New possibilities with EPBD revision for ventilation systems

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Building renovation and inspection of ventilation systems is a welcoming addition in the proposed revision of EPBD [**1**]. It's important to consider the various stakeholders involved in the process of designing, implementing, and monitoring a well performing ventilation system. The revised and consistent regulatory, together with interdisciplinary collaboration, new technology and user behavior, are significant factors in making energy-efficient buildings and healthy indoor environments that work both in theory and practice.

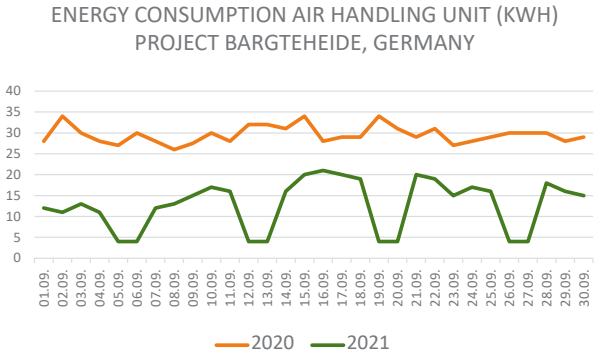
Best-case performance for worst-case buildings

Collectively, buildings account for 40% of Europe's energy consumption [**2**]. Building operations, including heating, cooling and electricity, account for 27% of all global energy-related carbon emissions [**3**]. Optimizing energy performance in buildings is an essential factor in cutting emissions, lowering energy consumption and reducing vulnerability to prices in Europe [**1**]. It should be the task of everyone involved to achieve the goal of carbon-neutral buildings by 2050 [**4**], without having to forgo a good indoor climate. In particular, the restrictions caused by the COVID-19 pandemic have shown that adequate ventilation in buildings is of great importance for health. The upcoming winter could reveal the challenge of the circumstances. Will there be time to choose between good indoor climate or energy saving?

Modern control technics optimize energy requirement based on user behavior, which means that a good indoor climate can be combined with the lowest energy performance. Studies have shown that modern control procedures in ventilation systems, demand-controlled ventilation systems (DCV) in particular, can reduce energy consumption of the building while also improving the overall air quality and indoor environment. Using this control method for ventilation is an indisputable alternative for energy efficiency in new buildings but should also be considered for energy efficient renovation and refurbishments.

A case study made by Lindab Innovation Hub in 2020-2021, showed how modifying an existing ventilation system and adding a wireless DCV system at room level in an office building in Bargteheide, Germany, saved as much as 68% energy after installation.

The system consists of ultrasound measurement technology for the flow controllers, Bluetooth room sensors for CO_2 and presence detection and mobile applications that give access for commissioning but also for the user of the room to control and monitor the system and the indoor air quality. The return on investment for the upgrade was calculated to be 4.5 years but this number would probably be more drastic



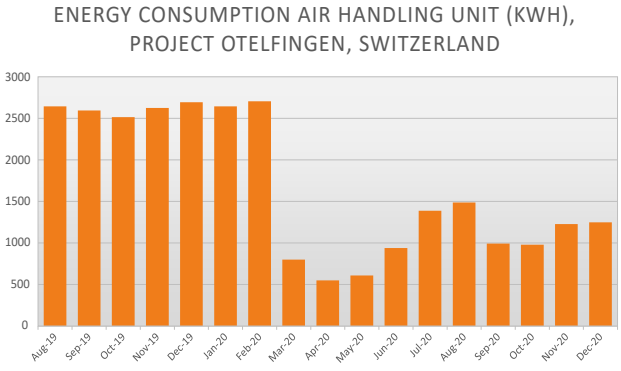
Energy consumption of an Air Handling Unit in comparison of September 2020 and September 2021, Office project in Bargteheide, Germany. Orange line shows the energy consumption before renovation (constant airflow according to design) and green line shows the energy consumption after renovation (Variable airflow with DCV).

if calculated with today's energy costs. As many as 100 million adults and children live, study and work in unhealthy houses in Europe [**5**] and around 75% of the EU's building stock is not considered energy-efficient [**6**]. Modifying existing ventilation in worst-case buildings with smart systems can be essential for indoor air quality, lowering energy consumption and cutting both direct, and indirect emissions of the building.

The double-edge sword of control systems in ventilation

To understand the accepted indoor climate in relation to energy performance, Lindab Innovation Hub made several long-term examinations in existing buildings with different control ventilation systems. The results showed in nearly all projects that the systems had failures, wrong settings, missing balancing adjustment or warning messages from the building management system that were ignored or not seen by the person responsible. Our conclusion is that without precise installation, well-functioning sensors and control, there is a high risk that the designed energy performance of a system will not be reached. In worst cases, an energy-saving system becomes a high-energy consumer that cannot guarantee a sufficient good indoor climate.

Since 1991, ventilation control has been mandatory in Sweden [**7**] and should be carried out by a certified inspector. It is a well-functioning system which is controlled regularly in most buildings, to show that the indoor climate is good, and that the ventilation system is working as it should. According to The Swedish National Board of Housing, Building and Planning the inspector must give suggestions on how the energy consumption can be reduced for the ventilation, without this resulting in a worse indoor environment [**3**]. With smart ventilation systems, it must be considered how the system as a whole is designed to perform on a daily basis. DCV systems are based on the presence of people to provide energy efficiency and ensure healthy indoor air. The system's capacity is worth considering when handing over to facility managers and for future controls and inspection. In Lindab Innovation Hub's case study from an office building in Otelfingen, Switzerland, a facility manager of a DCV system had the opinion that it was not performing well and that the energy costs had been too high. The investigation included an examination of the system drawing, re-calculations of the system and building energy requirement, as well as a long-term observation of different factors that could affect the system. An analysis of the results revealed that errors had gone unnoticed during the practical handling of the ventilation system in the past years. After corrective adjustments, the energy requirement of the ventilation system was reduced by 71%, while maintaining good indoor air quality.



Energy Consumption of an Air Handling Unit in kWh, Project Otelfingen, Switzerland. Corrective adjustments fixed in March 2020.

The results clearly indicate the importance of regular and regulated inspection and monitoring of ventilation systems but also a need for accessible information, understanding of the consequences of errors and warning signals and a plan of action for correction. It also implies the importance of comparing inspections to the original and intended performance of the ventilation design, and that any configurations and suggestions of change should be documented for future reference and in a dialogue with facility manager, commissioner, and system designer.

Interdisciplinary collaboration and involvement of end-users

Targeting building renovations and inspections of ventilation systems is a welcomed act in the proposed revision of EPBD and an important step to take on the ongoing challenges of energy consumption and carbon emission in the real estate industry. The need for action is clear while time for action is running out. A new Global Retrofit Index report (2022) finds that less than 1% of existing buildings in major economies are given the necessary retrofitting upgrade. To meet the IPCC 1.5-degree scenario, the average annual retrofitting rate should be 2.5% by 2030 while reduction in energy intensity should be 45% [**3**].

National regulations aside, to meet the ongoing building requirements and environmental targets there is a need to reconcile the building industry with smart systems and interdisciplinary collaboration of all stakeholders involved. Property owners must receive

advice to understand the consequences of their decisions so that indoor climate and energy performance meet their expectations. Maintenance and servicing need to be done by organizations that take authority of proper operation. Designers should have the facility to make sure that all technical equipment fits together and operates optimally according to performance and design. Briefing the contractor is also important so that the system is installed as designed and that it operates as intended.

Possibilities of communication between system designer, ventilation system, monitors and end-user.

Our experience with both Bargteheide in Germany and Otelfingen in Switzerland is a lesson learned about actions, including the importance of clear documentation, smart solutions and easy to use products and systems that more extensively involve the end-user. It is guiding us towards new technological opportunities with better communication between the system designer, the ventilation system, sensors, and the actual end-user.

Developing digital solutions for constant and long-term monitoring, along with user behavior, design and experience is a way forward to better understand the effectiveness and impact of healthy indoor air and energy consumption of a building. Presenting data in user-friendly way is a path to improve satisfaction and trust - and encourages end-users to engage with performance and the effect a ventilation system can have on indoor environment and building energy consumption. ■

References

[1] European Commission, *Proposal for a Directive of the European Parliament and of the council on the Energy Performance of Buildings (recast)*, European Commission, 2021. EUR-Lex - 52021PC0802 - EN - EUR-Lex (europa.eu) [accessed 26 October 2022).

[2] European Commission, *In focus: Energy efficiency in buildings*, European Commission, 2020. In focus: Energy efficiency in buildings | European Commission (europa.eu) [accessed 26 October 2022).

[3] Robert Kilgour, Joshua Deru, Laura Watson and Michael Lord, *Global Retrofit Index*, 3Keel in association with Kingspan, 2022. https://www.3keel.com/wp-content/uploads/2022/10/Global_Retrofix_Index.pdf [accessed 01 November 2022).

[4] European Commission, *European Green Deal: Commission proposed to boost renovation and decarbonization of buildings*, European Commission, 2021. Renovation and decarbonisation of buildings (europa.eu) [accessed 26 October 2022).

[5] Velux, *Healthy Home Barometer*, Velux 2019. HHB_Main-report_2019.indd (azureedge.net) [accessed 26 October 2022].

[6] European Commission, *Driving energy efficiency in the European building stock: New recommendations on the modernisation of buildings*, European Commission, 2019. Driving energy efficiency in the European building stock: New recommendations on the modernisation of buildings | European Commission (europa.eu) [accessed 26 October 2022].

[7] Boverket, *OVK – oblikatorisk ventilationskontroll*, Boverket 2021 (link).