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Sveučilište u Zagrebu
Arhitektonski fakultet
University of Zagreb
Faculty of Architecture



MOTOVUN 2011.

TRADITION, CREATIVITY & SUSTAINABILITY

Sustainability and quality of buildings

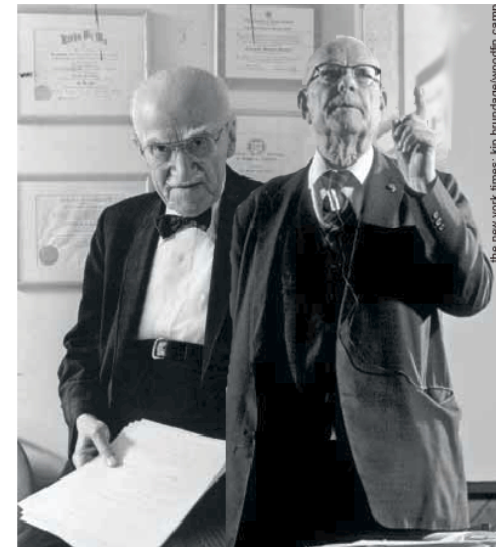
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SVEUČILIŠTE U ZAGREBU
GRAĐEVINSKI FAKULTET
UNIVERSITY OF ZAGREB
FACULTY OF CIVIL ENGINEERING

What is quality?

- J.M. Juran defines quality as **satisfaction of a customer and a suitability for exploitation**
- Satisfaction of a customer and suitability for exploitation are the **characteristics of a product**
- The product is software, goods, service or **buildings**



Quality of completed product

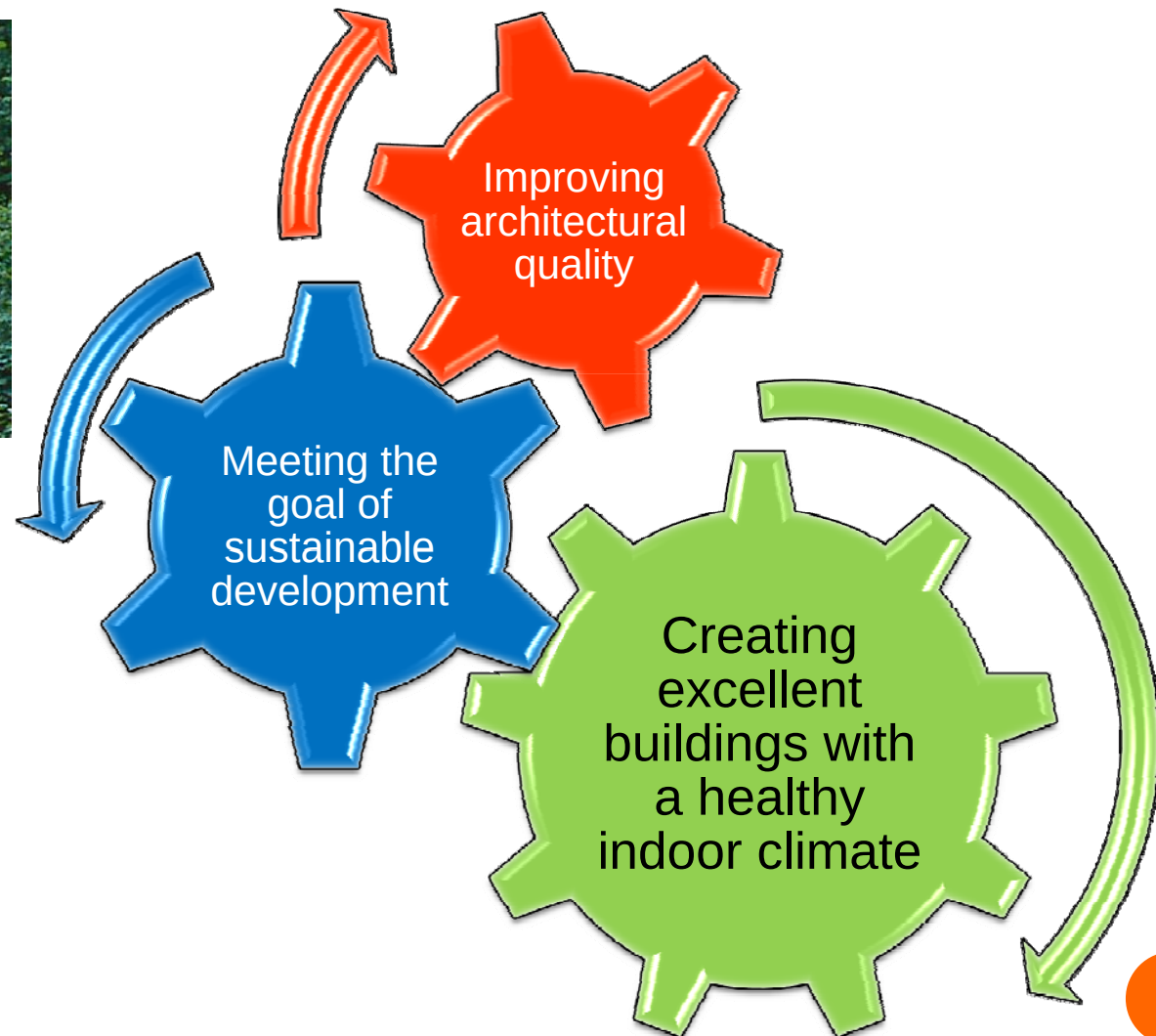
- Connections can be depicted with the quality circle:



DGNB (German sustainable building scheme)

DGNB criteria	
Ecological quality of the building	mostly based on life cycle analysis (LCA) of the <u>building products</u> used in the construction
Economical quality	particularly viewed not through the up-front cost of the building but through a life cycle costing and expected impact of different choices on the long-term value of the building
Socio-cultural aspects and functionality,	in particular the health and comfort aspects of a building as well as how it impacts its local environment
Technical quality,	especially regarding the thermal performance of the building but also other key issues such as fire safety
Process quality,	a focus on ensuring a good planning process and a high level of quality as built

Improving the quality of buildings



Why to look after the quality of process and product?

- Process and product are **inextricably linked**, so that **consideration of one in isolation from the other is a recipe for failure**.
- There have been **many attempts at bringing change** in the way buildings are “produced”, only to fall by the wayside because they **ignored the product** and **what it meant to occupants** (those who have to use buildings).

Many examples of failed projects

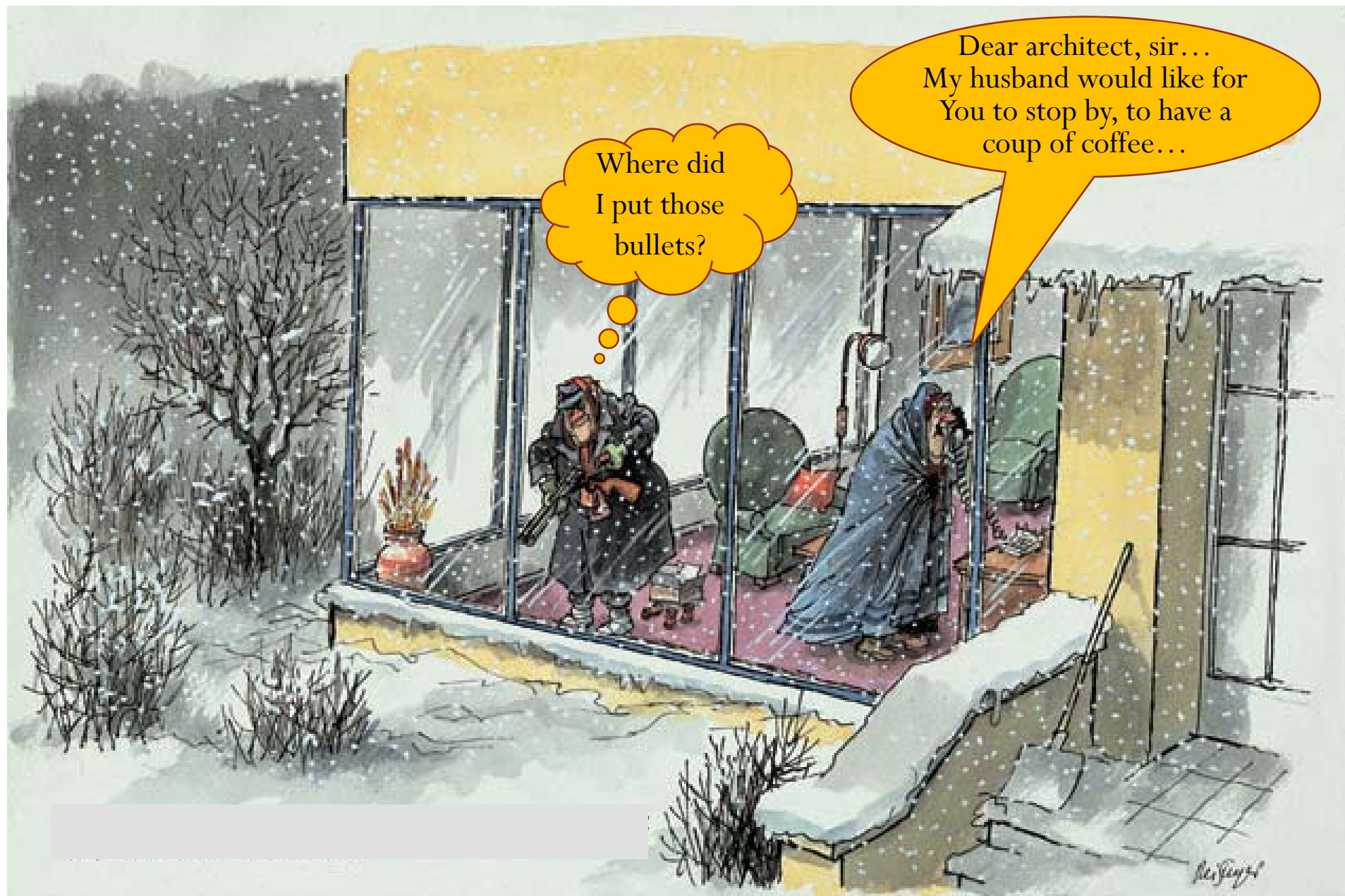


- Unskilled construction of thermal insulation – often leads to construction damage!

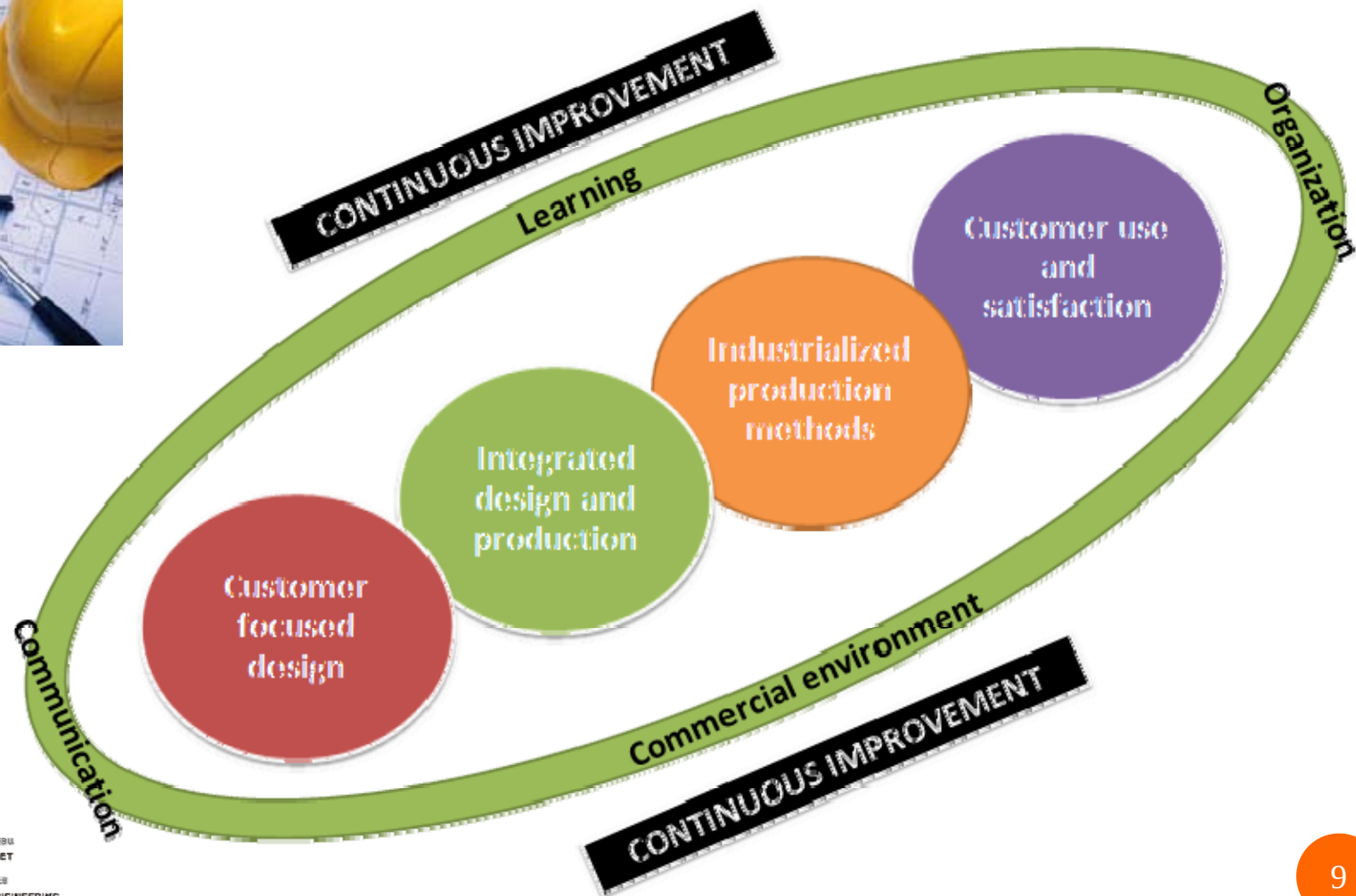


- Ulica Domovinskog rata – Vukovar
- 150 m² facade destructed after a storm

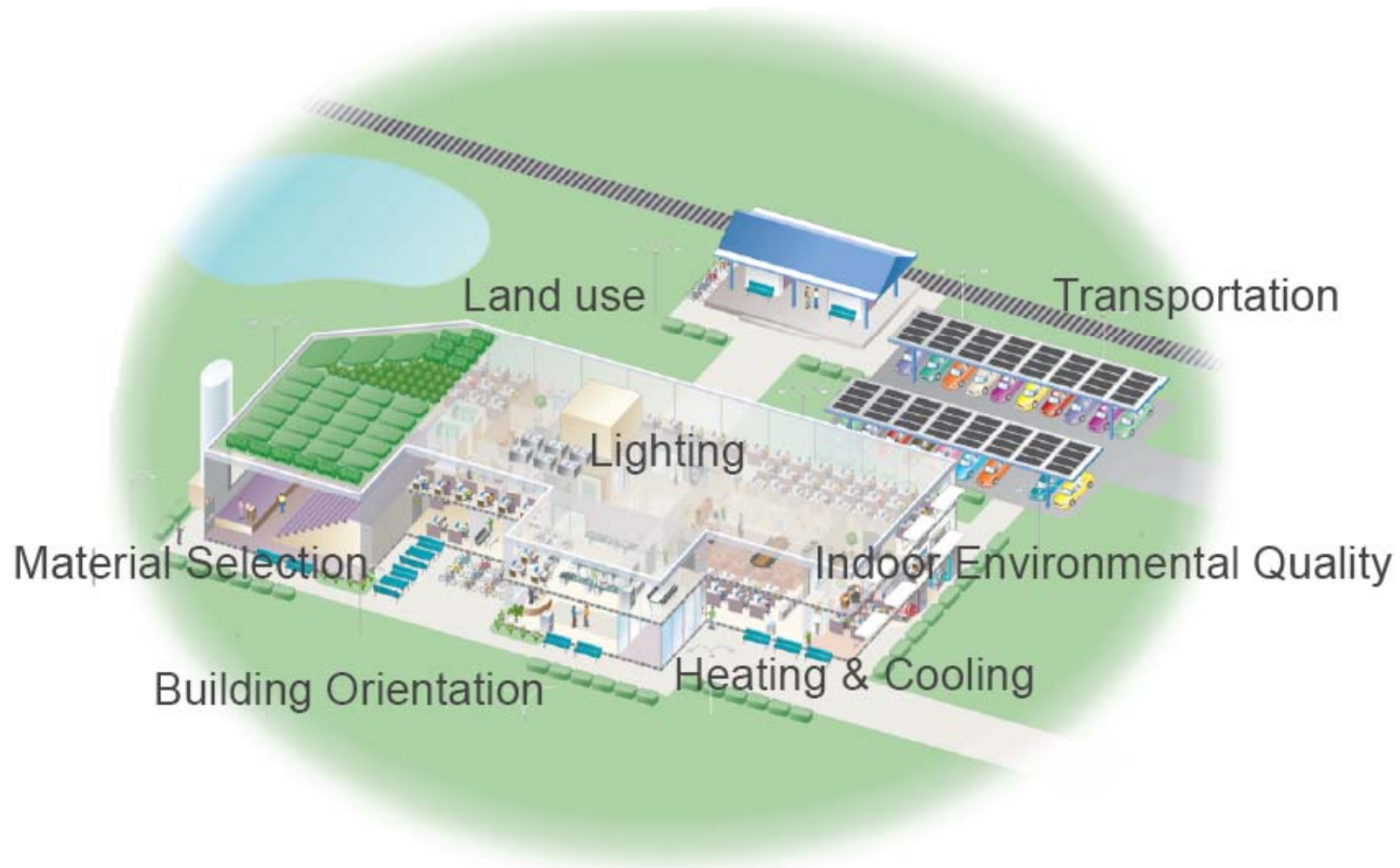




Receipt for good quality buildings



Whole building approach



Voluntary sustainability (quality) control

- Green Building Rating Systems are voluntary

- LEED

BREEAM 

- BREEAM

- DGNB German sustainable building scheme

- ...



e.g. LEED

- LEED loosely defines green structures as those that are “**healthier, more environmentally responsible and more profitable**”
- The rating system is based on an assessment of attributes and an evaluation of the use of applied standards.



Sustainable Sites **SS**



Water Efficiency **WE**



Energy and Atmosphere **EA**



Materials and Resources **MR**



Indoor Environmental Quality **IEQ**



Innovation and Design **ID**



Regional Priorities **RD**

Is it possible to enhance quality and remain sustainable?

- ***YES! Through some principles:***
 - ***Eco-design***
 - Set of rules and principles which is intended to eliminate harmful influence through correct choices in design phase.
 - **Eco-Efficiency**
 - Through the delivery of competitively priced goods and services that satisfy human needs, while progressively reducing ecological impacts throughout the life cycle.



Factors determining sustainable qualities of a material

With growing awareness about sustainable design other qualities of materials besides mechanical properties became important:



energy required to produce the material



CO₂ emissions resulting from the material's manufacture



impact on the local environment resulting from the extraction of resources



toxicity of the material



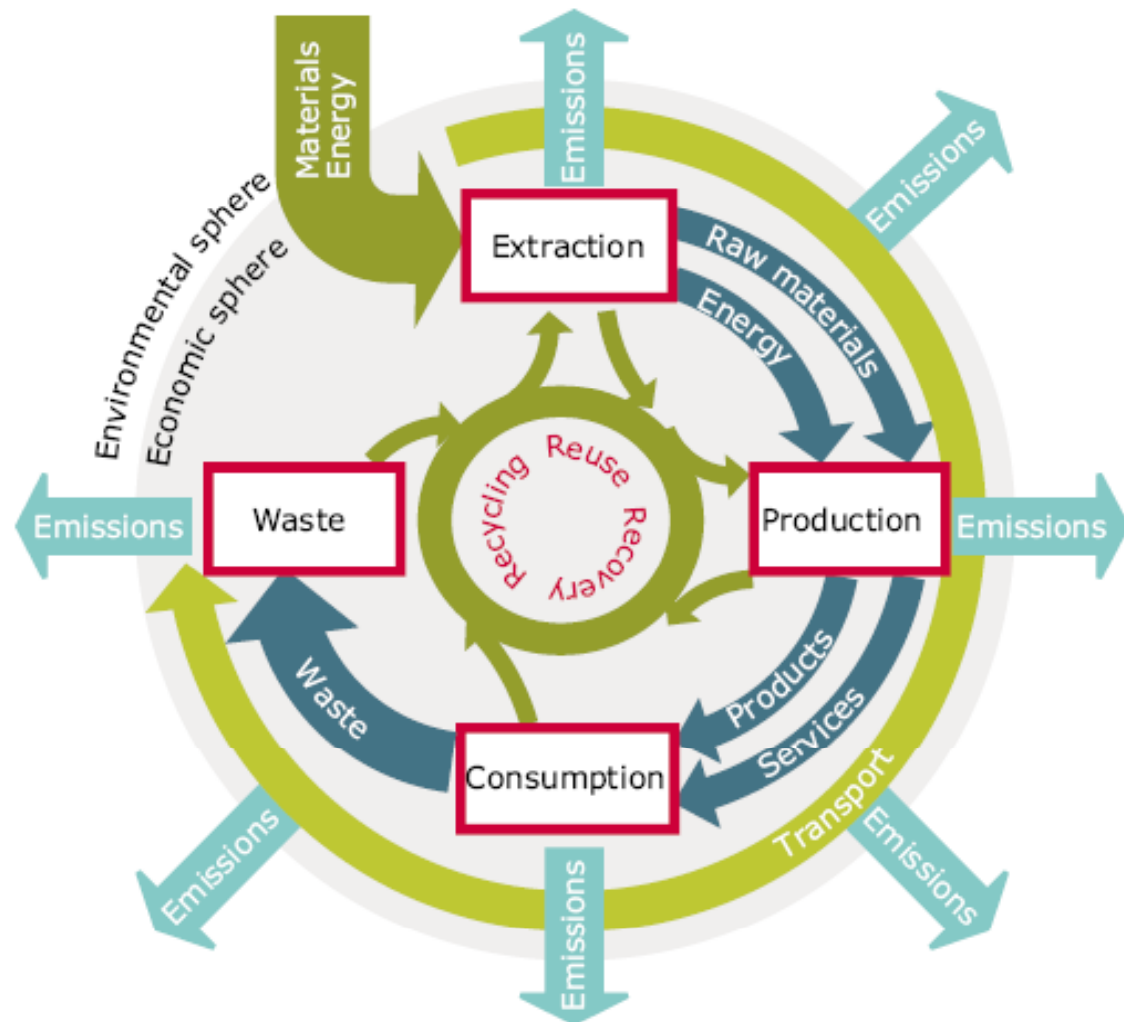
transportation of the material during its manufacture and delivery to site



degree of pollution resulting from the material at the end of its useful life

Life cycle approach

- Life-cycle chain:
 - extraction
 - production
 - consumption
 - waste



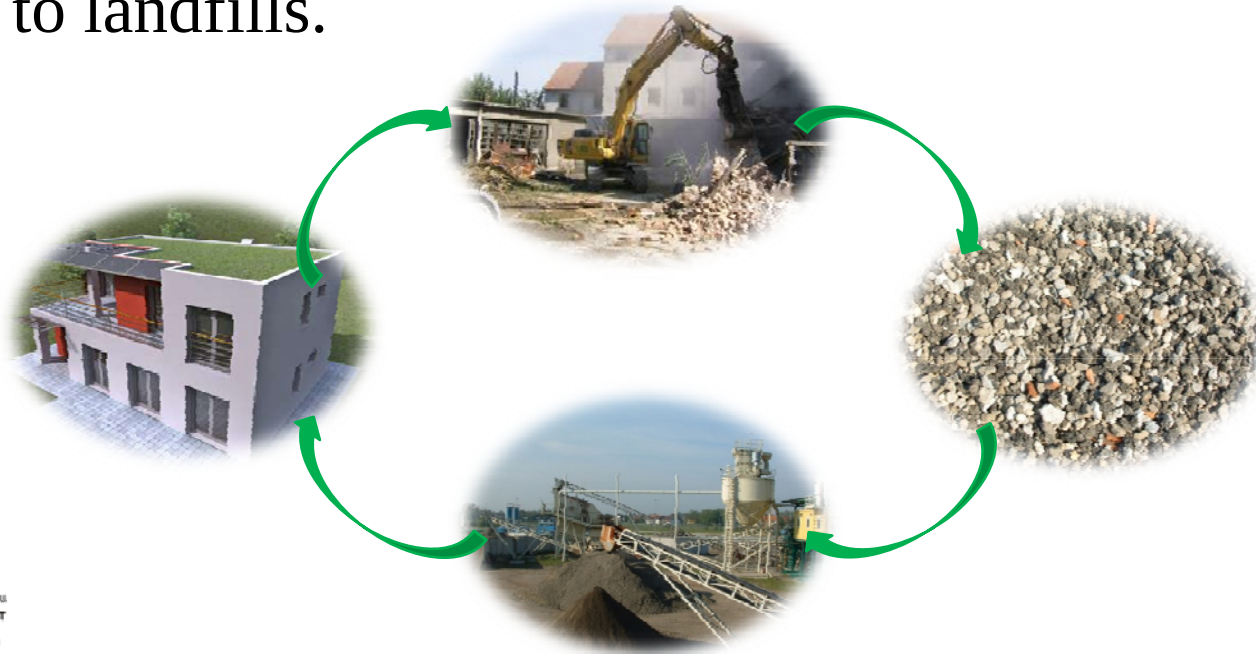
Life cycle approach

- Waste recycling (and waste prevention) is closely linked to material use.
- Depending on material used in construction you will influence sustainability of the building
 - much of the material is sooner or later turned into waste



Waste materials or resources?

- Waste is **increasingly seen as a production resource** and a source of energy.
- Use of recycled materials with post-consumer content that originates from a previous use, that would otherwise be diverted to landfills.



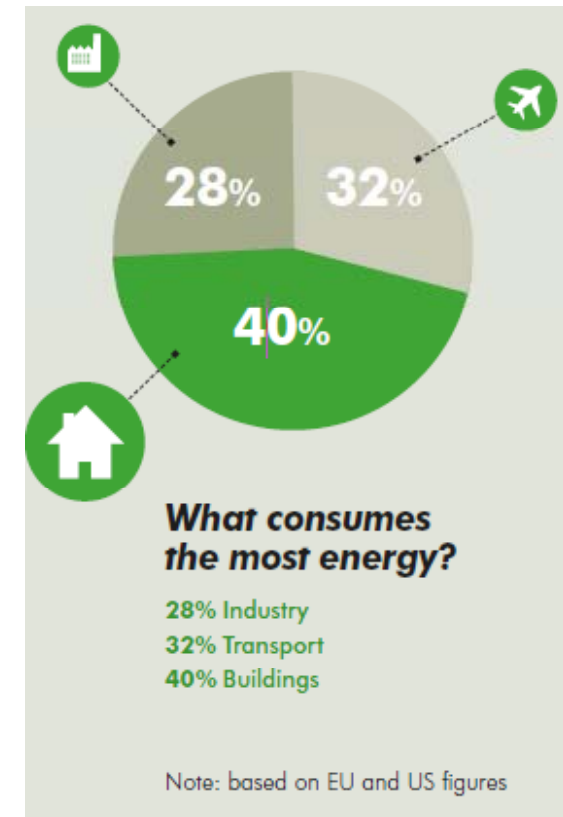
Energy efficiency

- **Energy efficiency and environmental stewardship complement each other**
- No matter how you look at it, permanently reducing the volume of fuels and kWh used reduces the total raw fuel inputs
- Reducing fossil fuel combustion ultimately reduces air pollution.



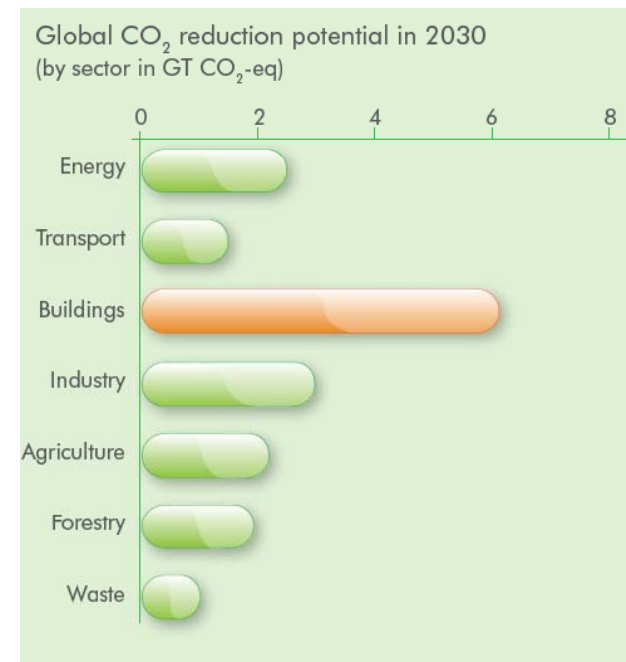
Reducing energy-in-use requirements

- *Buildings and energy: impossible to ignore!*
- Whilst supporting non-fossil based energy is important, the **huge saving potential from buildings** needs to be recognized and acted upon.



Reducing energy-in-use requirements

- Since buildings consume so much, the savings opportunities are huge!
 - **equivalent of 3.3 million barrels of oil** a day could be saved for the European Union alone or
 - the equivalent energy that would be saved by **taking 230 million cars** off the roads in Europe.



Insulation of building elements

- The cost of reducing energy use is low and the benefits are extensive.
- Simple solutions such as insulation exist today and are simply waiting on the shelf to be deployed.
 - Insulation can cut energy use and thus carbon dioxide emissions from existing buildings by a third and more...



The best energy is saved energy

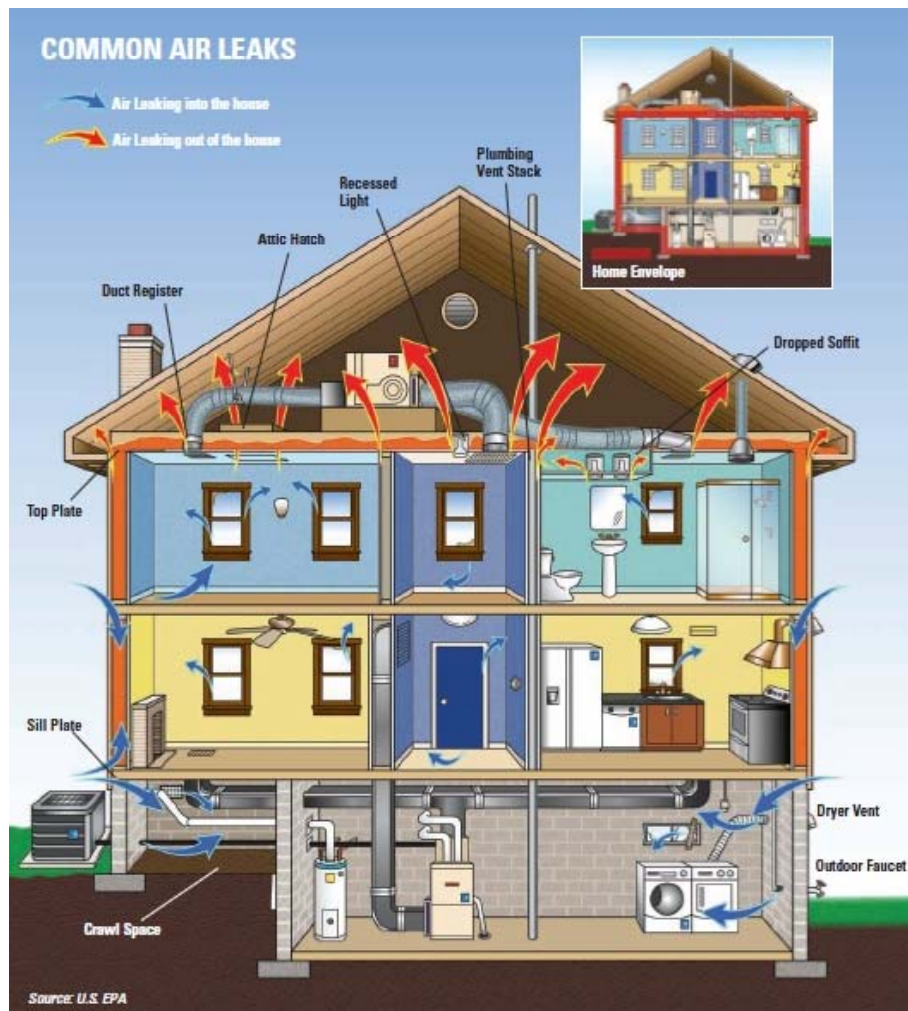


Details – Leakages

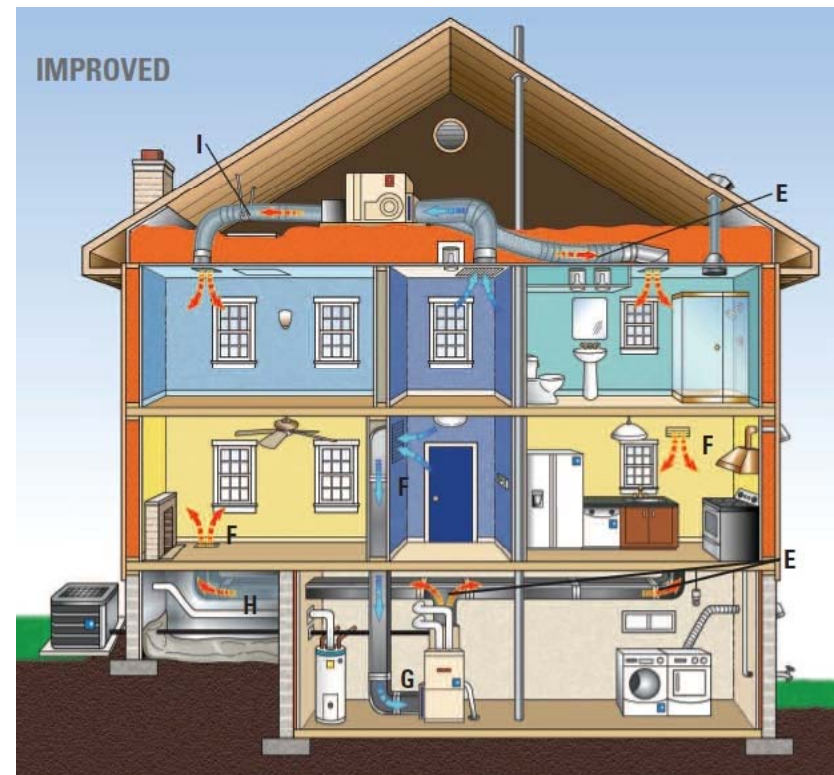
- Especially important is conducting testing during the construction process, before its completion
- Proving the absence of leakages through building elements



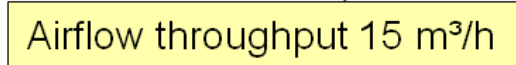
Air permeability



- By sealing, reduce the unwanted heat losses and optimize technical system

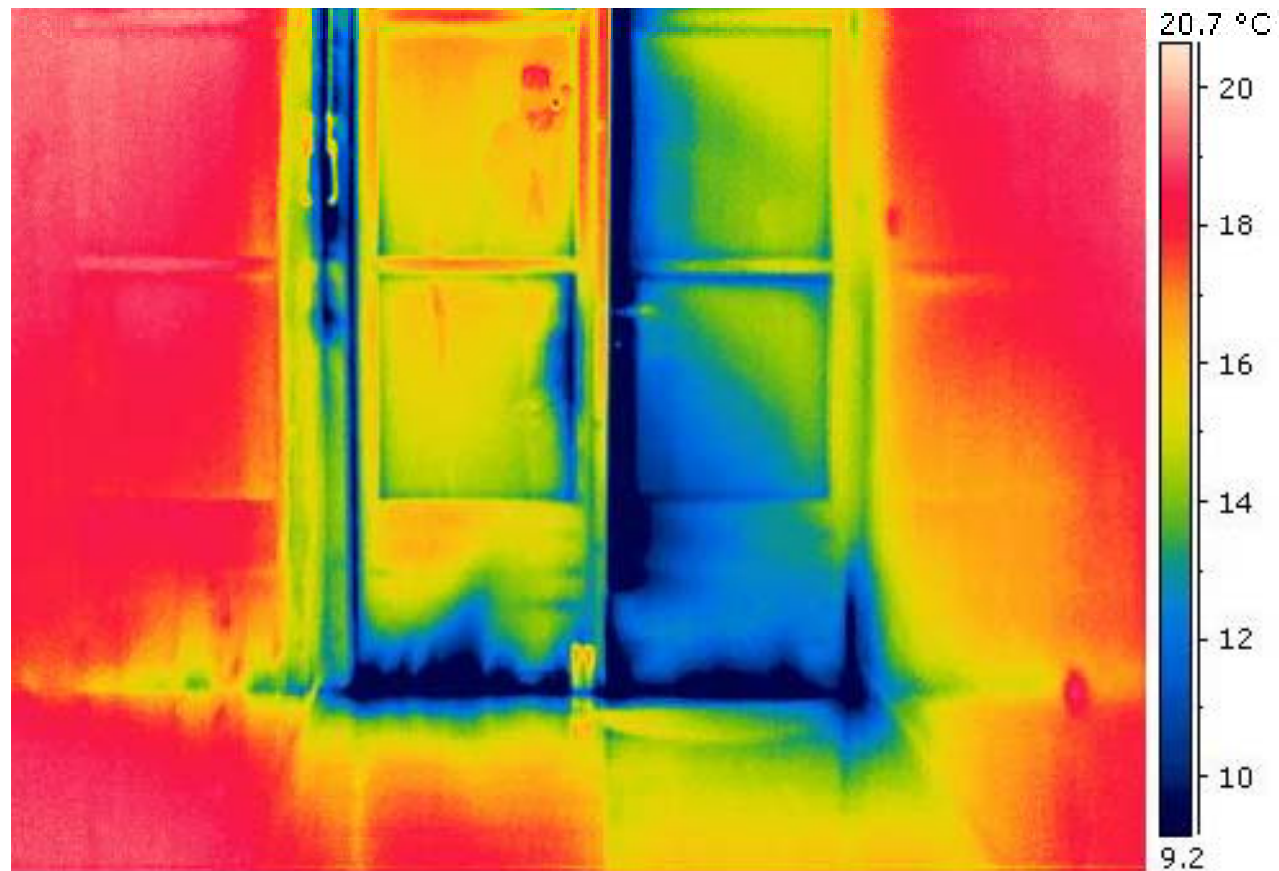


- Calculation nomogram for air flow through leakages

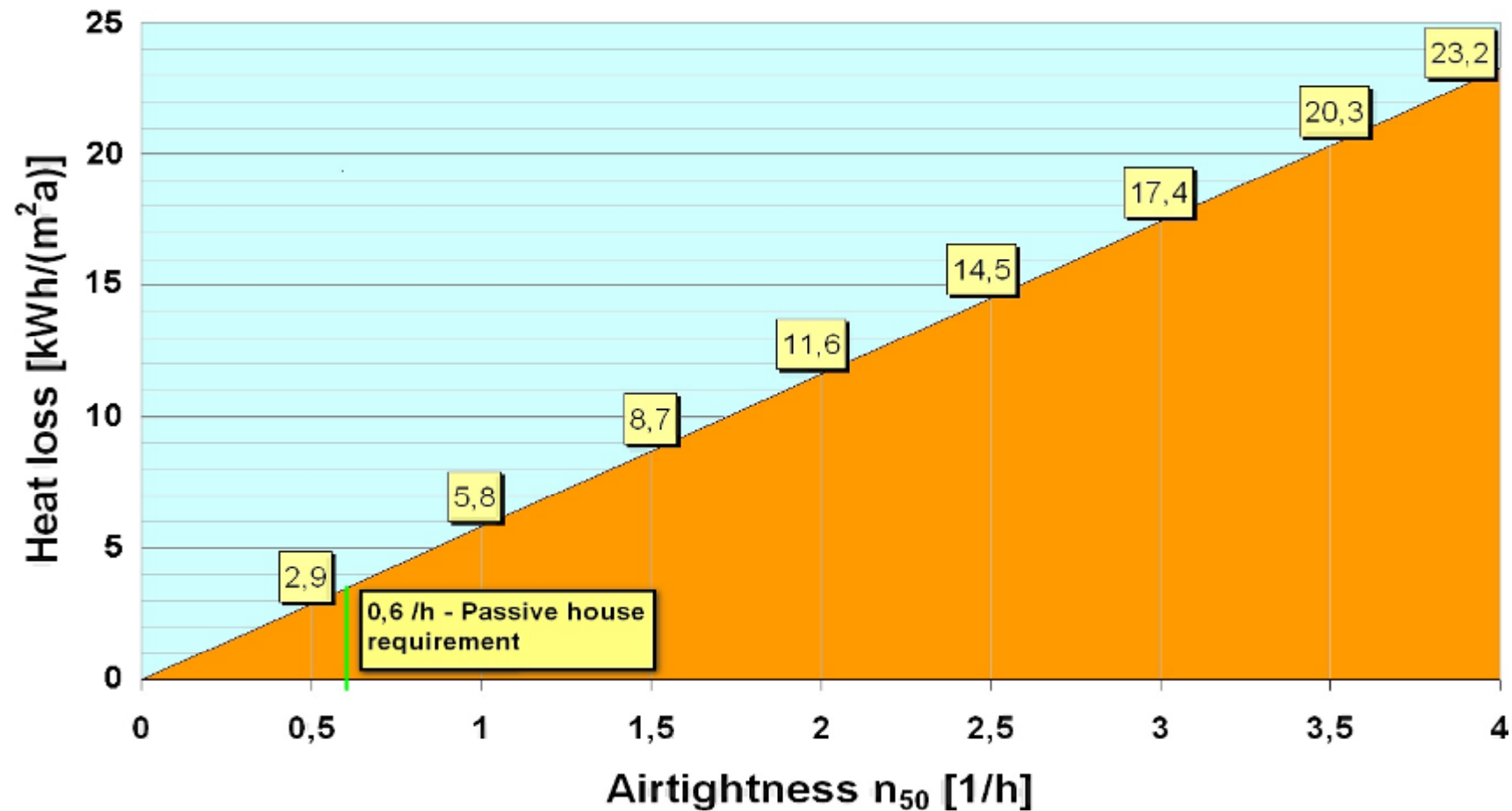


Air permeability

- Unsealed doors...



Air permeability of buildings - motivation:



Infrared thermography

- *“A picture is worth a thousand words”*

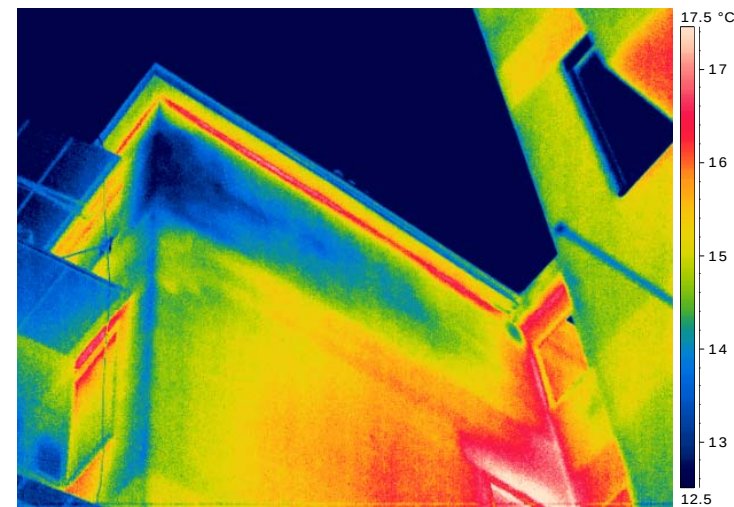


Use of IR testing in buildings

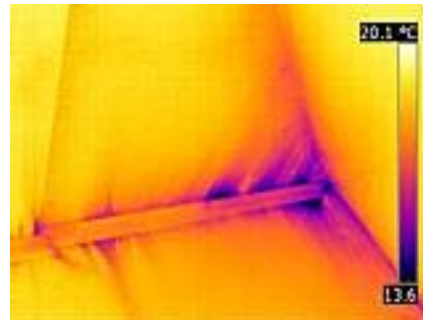
- Thermal bridges



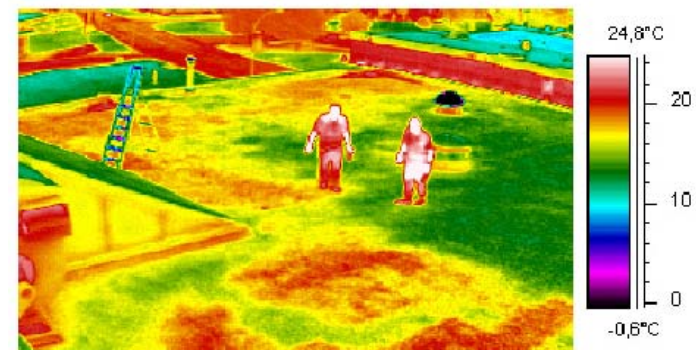
- Insufficient or poor insulation



- Cold air infiltration



- Moisture



Conclusions



- The benefits of “green building” - sustainable building



Conclusion

- In order to sustain:
 - untouched nature,
 - vivid history and
 - cultural identity,
- As one of the most beautiful countries in the world.





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Thank You for Your attention!



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