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Energy efficiency and health go hand in hand in creating the ideal indoor climate

Each year sees updated energy-saving laws and regulations come into force, such as the new German Energy Conservation Regulation brought in last year (EnEV 2014). In this way, legislative authorities are increasingly regulating energy consumption in buildings, which is in part determined by the systems technology used in their construction. But wherever the focus is predominantly on the energy and cost efficiency of products, the key quality indicator – namely, the human consumer – is often neglected. One area that scientists at the Fraunhofer Institute for Building Physics IBP are extensively researching is indoor climate and the effects this has on the individual. Now IBP scientists have completed a basic investigation that underscores the need for research in this area and highlights important aspects that should be considered in the course of industrial development.

In industrialized societies, most people spend an average of 90 percent of their time indoors. For this reason, apartments, schools and workplaces should have indoor climates that are as pleasant as possible in order to support our mental and physical performance and to ensure we feel comfortable. As users of these facilities, we consume resources – mostly energy – to provide heating, cooling, ventilation and lighting. Climate change, rising energy prices, dwindling resources and a heightened awareness of the need to save energy have all resulted in energy efficiency becoming more of a central concern for energy consumers. Laws and regulations have been established to help us meet climate targets, with the German federal government leading the way by issuing such objectives for 2020. Numerous accompanying research projects – often publicly funded – are also under way to support these requirements set by policy makers.

To determine the current need for research and action within the EU, Fraunhofer IBP scientists launched a baseline study on the effects of indoor climate on consumers. Drawing on scientific, technical and medical databases, specially selected expert journals and independent scientific expertise, the study focused primarily on humidity, ventilation, lighting and temperature as indoor climate parameters. “One of the objectives of our analysis is to show the relationship between indoor climate in schools and residential buildings and its impact on consumers’ health, physical and mental well-being, motivation and ability to rest and recover,” explains Professor Gunnar Grün, head of department at Fraunhofer IBP and initiator of the study.

For several years now, Fraunhofer IBP has been intensively researching the interactions among physical, physiological and psychological variables in interior spaces as part of

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its “People Inside” graduate program. The program aims to clarify the basic relationships between the physical conditions found indoors, and the productivity and well-being of consumers, as well as to identify important physical and mental mediators. “We’ll be able to use the experience and insights we gain from this graduate program and can feed them into future projects. The baseline study has once again highlighted quite how much research still needs to be done in this field,” says Grün, commenting on the outcomes of his work.

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Results and findings breakdown

One of the main problems affecting European homes is the increasing prevalence of excess moisture. Mostly this leads to the formation of mold or mildew and other associated damage to the property. In recent years, this has affected on average around 16 percent of the European population, or some 80 million people. The risk of contracting an infection in an environment contaminated with mold or mildew is almost twice as high as under normal conditions.

A crucial criterion for a comfortable and healthy indoor climate is allowing the right amount of air exchange to take place with the outside environment. Adequate ventilation not only counteracts excess or insufficient moisture, it also prevents the buildup of too much CO₂ and helps ensure that air quality remains high. These sorts of poor conditions are very often found in classrooms, a situation that calls for appropriate action.

Another factor in indoor climate is daylight, which significantly impacts our psyche and our physical well-being. Insufficient exposure to sunlight also has negative effects on mental health, with the reverse principle being that an adequate supply of daylight can also promote recovery, and so lead to shorter hospital stays for patients.

Bedroom temperatures are very much something researchers are interested in, as these have proven to influence sleeping patterns and quality of sleep. For instance, increasing the bedroom temperature by 5 degrees Celsius reduces the amount of time the sleeper spends in deep sleep by about 15 percent – precisely that phase of the sleep cycle that is so important for recuperation.

Another study demonstrates how heat waves affect mortality rates among the sick and elderly. For example, whenever the temperature rose by around 5 degrees Celsius above a local threshold value during a heat wave, the natural mortality rate was found to increase by between 9 and 15 percent. This particularly affects people suffering from respiratory disease.

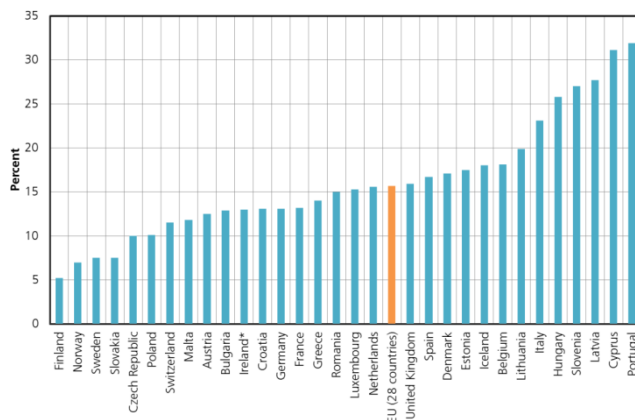
Initial results from the baseline study thus reveal the significant impact that indoor climate in European schools and homes has on the health and productivity of energy consumers. What’s more, considerable shortcomings have been identified in current

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housing stock. These facts point to a clear need for action both in terms of research and on the part of relevant EU bodies. The Fraunhofer study will now help to lay the groundwork for future projects, give manufacturers a sound basis for their development work and eventually enable proposals to be laborated for inclusion in EU laws and regulations.

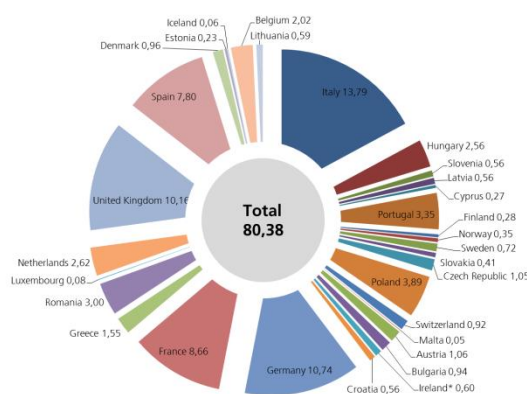
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Proportion of the total European population living in homes with leaking roofs, damp walls, floors or foundations, and rotten window frames. – Data from 2013, Ireland data from 2012.

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European population (in millions) living in homes with leaking roofs, damp walls, floors or foundations, and rotten window frames. – Data from 2013, Ireland data from 2012, population statistics for January 1.

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Building physics is one of the keys to a successful building project. The **Fraunhofer Institute for Building Physics IBP** focuses its work on research, development, testing, demonstration and consulting in the various fields of building physics. These include noise control and sound insulation in buildings, the optimization of auditoria acoustics and solutions for improving energy efficiency and optimizing lighting technology. Fraunhofer IBP's work also covers issues of climate control and the indoor environment, hygiene and health protection, building material emissions, weatherproofing and protection against heat and moisture, preservation of building structures and the conservation of historic monuments.

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