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HVAC for Net Zero Energy Buildings
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Indoor Air Quality and Climate Consideration in Zero Energy Buildings

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Halton Group

Halton

- The construction sector covers 7% of total employment and 28% of industrial employment in the EU
- 50% of all materials extracted from the earth's crust are transformed into construction materials and products
- Buildings consume 40% of all energy

70-85% of buildings that will exist in 2030, exist today.

Requirements towards more energy efficient buildings

EBPD demands Member States to fix and implement:

- **A methodology to calculate and rate the energy performance**
- **Minimum energy performance requirements (nZEB) for new and for major renovation**
- **Energy performance certificates**
- **Regular inspections of heating and air-conditioning systems**

Ecodesign Directive main legal instrument to improve the environmental performance of **energy-related products**

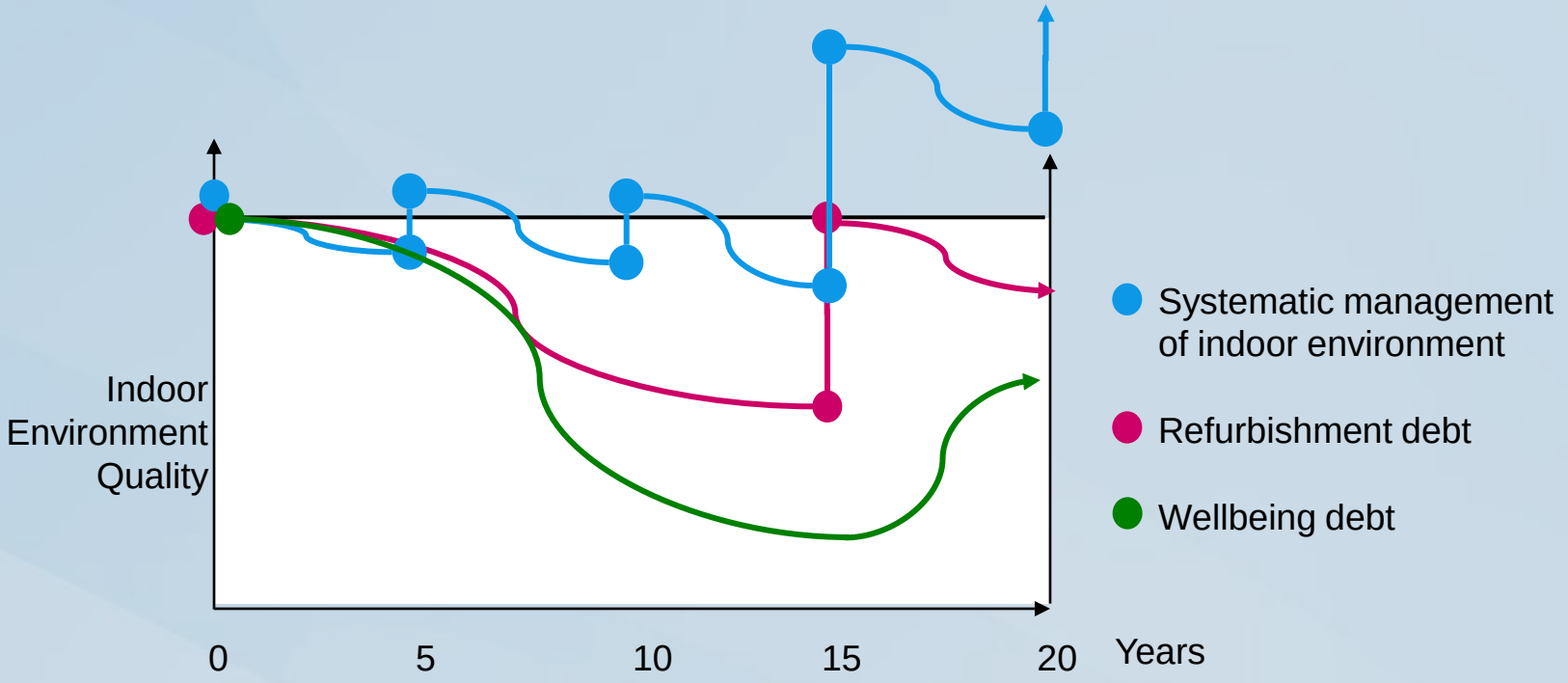

Wellbeing and health of people
Environment friendly
Life time cost effective
Sustainable Indoor Environment

Healthy and Satisfied Persons

- Clean air to breath.
- Thermal balance is a result of a various environmental conditions.
- Comfort sensation depends on the individual: the metabolism, the activity level of body and the clothing resistance.
- Light is the most important factor influencing our daily rhythm.
- Disturbing sound environments cause irritation
- Discomfort increases stress hormone level, breaks and sick leaves and reducing productivity.

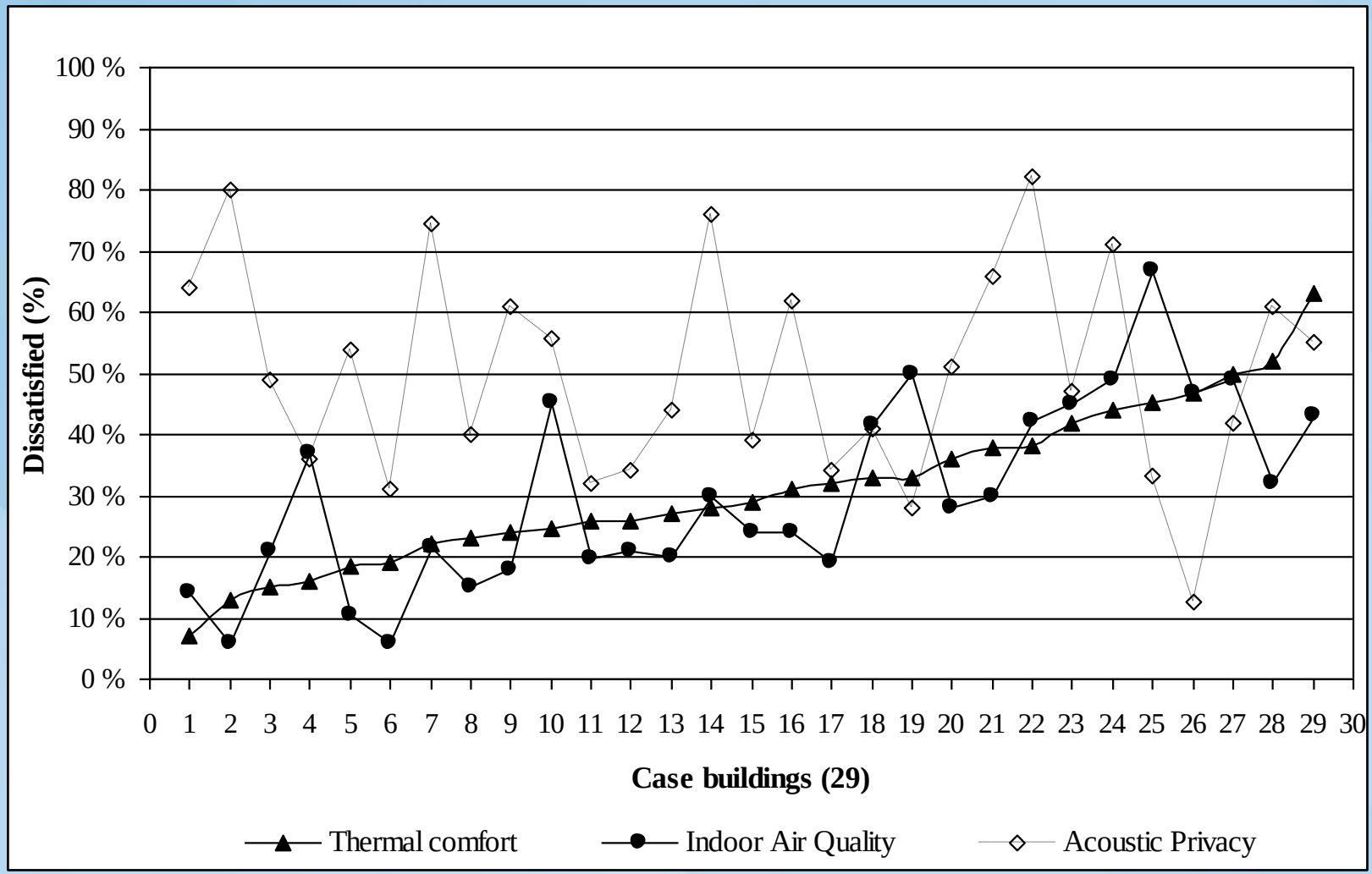
In comfortable environment human brains work more effectively.

Indoor Environment and Wellbeing Debt



- Wellbeing debt grows slowly
- After refurbishment it disappears slowly

The percentage of the dissatisfied on thermal comfort, air quality and acoustic privacy



Dissatisfaction in Office Environment

(thermal comfort of the whole body)

< 6% (A-class, pr EN15251)

> 30 % (real projects)

Is project designed poorly ?

Is building built wrongly ?

Is maintenance poor ?

Are spaces used wrongly ?

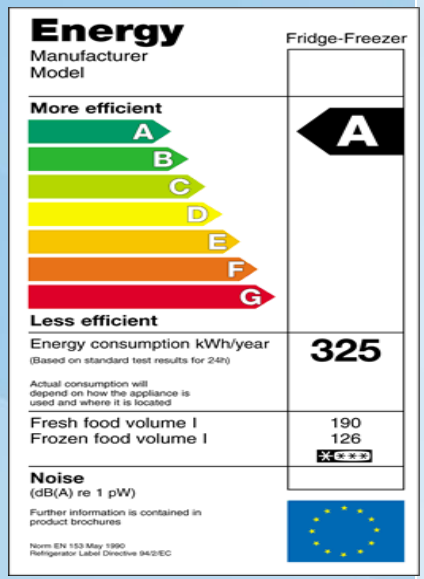
What should we do as an industry?

Sustainability

1. Conservation of energy, water and materials
2. Sustainable sites and transportation
3. Outdoor atmosphere
4. Indoor environmental quality
5. Waste

Source: LEED™ (Leadership in Energy and Environmental Design) standard of US Green Building Council

Sustainable Living Environment



ENVIRONMENT

Use of energy and other resources

VS

WELLBEING:

Healthy, productive, comfortable indoor environment

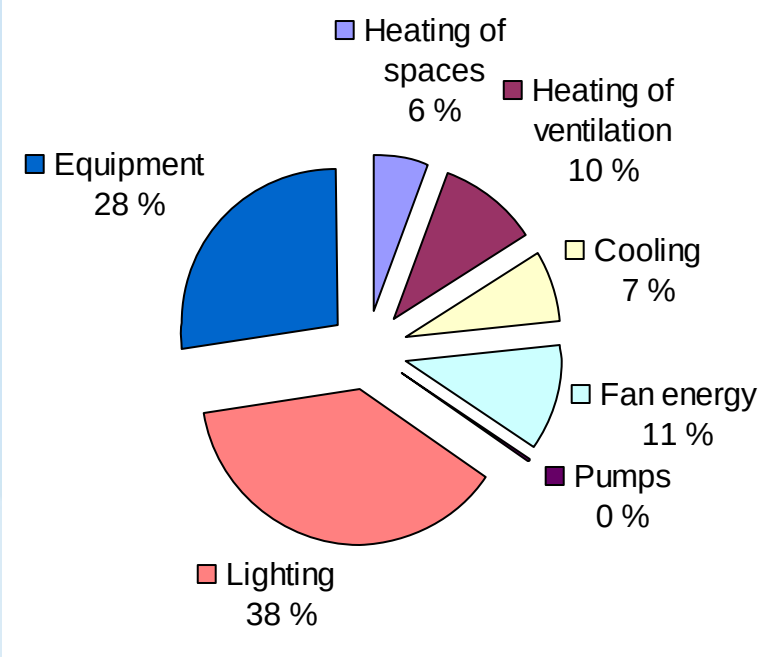
Aspects of implementation and impacts of EPBD in member states:

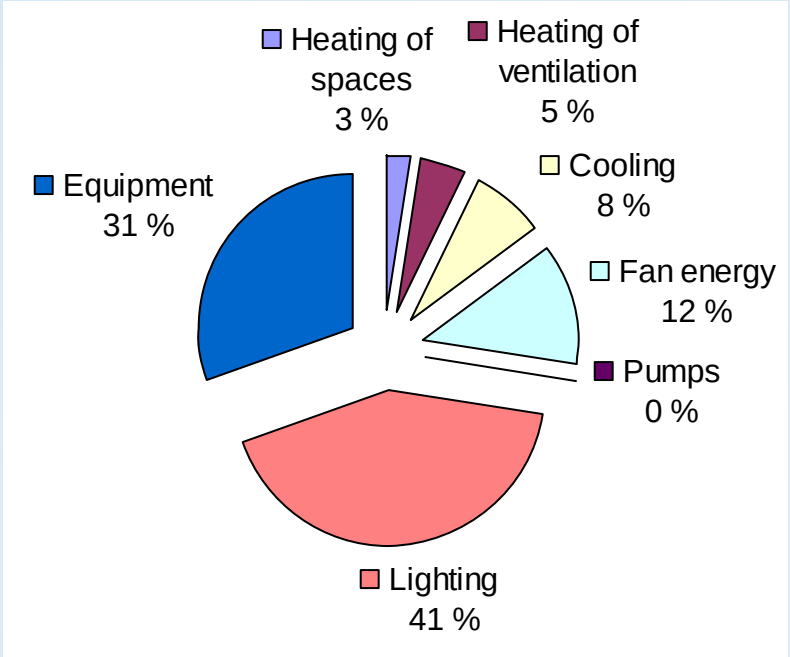
The meaning of Ventilation

- Underestimation the meaning of ventilation in energy consumption
- Ignorance of possible productivity effect of indoor air quality
- Health effects of indoor air quality is not really realized

➢ **Healthy, productive, comfortable indoor environment should be the main focus: buildings are for people**

Delivered and Primary Energy Consumption





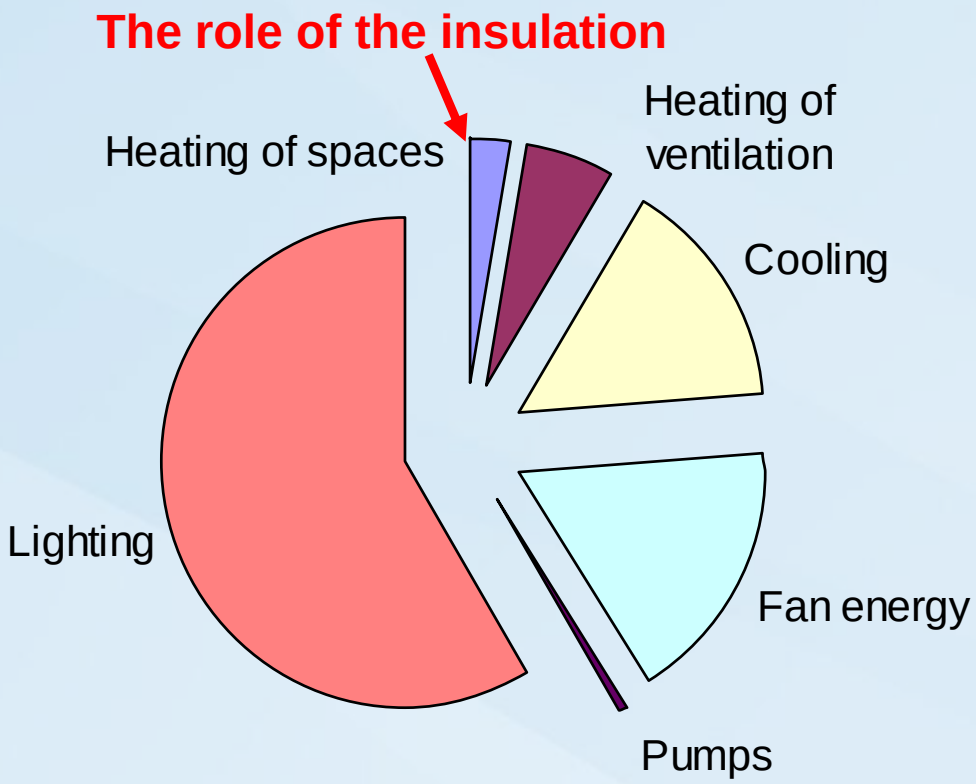
Delivered energy 77.7 kWh/m^2,a

HVAC + lights: 48.9 kWh/m^2,a

Primary energy 175.4 kWh/m^2,a
(Primary energy factors: Gas 1 , Electricity 2.5)

HVAC + lights: 125.9 kWh/m^2,a

Improvement in Primary Energy Efficiency: Focus should be on Building Services



”Use technologies that enable the use of sustainable low energy cooling:
- displacement ventilation
- chilled ceilings
- chilled beams”

Source: Sustainable low energy cooling: an overview
CIBSE Knowledge Series, 2005

Demand Controlled Ventilation Saves Energy

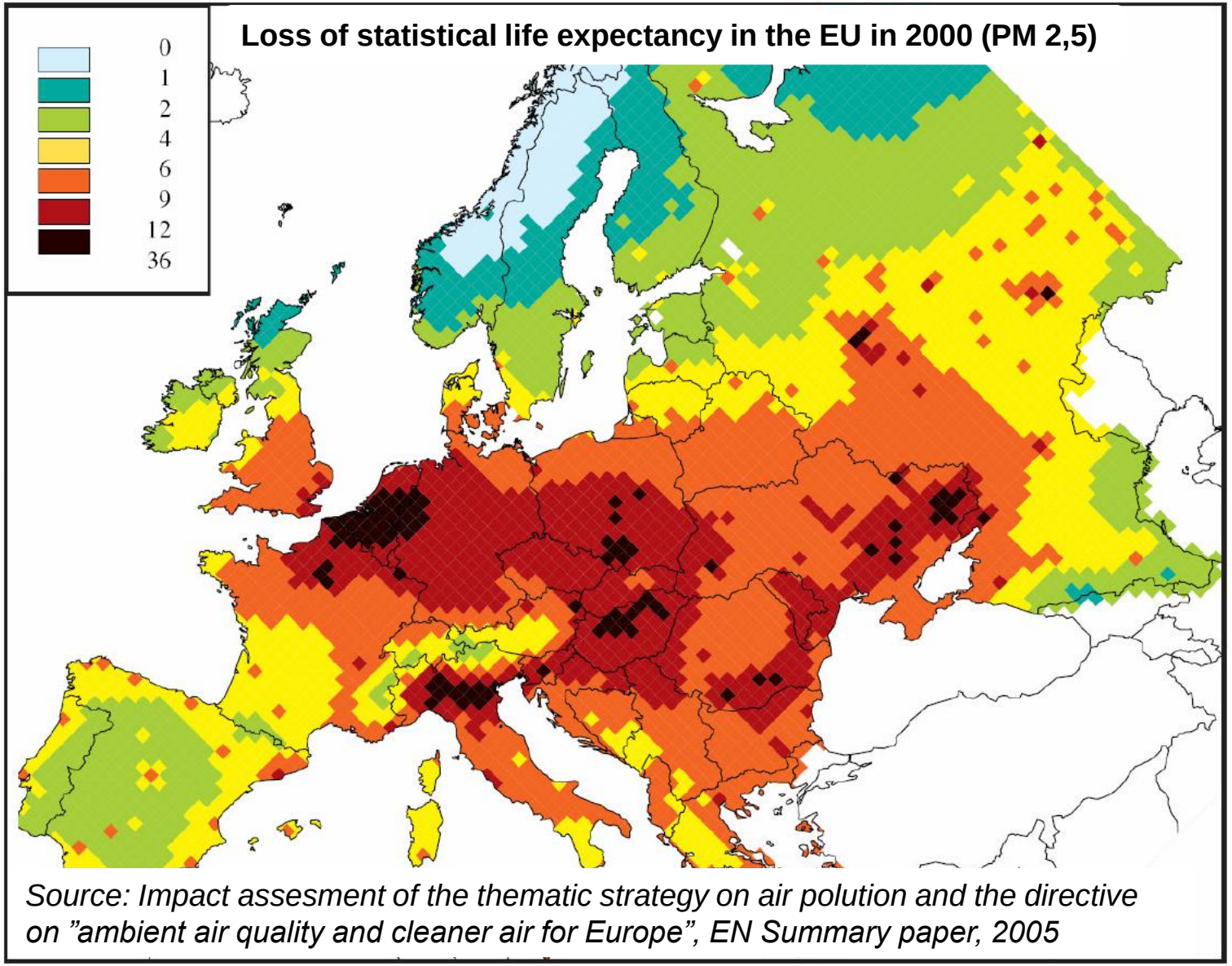
”Considerable amounts of energy can be wasted on ventilation of empty offices”

”Reduced energy costs in demand controlled ventilation (DCV) alone will cover an investment of about 300 € in Norway or 700 € in Denmark per cellular office.”

Source: Demand controlled ventilation for office cubicles – can it be profitable?
Mysen et.al., Energy and Buildings, 2002

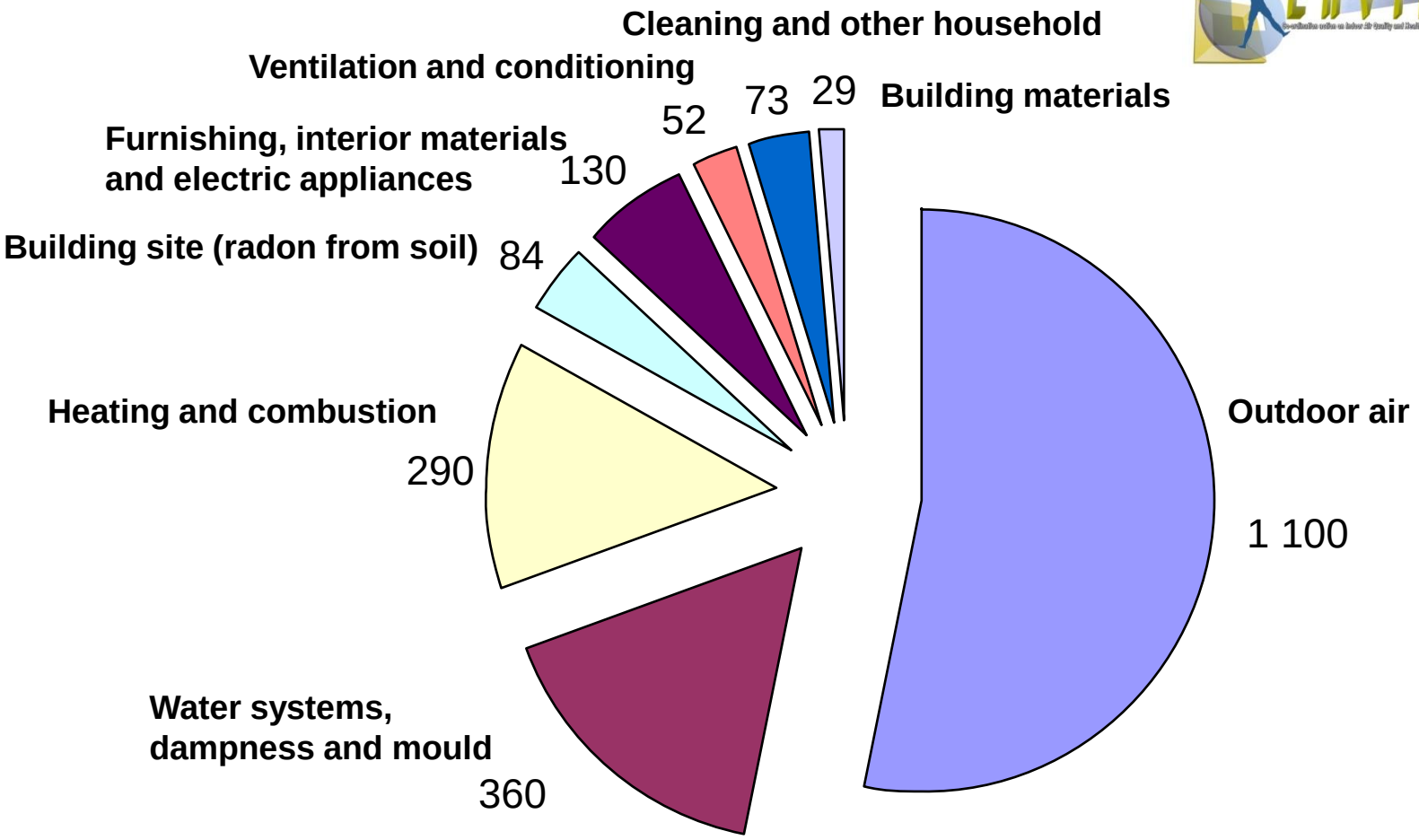
Every year, indoor air pollution is responsible for the death of 1.6 million people - that's one death every 20 seconds.

Source: WHO fact sheet n:o 292, Indoor Air Pollution and Health, 2005
www.euro.who.int



Source: Impact assesment of the thematic strategy on air polution and the directive on "ambient air quality and cleaner air for Europe", EN Summary paper, 2005

Source of indoor air contaminants in EU-27



ETS excluded!

Effect of Ventilation System

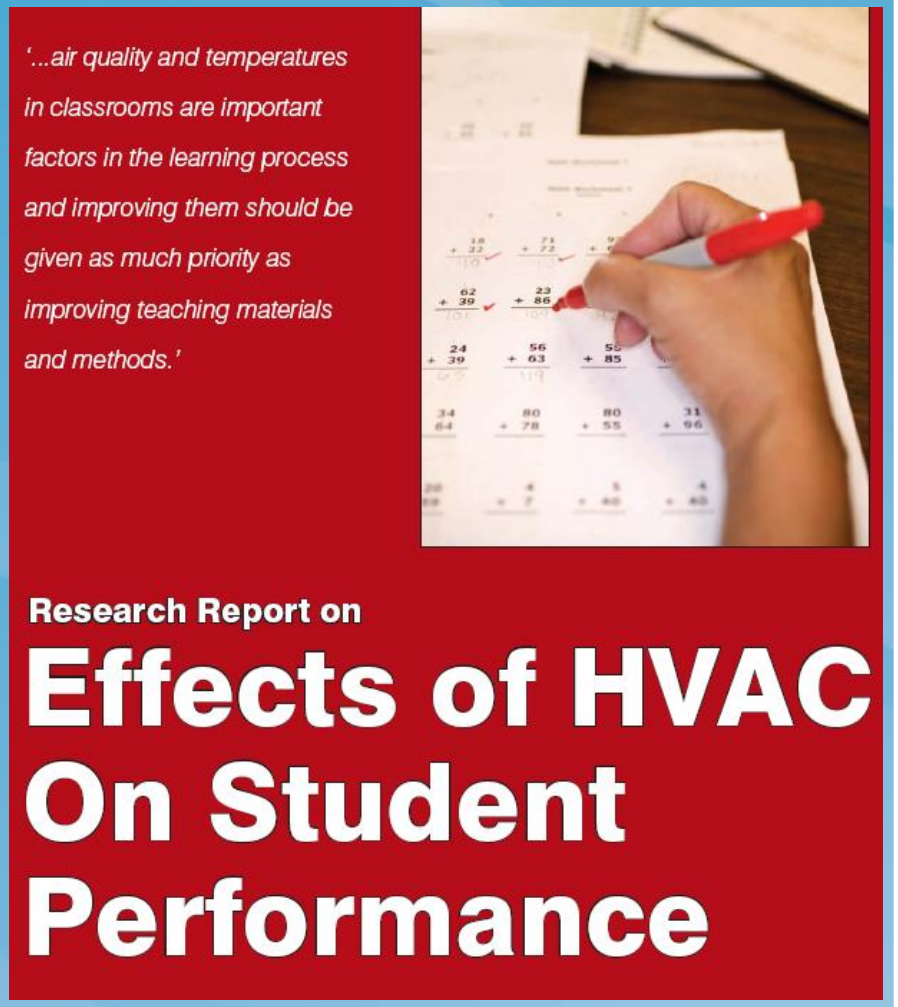
”In more recently built buildings with advanced filtered mechanical ventilation and air conditioning systems, the infiltration of outdoor air fine particles (PM2,5) is significantly lower than in old buildings with natural ventilation via open windows and vents.”

Source: Hänninen, et.al, Reduction Potential of Urban PM2,5 Mortality Risk Using Modern Ventilation Systems in Buildings, Indoor Air 2005

Indoor Climate and Productivity

- ”A minor 1 % (5 min/day) increase in office work can off-set the annual cost of ventilating the building.”
- ”Doubling the outdoor air supply rate can reduce sick leave prevalence by 10 %, and increase office work by 1,5%.”

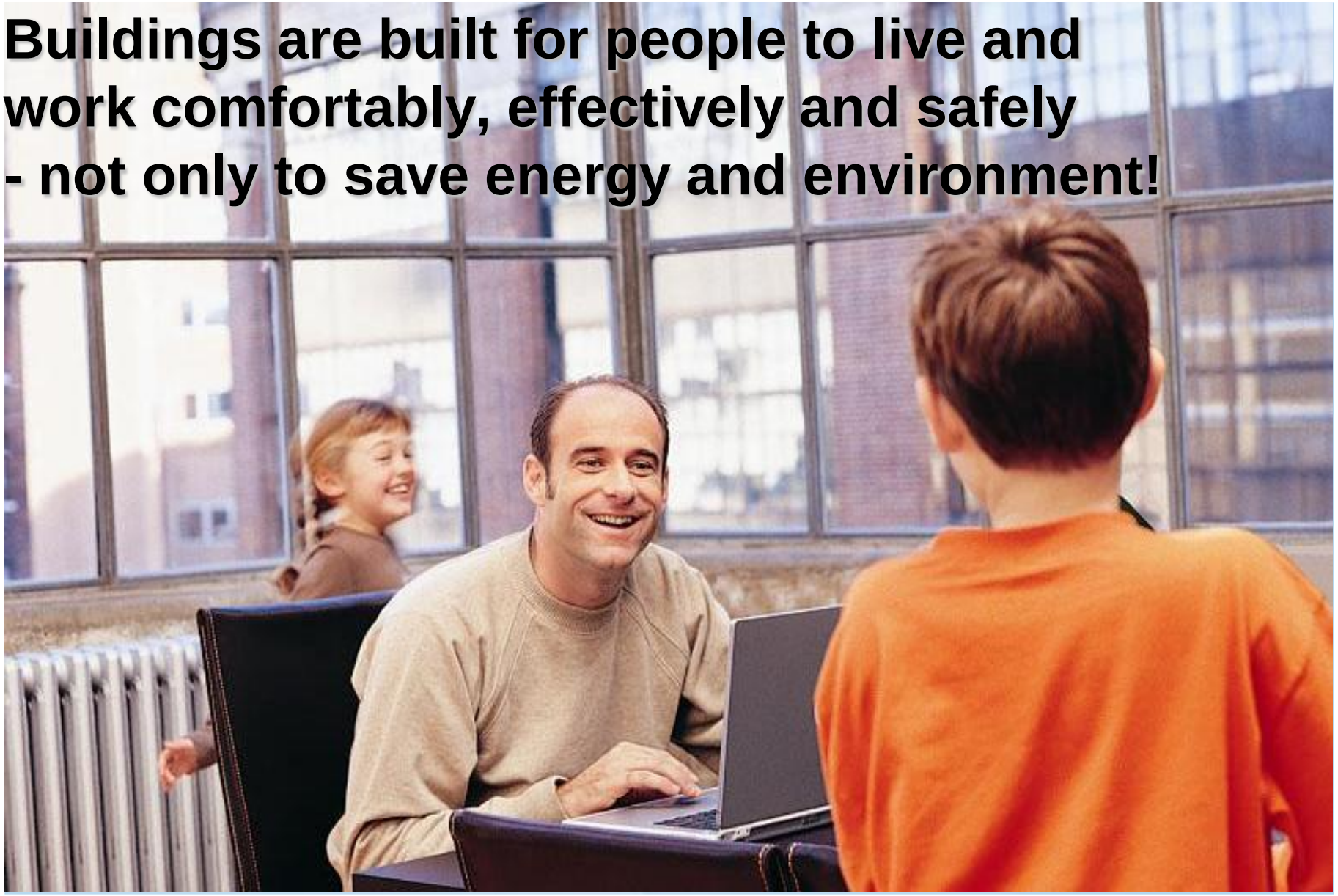
Source: Wargocki, Seppänen: Indoor Climate and productivity in Offices, Rehva guidebook n:o 6, 2006.



Sustainable Indoor Environment

- Well insulated and tight buildings with good solar shading.
- Mechanical air intake with good outdoor air filtering.
- Demand based ventilation.
- Right temperature, high air quality, low velocities and noise in the space.
- Low energy cooling and heating technologies and renewable energy.
- Individual control of indoor environment.

Buildings are built for people to live and work comfortably, effectively and safely - not only to save energy and environment!



A thought to finish

"You cannot fight against the future, time is on our side."

William Ewart Gladstone