

REHVA Seminar at AQUATHERM 2014

Technologies for nZEB

March 5 2014 – 12h00-14h00

Prague, Czech Republic

Seminar Programme

- 12.00-12.20** ➤ IEQ and high energy performance buildings
Karel Kabele, CTU in Prague, REHVA President
- 12.20-12.40** ➤ nZEB definitions in Europe
Jarek Kurnitski, Tallinn University of Technology, REHVA Vice-President
- 12.40-13.00** ➤ HVAC impact on building valuation
Frank Hovorka, Caisse des Dépôts, REHVA Vice-President
- 13.00-13.20** ➤ Energy saving of HVAC systems with continuous monitoring
Zoltan Magyar, Budapest University of Technology, REHVA Vice-President
- 13.20-13.40** ➤ EN15603 and other 2nd generation of EPB standards: a firm basis for the NZEB definition
Jaap Hogeling, ISSO, Chair CENTC 371 Program Committee on EPBD
- 13.40-14.00** ➤ Q&A



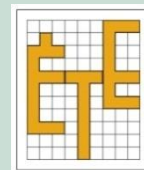
REHVA

professional organisation
representing more than

100 000

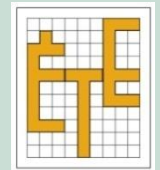
building services engineers
from 26 European countries

Established in 1963





- More than 100 000 individual members of NA
- Co - operation with more than 1500 industrial companies
- Over 20 journals with more than 110 issues per year
- Close to 100 congresses per year- focus on HVAC and energy
- Hundreds of training events
- Support to more than 10 regular international exhibitions
- But... 26 national languages!



REHVA Supporters



Daily activities of REHVA

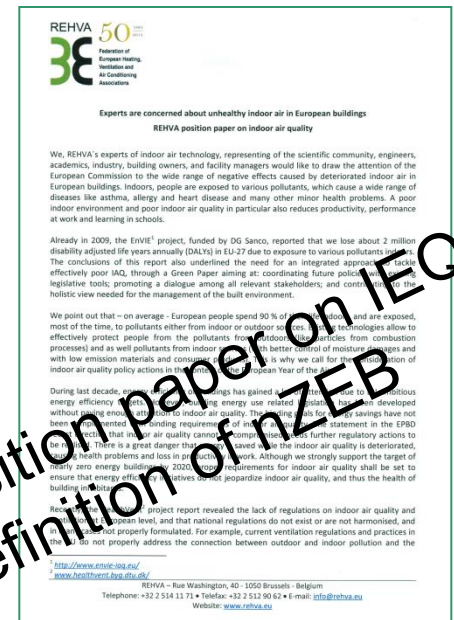


Technology and Research Committee

Task Forces

International working-groups, focusing on areas where development and/or dissemination of knowledge is needed

- **Indoor climate and energy of school buildings**
- **Building simulation**
- **Air conditioning inspections**
- **HVAC in large commercial buildings**
- **Low energy cooling and thermal comfort**
- **Advanced air distribution systems**
- **HVAC for building owners**



REHVA Task Forces - Guidebooks

2014 - 20 Guidebooks



Available on www.rehva.eu or through National associations

Federation of European Heating, Ventilation and Air-conditioning Associations

Prof. Karel Kabele, REHVA president

Publishing and marketing committee



- Focus on European HVAC technology, policy and regulations
- Six issues a year
- Technical articles
- Website www.rehva.eu
- International editorial board
- Prof. Olli Seppänen, Editor-in-Chief

Education committee

REHVA Seminars, workshops, courses



Education committee

REHVA Student Design Competition for graduate student and master students.



CLIMA 2013

11th REHVA World Congress & 8th International Conference on IAQVEC

16.–19. 6. 2013 – Prague Congress Centre – Czech Republic
„Energy Efficient, Smart and Healthy Buildings”

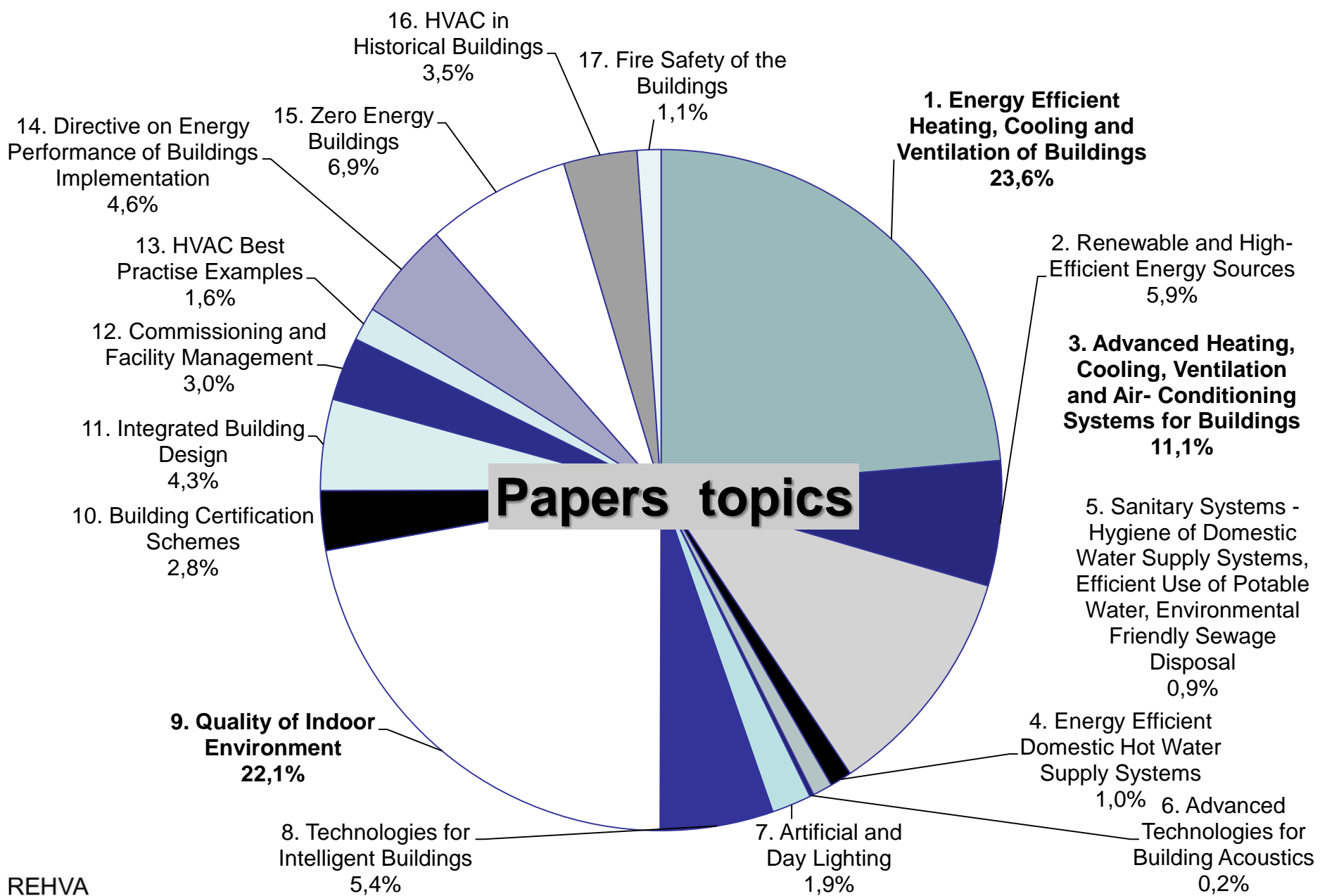
BASIC FACTS

- ✓ 955 participants
- ✓ 60 countries
- ✓ 5 continents
- ✓ 6882 pages proceedings



CLIMA HISTORY

Year	City	Papers
1975	Milano	
1980	Budapest	
1985	Copenhagen	400+
1989	Sarajevo	400
1993	London	229
1997	Brussels	151
2001	Naples	300
2005	Lausanne	300
2007	Helsinki	480
2010	Antalya	517
2013	Praha	702
2016	Aalborg	???





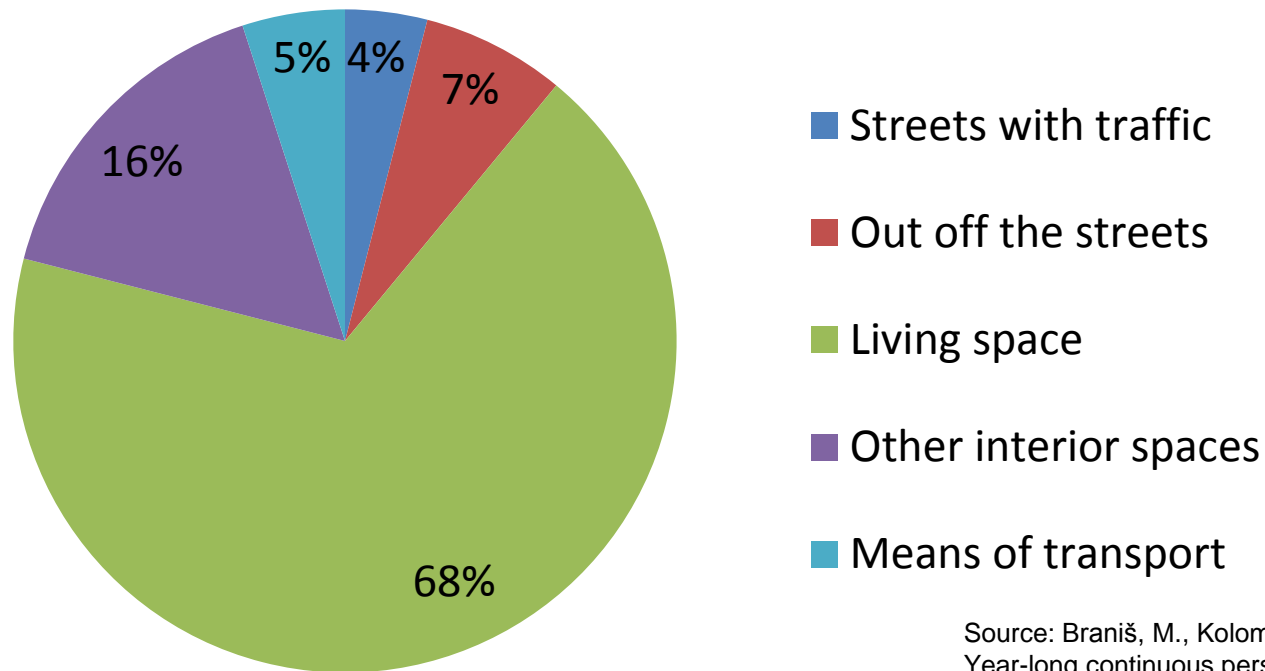
INDOOR ENVIRONMENT IN HIGH ENERGY PERFORMANCE BUILDINGS

Prof. Ing. Karel Kabele, CSc.
CTU in Prague



Indoor Environment of Buildings

Up to 90 % of our life we spend indoors... (SZÚ 2012)



Source: Braniš, M., Kolomazníková, J. (2010)
Year-long continuous personal exposure to PM_{2.5}
recorded by a fast responding portable
nephelometer. Atmospheric Environment 44(24):
2865-2872



Indoor Environment of Buildings

- Ind. Environment influences:
 - Health
 - Productivity
 - Comfort



Indoor Environment of Buildings

=

Internal Microclimate

=

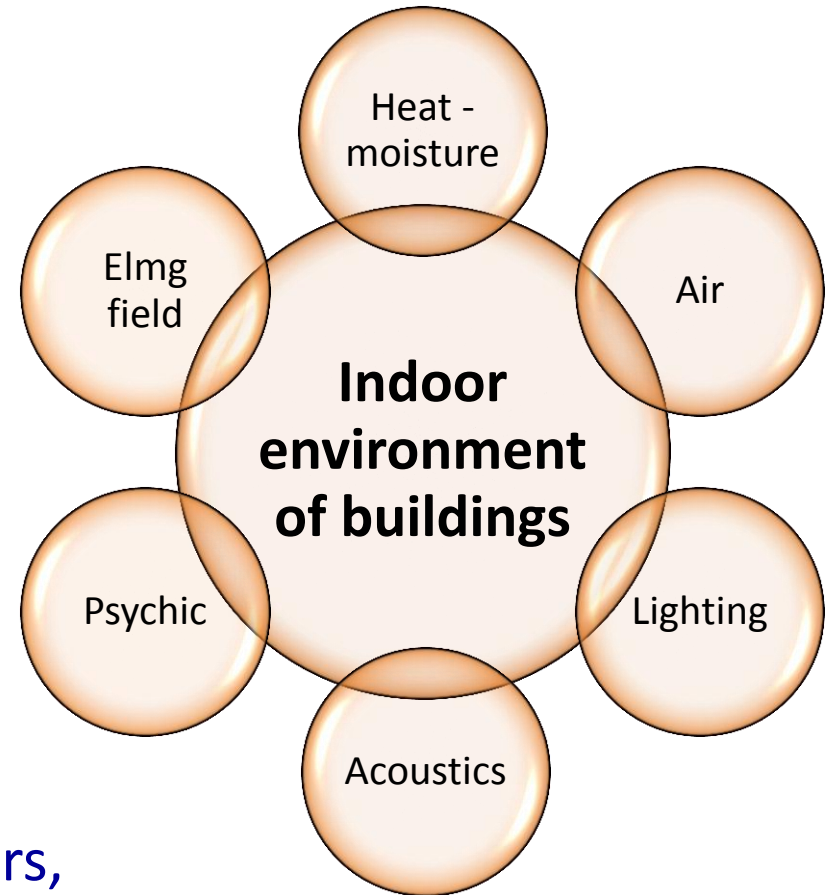
Indoor Environment (IE)



Indoor Environment of Buildings

Components of IE

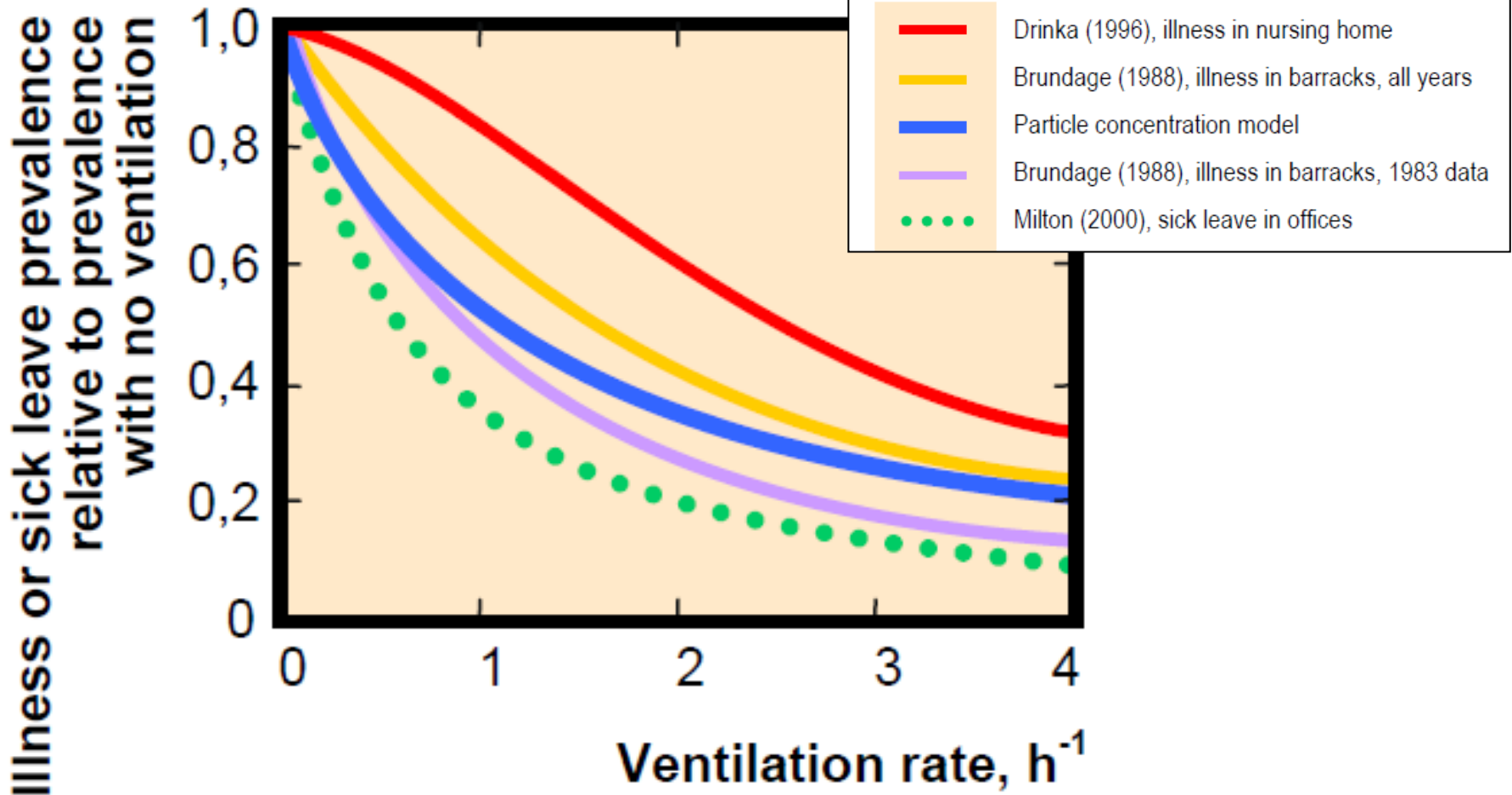
- Heat - moisture
- Air quality
 - gases
 - aerosols
 - microorganisms
- Acoustics
- Lighting
- Electro -static, -ion, -magnetic, ionizing and radiation field
- Psychological comfort (colors, surfaces, architecture ...)



Source : Jokl 1986

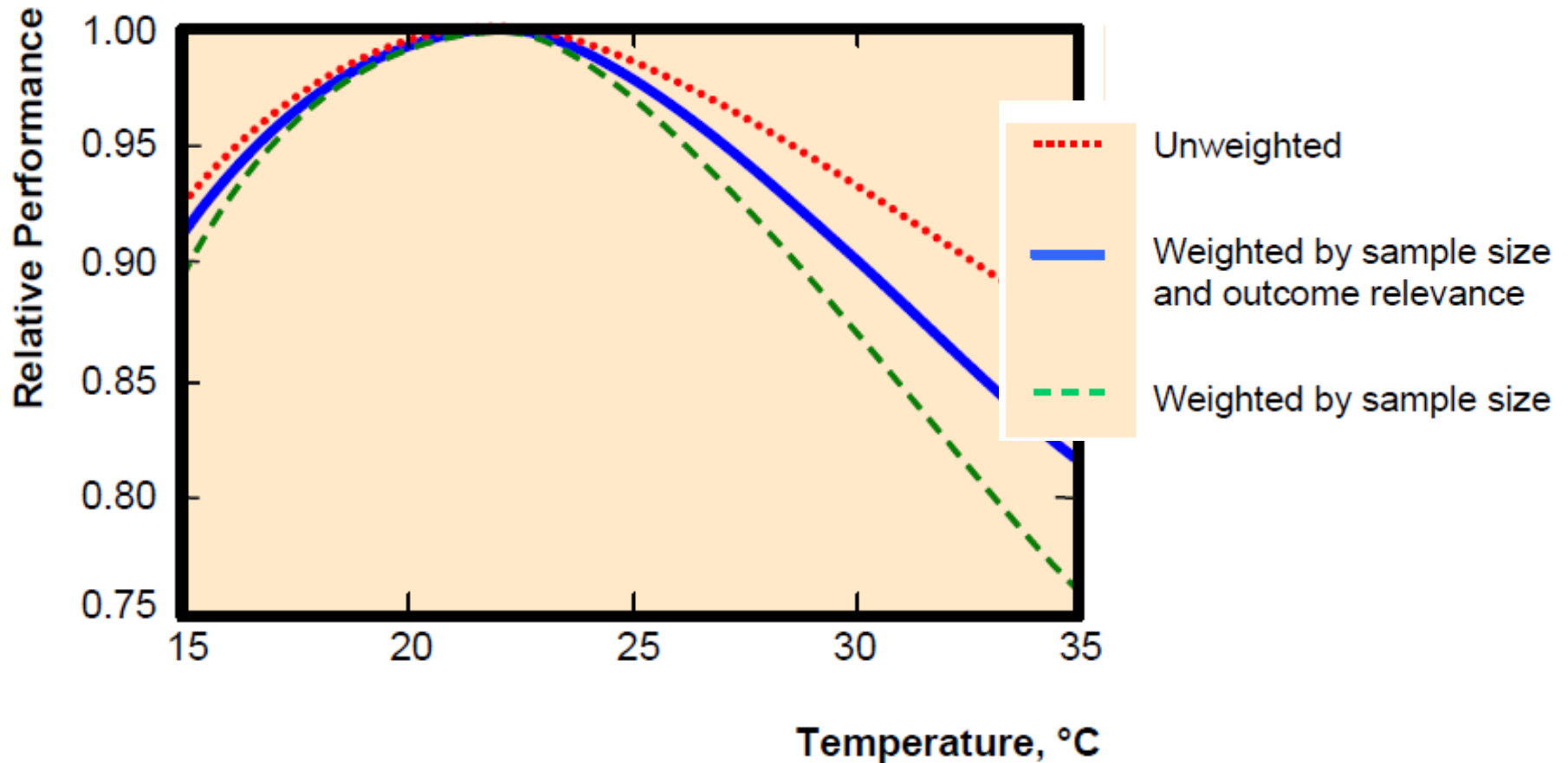


Ventilation rates and sick leave





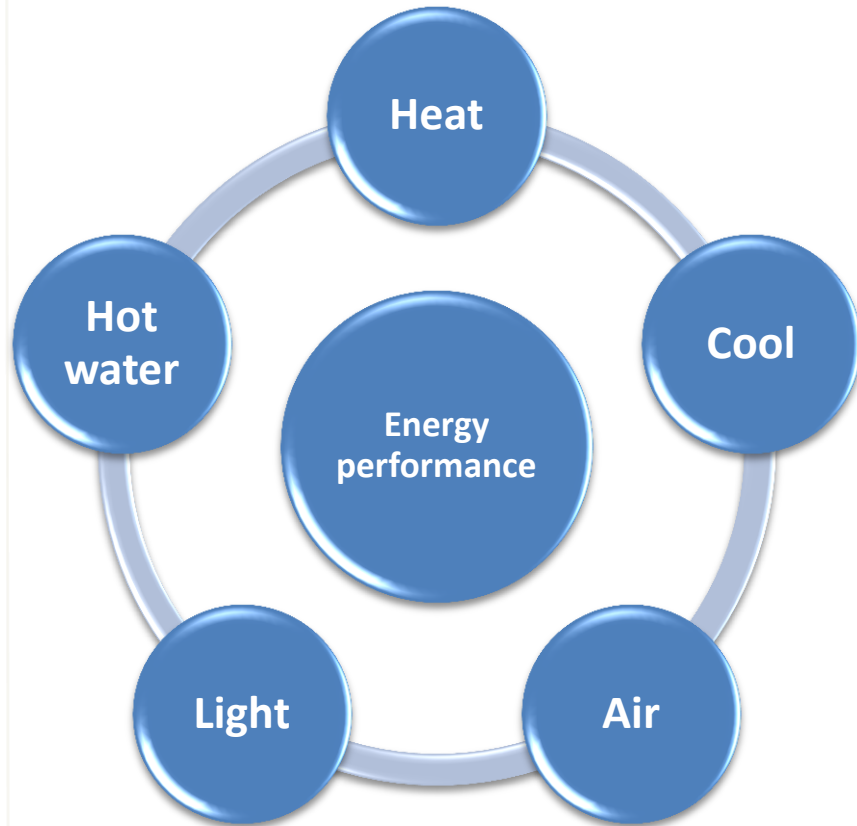
Temperature and performance



ENERGY PERFORMANCE OF THE BUILDINGS



Energy performance of building

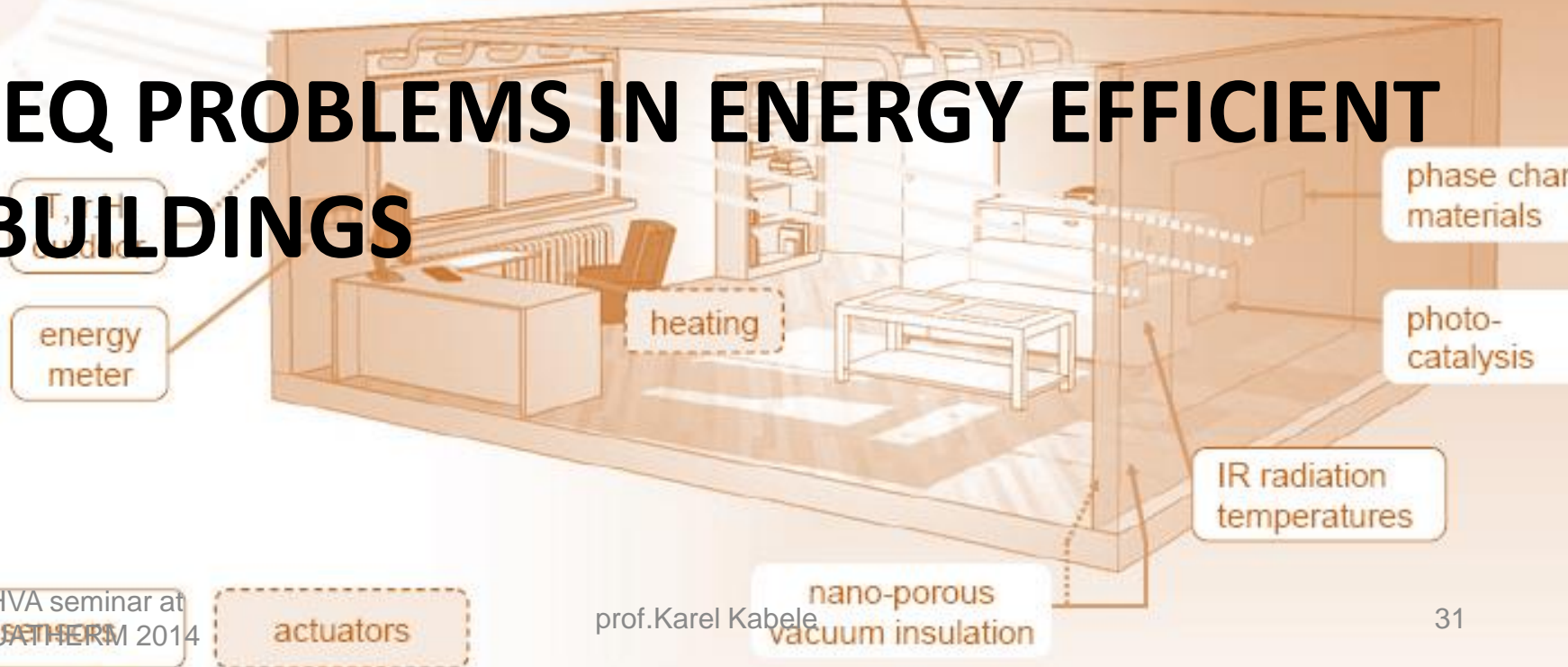
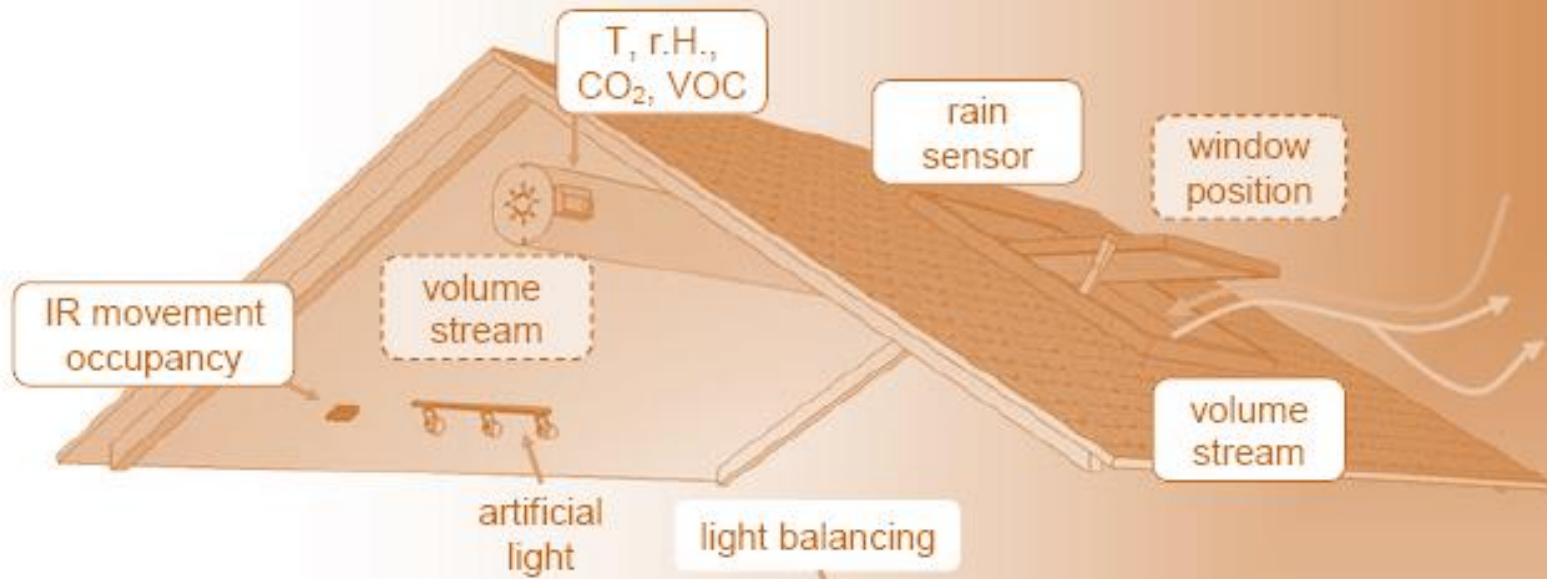


... means the calculated or measured amount of energy needed to meet the energy demand associated with a typical use of the building, which includes, **inter alia**, energy used for:

- **Heating**
- **Cooling**
- **Ventilation**
- **Hot water**
- **Lighting....**

*Source: DIRECTIVE
2010/31/EU*

IEQ PROBLEMS IN ENERGY EFFICIENT BUILDINGS





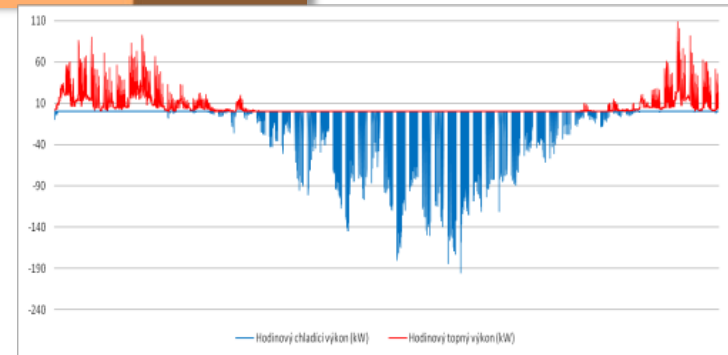
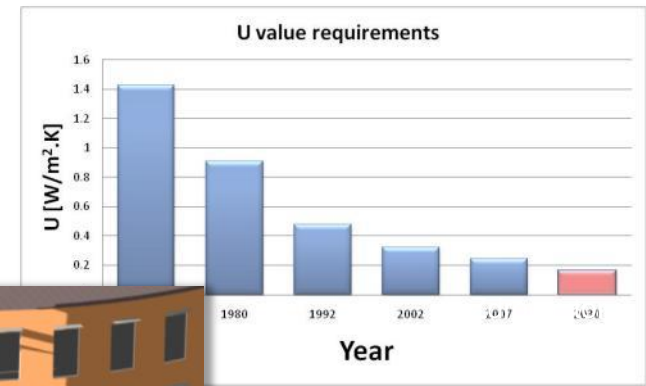
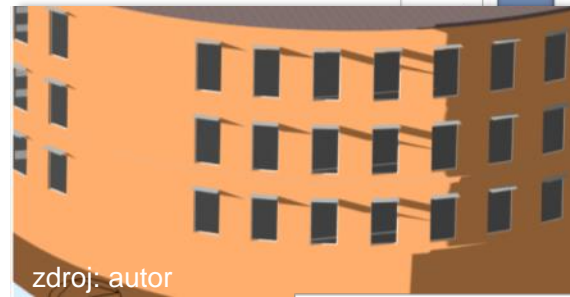
Building Envelope

Facade

- Thermal insulation - limit?
- Advanced materials
 - Vacuum insulation
 - PCM materials
- active facades
 - Double facades
 - Smart "shading,"
 - Integrated PV, PT systems



<http://www.terraduct.com>



Reduction of heating and cooling



Building envelope

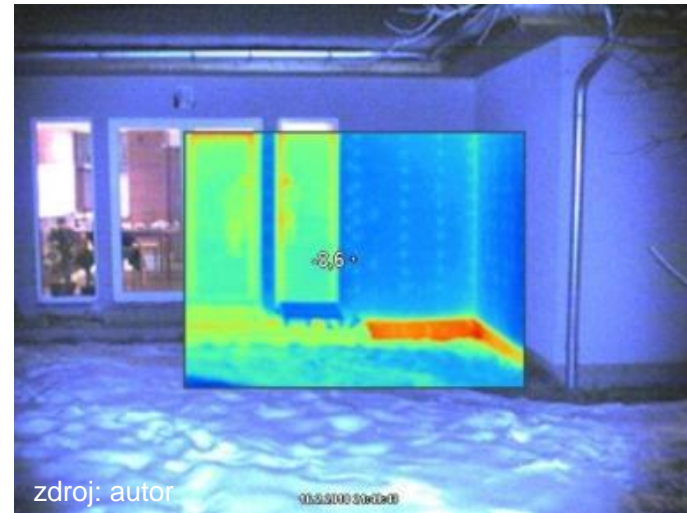
Windows

- Glazing
- Thermal bridges

Active glazing

– electrochromic?

Heat losses and heat load
minimizing
Ensuring daylight

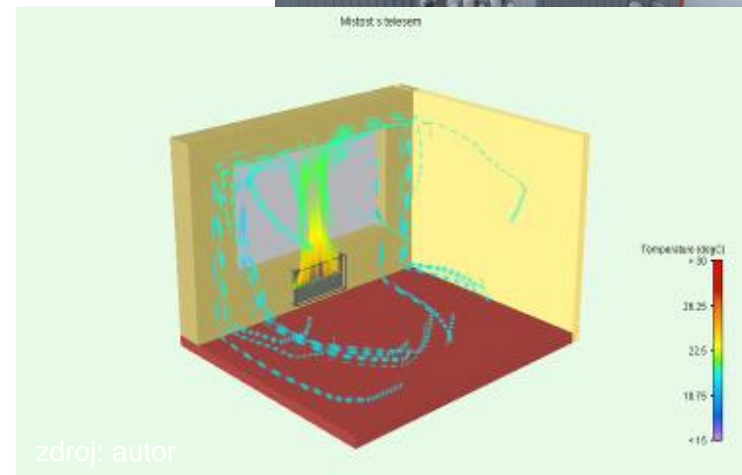
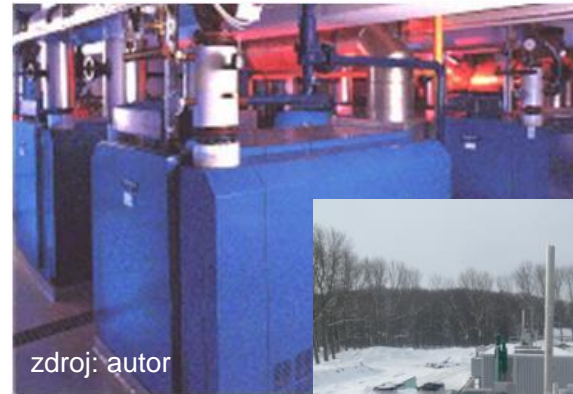




Heating of buildings

Heating

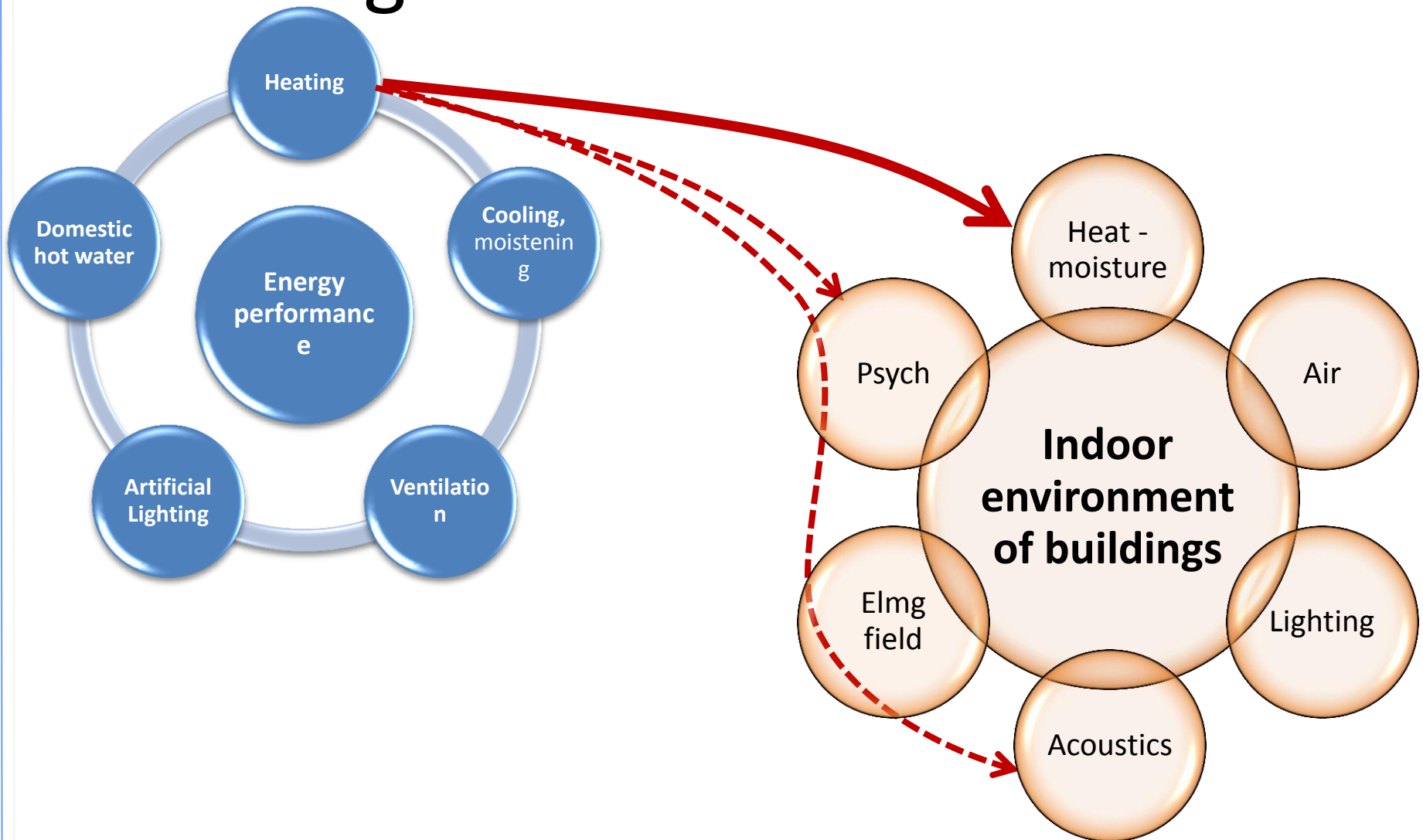
- Renewable sources
- Heat storage
- Efficient sources
- Efficient heat distribution (pumps)
- Heat emission
- Measurement and control



Efficient power and power control
Renewables



Building and Indoor Environment...

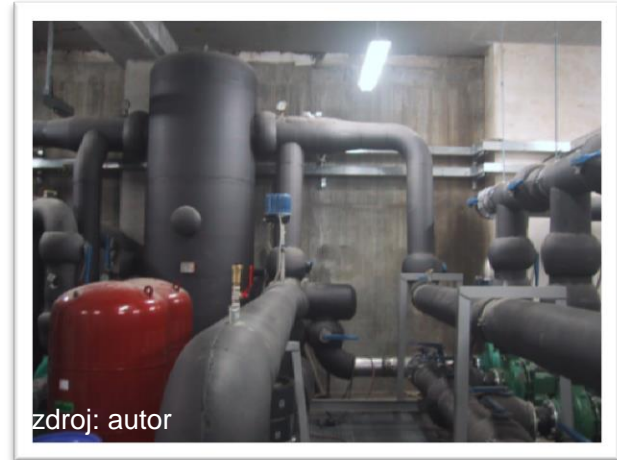




Cooling

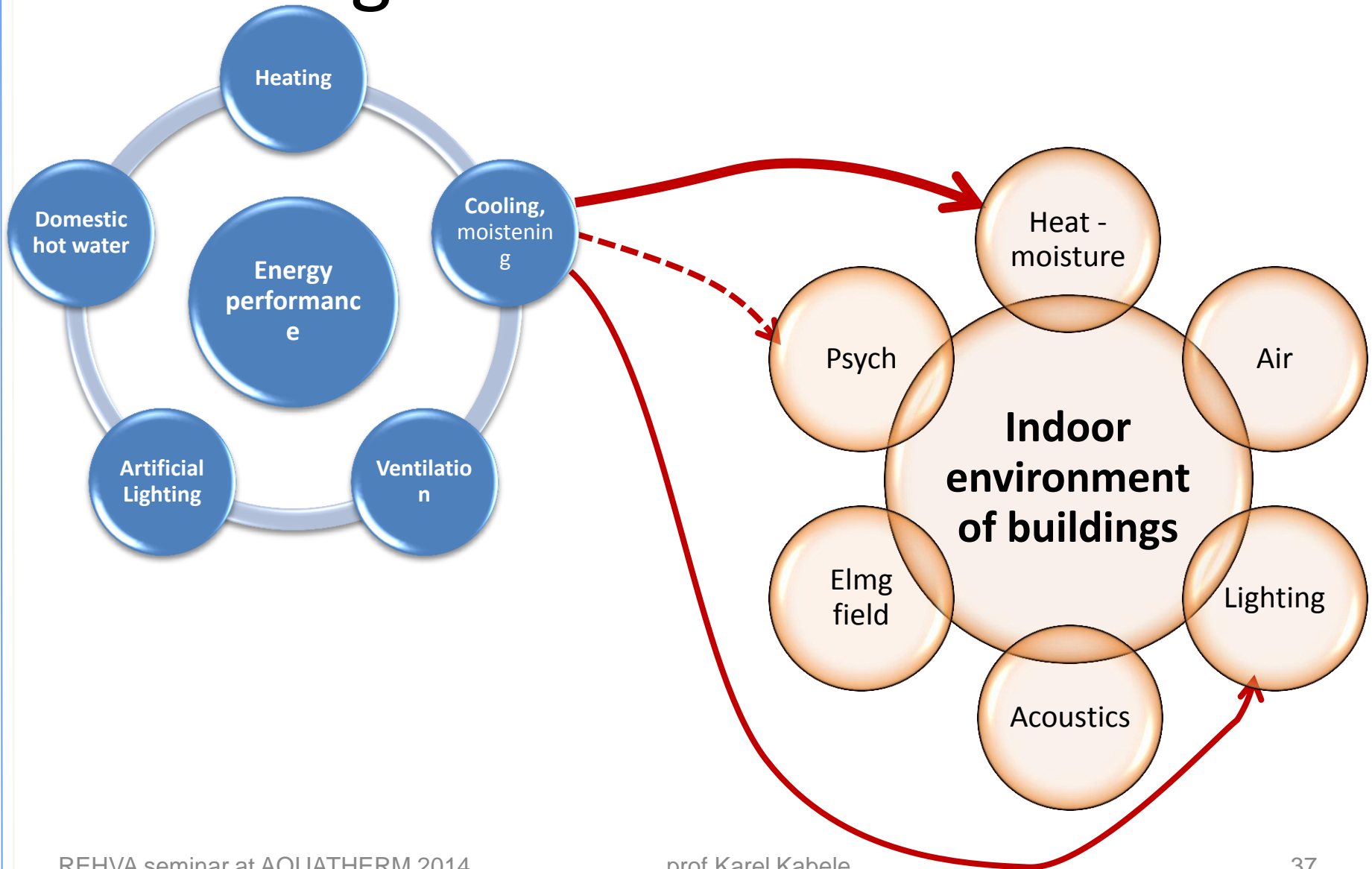
- Reducing heat load
- Efficient chillers
- Accumulation of cold
- Efficient cold distribution
- „High-temperature“ cooling
- Control and strategy(night ventilation)

Passive systems
Efficient power and power control
Renewable cold sources





Building and Indoor Environment...

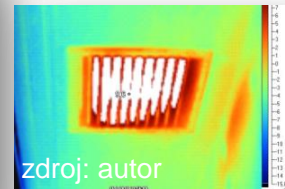
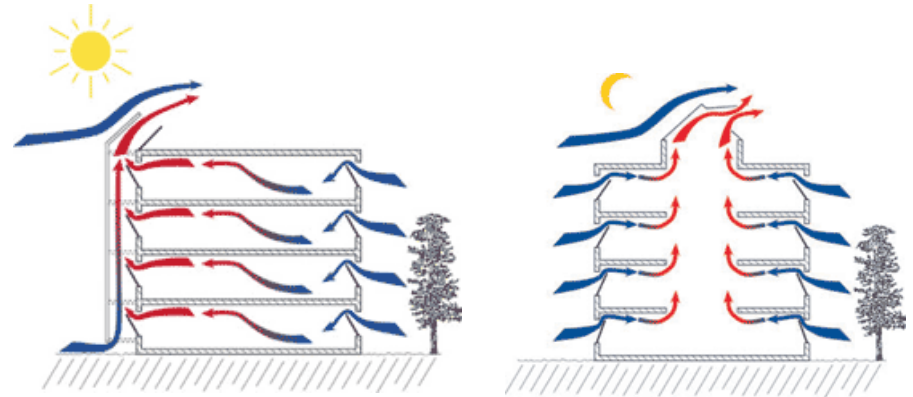




Ventilation

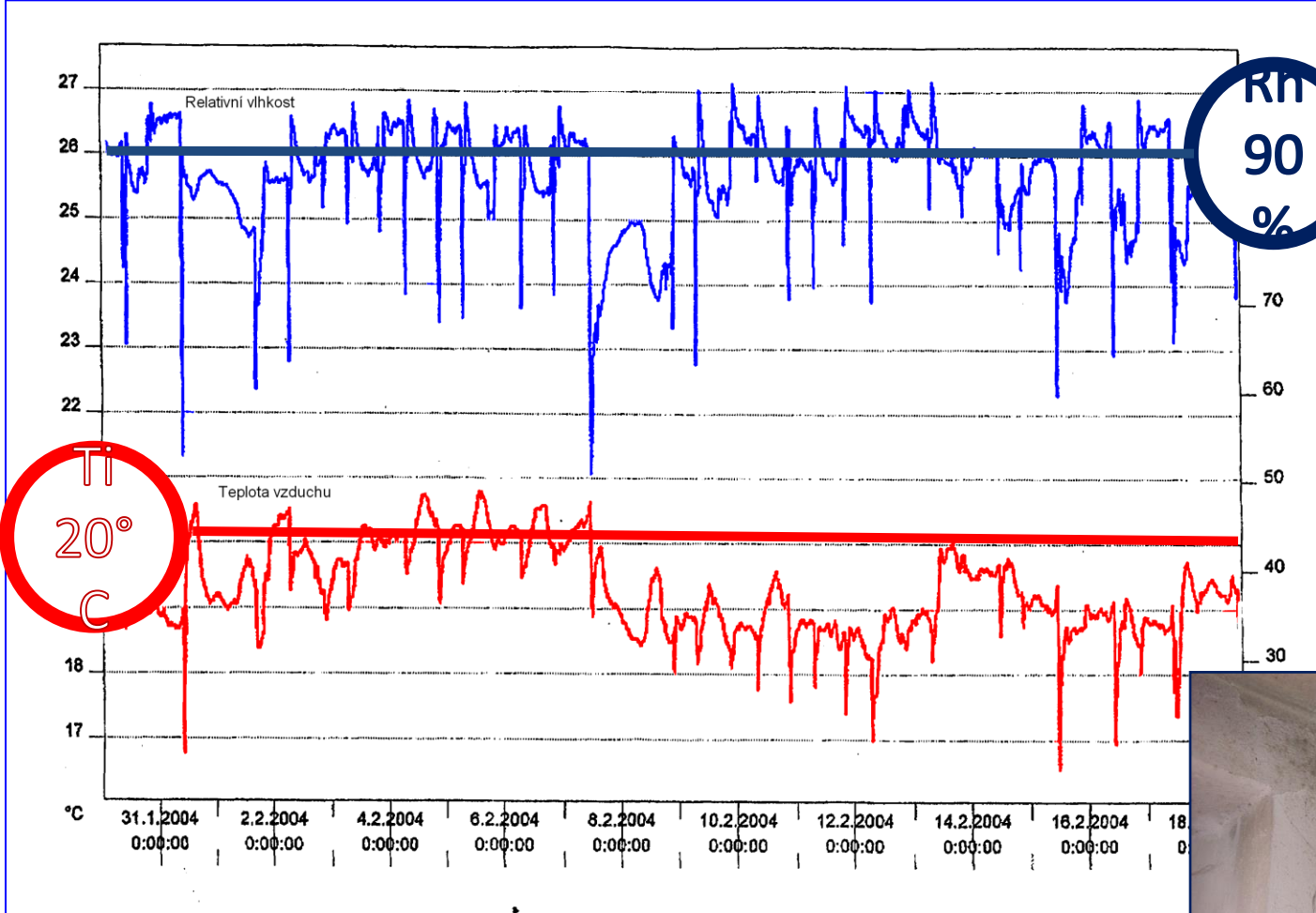
- Ventilation air amount optimization
- CO₂, VOC, IAQ sensors
- Low-pressure distribution network
- Natural ventilation
- Control strategy

Natural ventilation systems
Controlled mechanical ventilation





Example: a consequence of "energy conscious" user behavior



Source : Kabele 2006



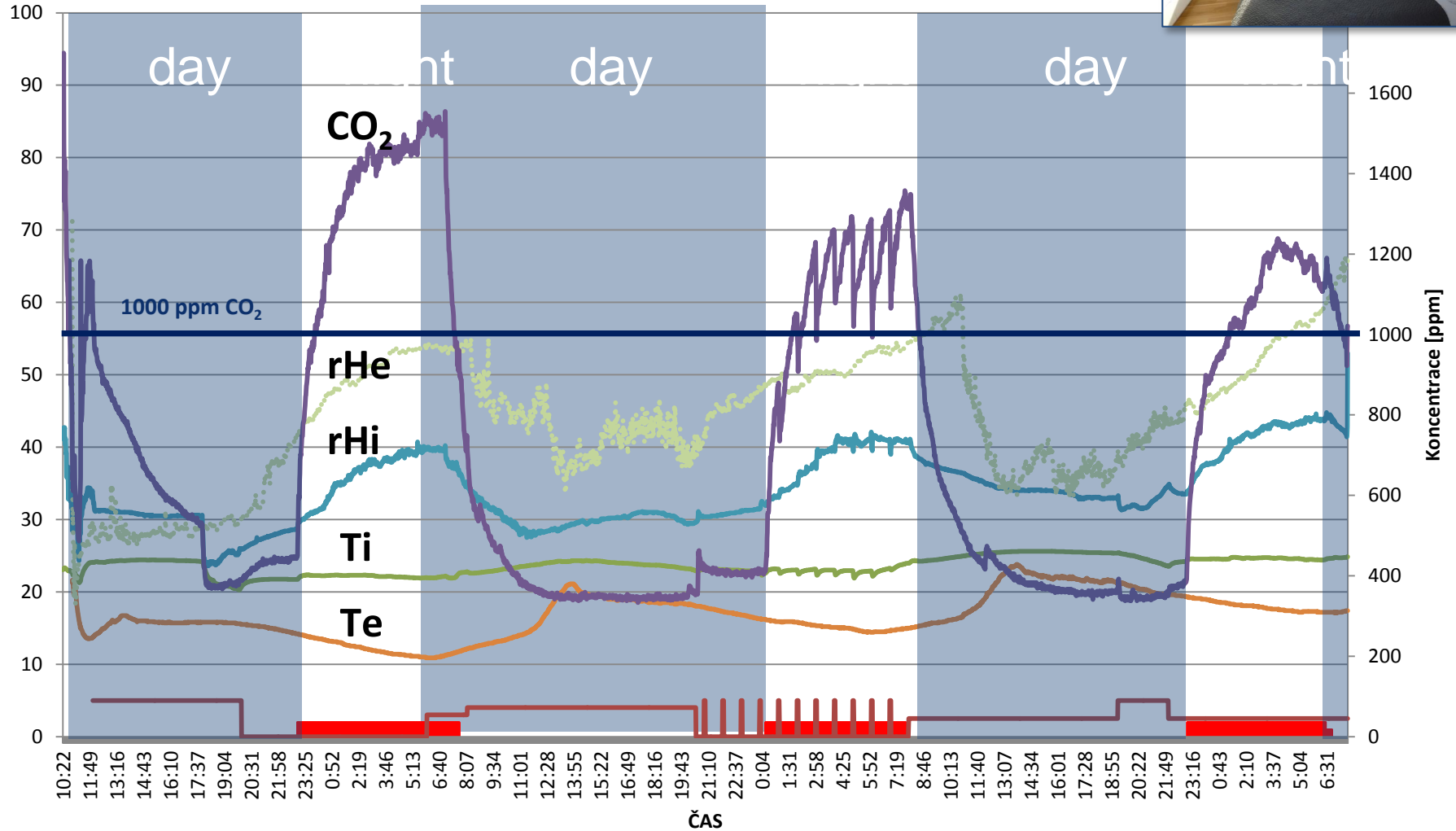
Case study: Refurbished apartment



- Modern, tight windows
- Natural ventilation strategy?



Apartment - bedroom



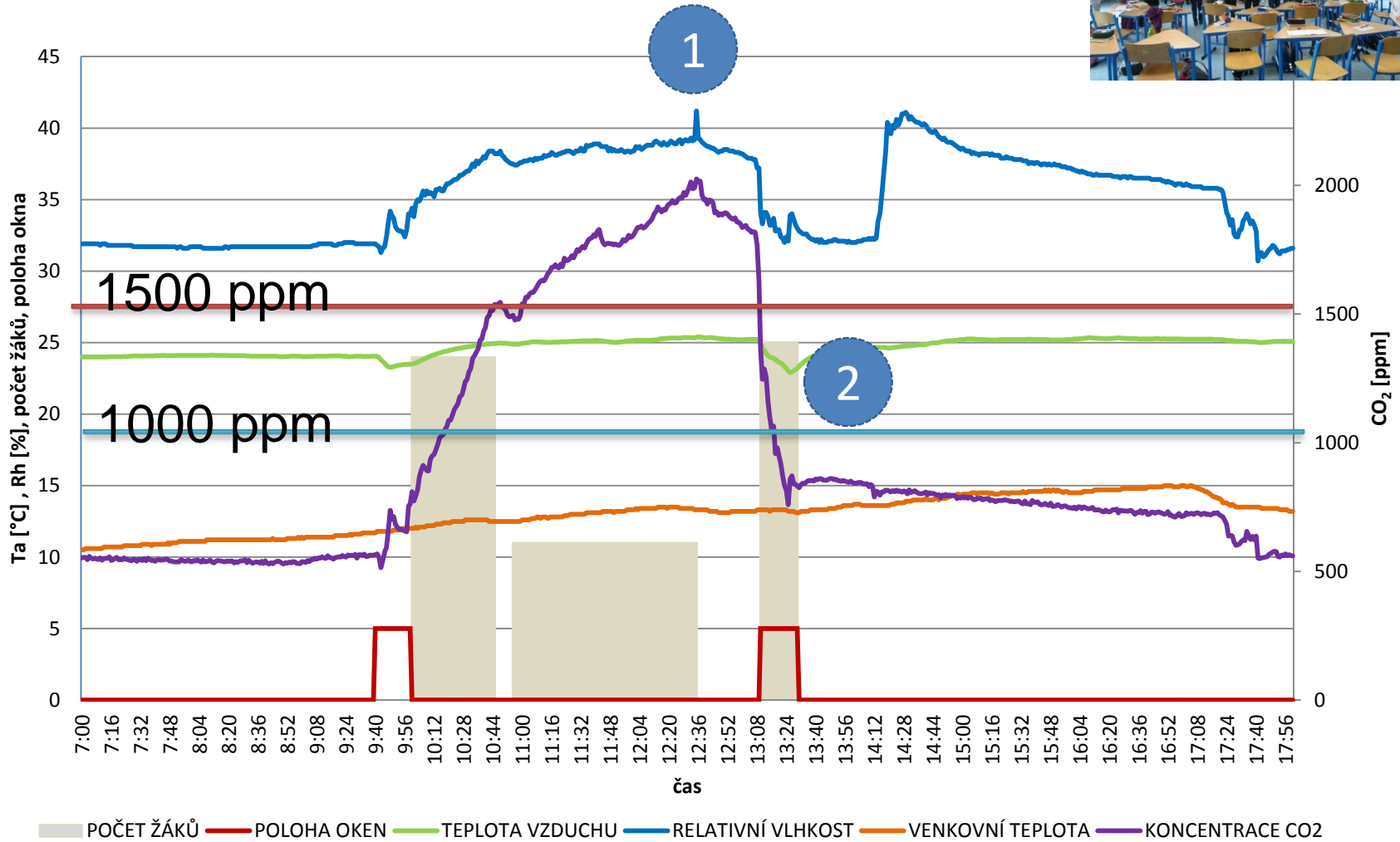


SCHOOL



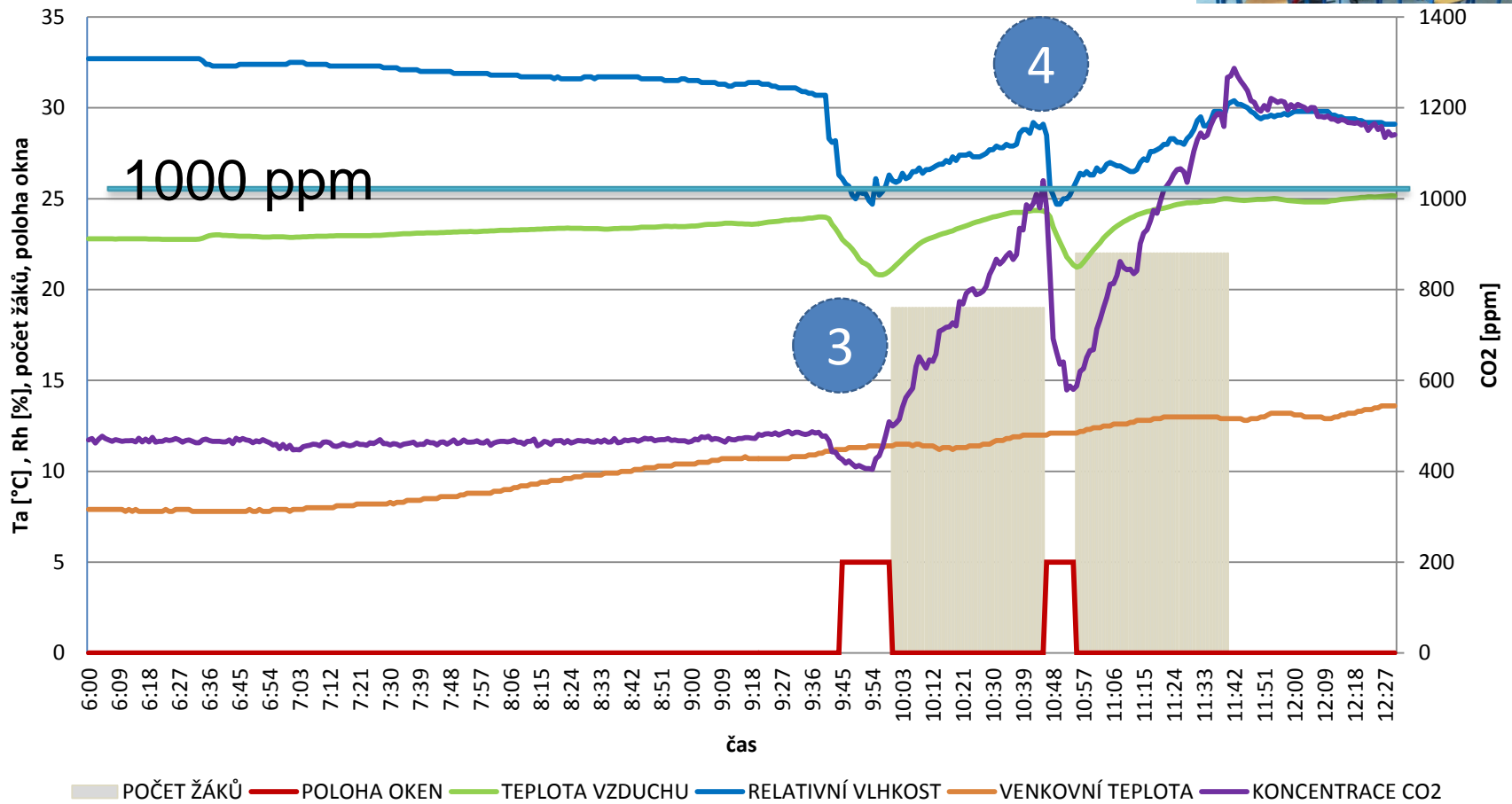


Windows closed



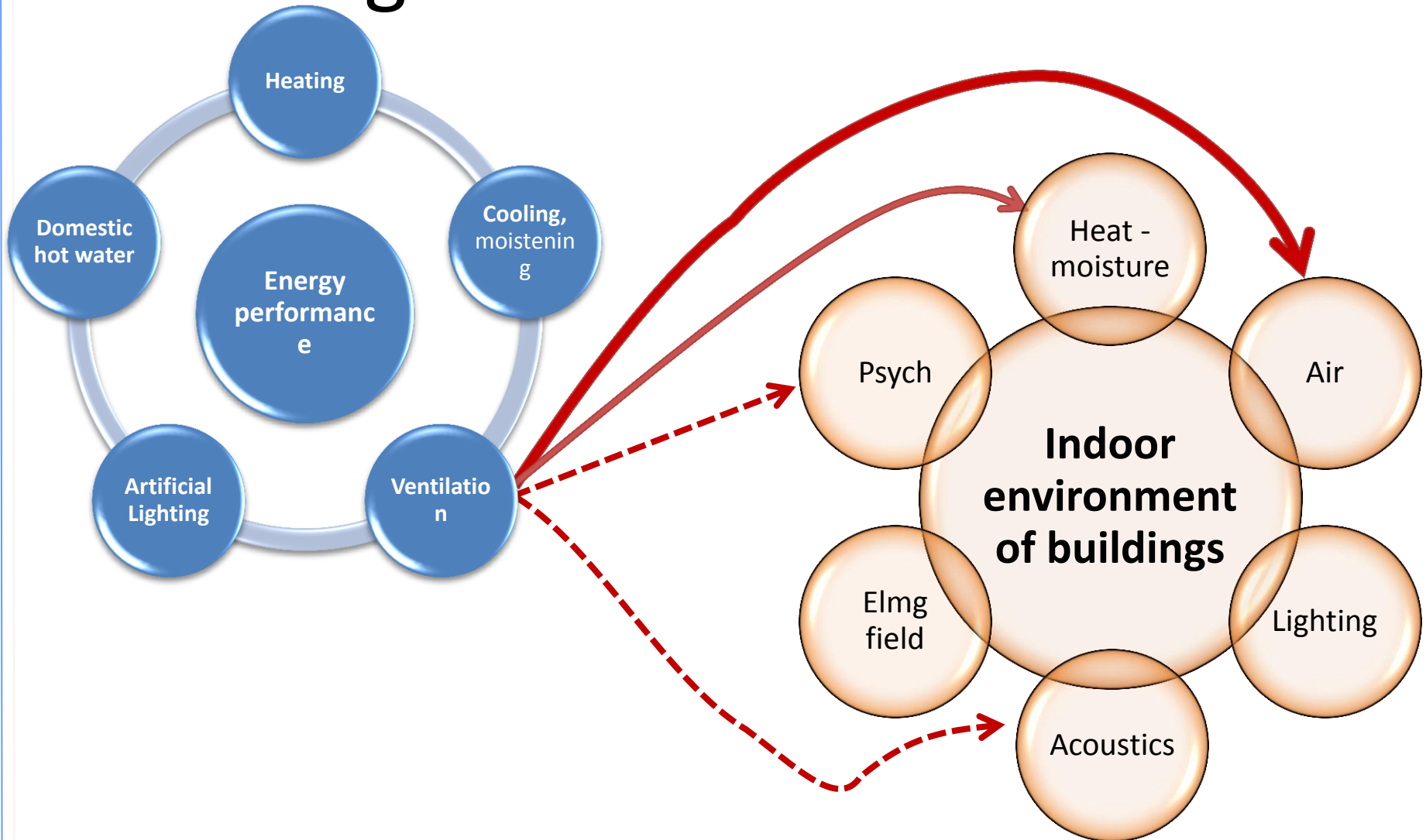


Windows opened before lesson





Building and Indoor Environment...





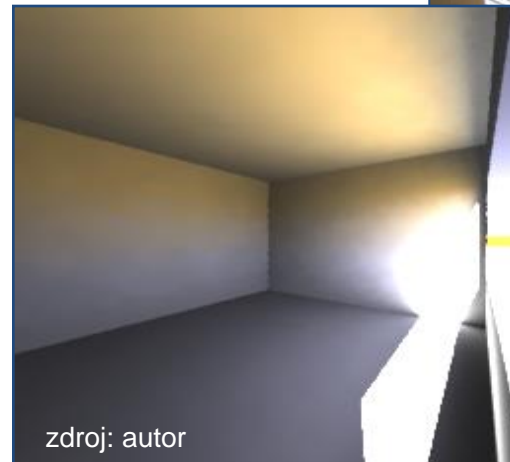
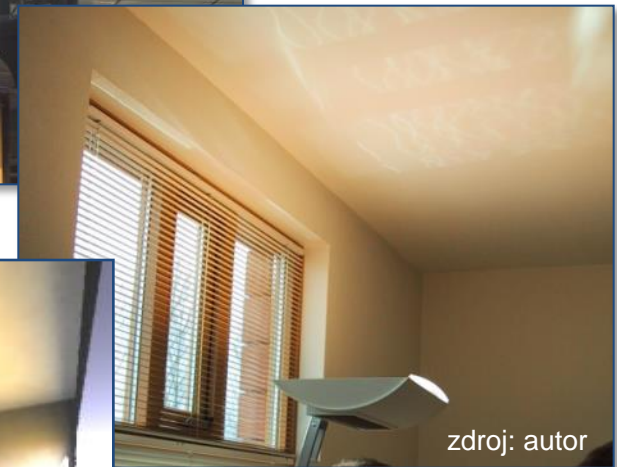
Light

Daylight and mixed lighting

Light ducts

Effective sources - LED?

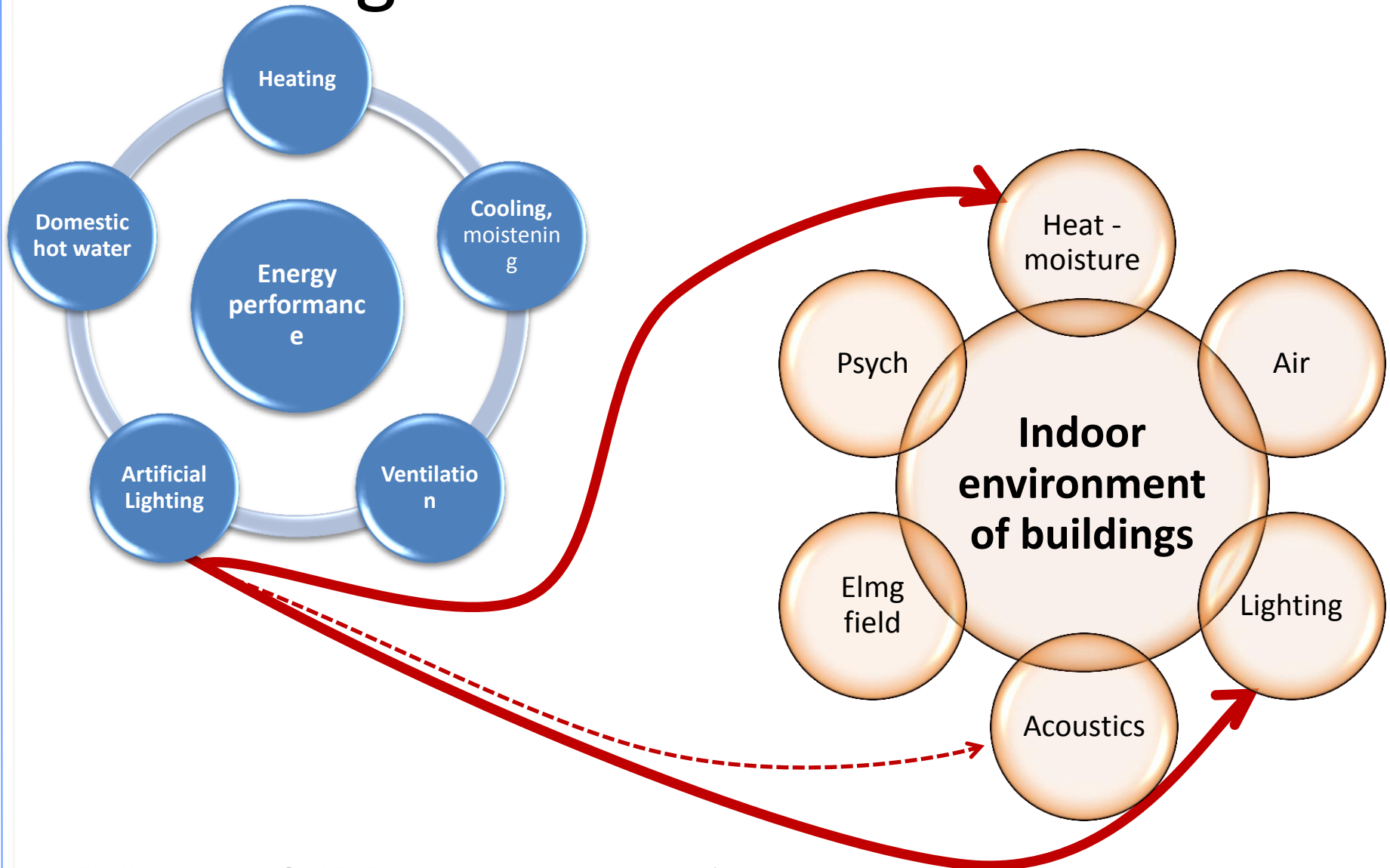
Control



Daylighting
Artificial – new sources



Building and Indoor Environment...

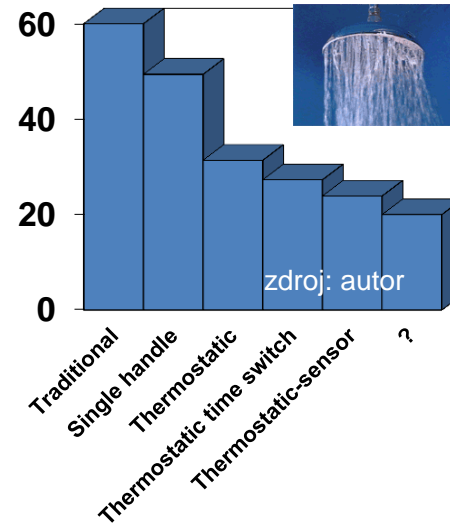




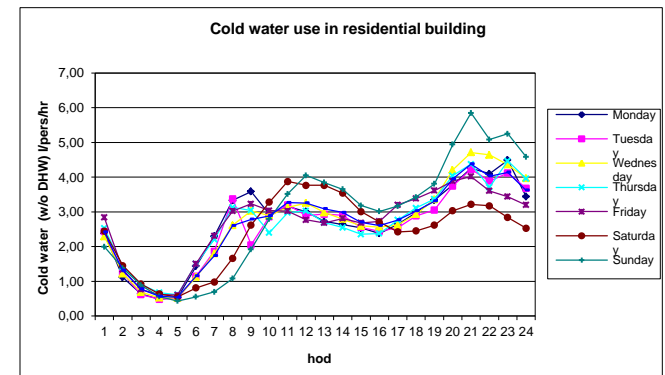
Domestic Hot Water

- DHW consumption!!
- Efficient DHW generation
- Temperature
- Distribution network
 - Circulation
 - Control
- Legionella!!!!

Hot water demand
litres/shower

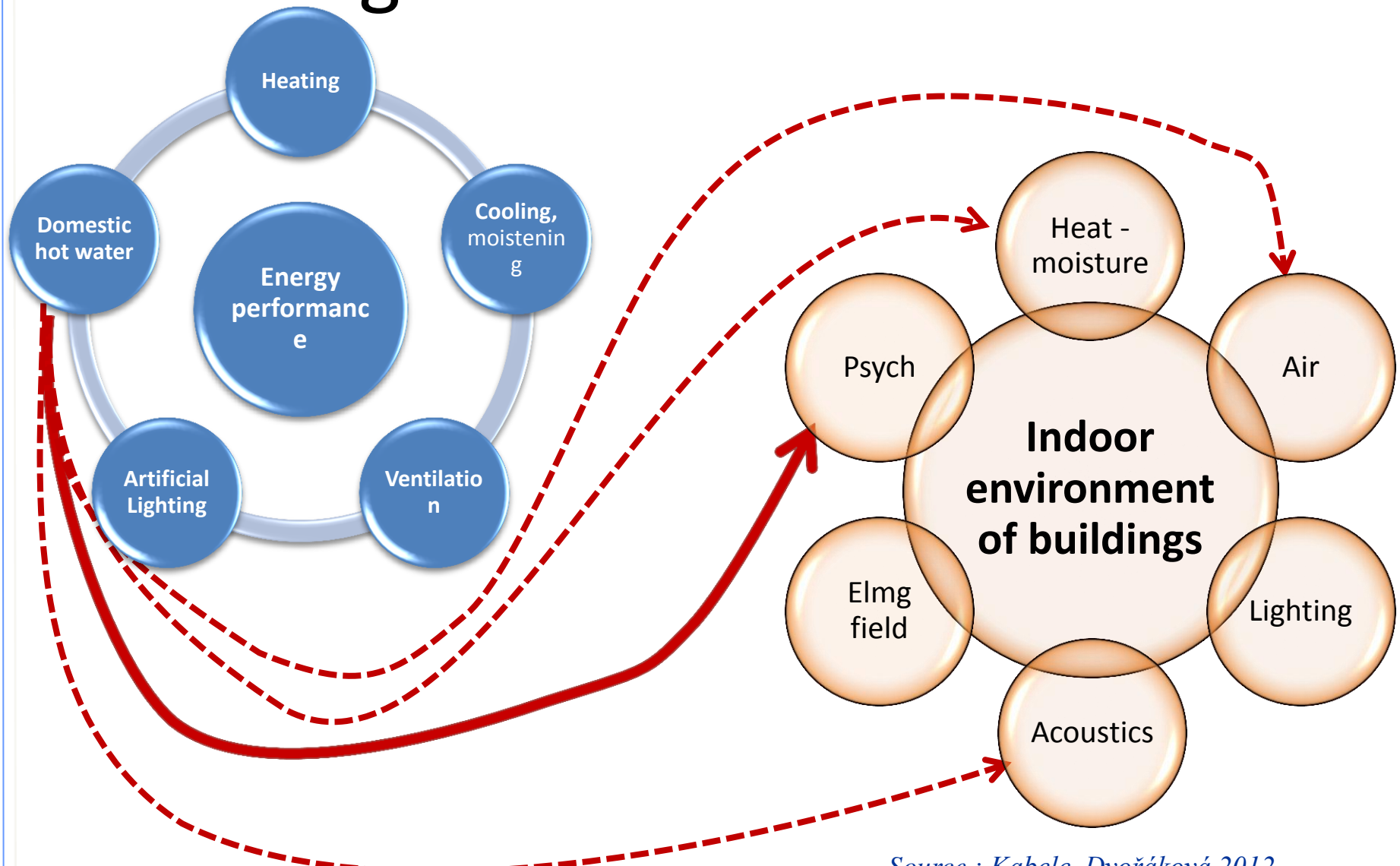


Water temperature –
hygiene
Human factor



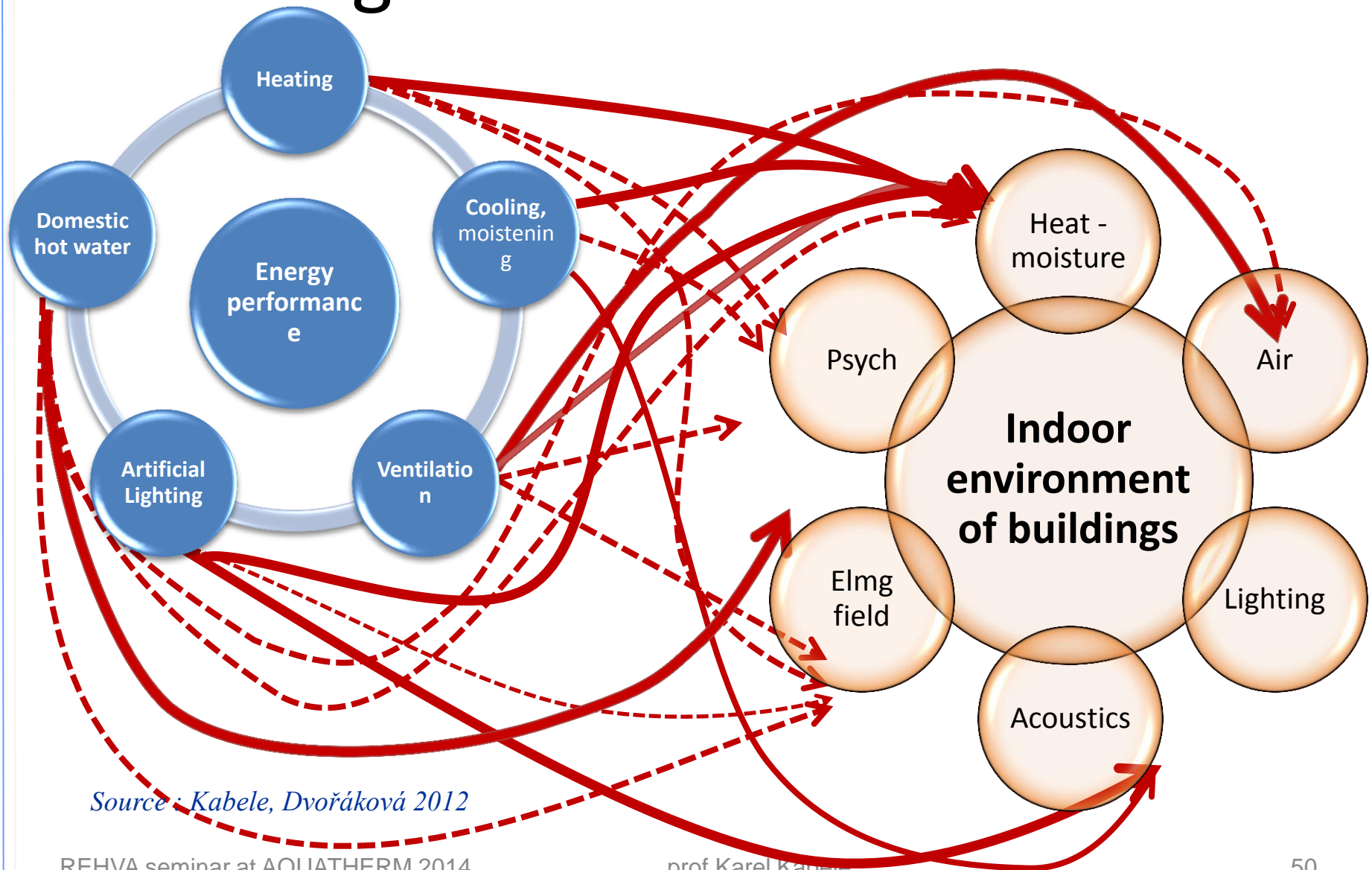


Building and Indoor Environment...





Building and Indoor Environment...



Source : Kabele, Dvořáková 2012



THANK YOU FOR YOUR ATTENTION

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