to deliver these savings, **BACS are the cornerstone of every healthy building**: BACS control and integrate the operation of the technical building systems to create the comfortable, safe and healthy environment desired by the building occupants, optimising thermal comfort, air quality and lighting while preventing malfunctions and other infections.

Some of the most **relevant benefits delivered by BACS** in this framework are:

- ▶ Well-controlled internal comfort conditions
- ▶ Safe and healthy built environment
- ▶ Possibility for individual space control
- ▶ Increased productivity

<sup>10</sup> "The impact of the revision of the EPBD on energy savings from the use of building automation and controls", Waide Strategic Efficiency, 2019



Some of the **most important automation functions** in this framework are:

- ▶ Automatic adjustment of indoor climate conditions according to occupancy
- ▶ Integrating temperature control with a weather station that monitors rain, wind, and brightness for automatic deployment of awnings, blinds, and lighting,
- ▶ Demand-based thermal and air quality control of established micro-zones
- ▶ Self-learning to adjust the control algorithm according to the preferred settings of the occupants

Effective control of the heating, ventilating, air conditioning and lighting systems in a building is essential to provide a productive, healthy and safe working environment for the occupants.

The role of BACS is especially important in building operation aiming for sustained indoor comfort with energy-efficient control of building systems.

In particular in the residential sector, it is worth mentioning that the use of thermostatic valves on radiators is able to significantly increase comfort and health, individually adjusting room temperature in a cost-effective way, while allowing later integration with the comprehensive networked automation system.

Daylight management through automated solar shading, combined with electric lighting management is a key success factor to reach both healthy buildings and energy-efficient buildings. Real demonstration has shown that the combination of automated solar shading with artificial lighting brings -54% in the lighting consumption, and -29% of energy consumption of HVAC<sup>11</sup>.

<sup>11</sup> [Onix Study, Signify \(Philips Lighting\), Somfy and Serge Ferrari.](#)