Session 3: Systemic approaches to policy setting and related standards developments

Practical illustration of the concept of a systemic approach: **Energy efficient buildings**

Ir. Dick (H.A.L.) van Dijk
Prof. Dr. Essam E. Khalil

About the authors

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Senior scientist
at TNO Research organisation, The Netherlands
Responsible for Dutch overall energy code since 1990's. Coordination / participation international (EU, IEA) research projects and standardization activities (CEN, ISO) in the field of energy in buildings.

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Since 1995 responsible for national energy code and energy performance of buildings in Egypt (→ Arab Energy Code). Fellow of ASHRAE, ASME and AIAA. Contributed to more than 550 published papers and 11 books in English

The authors are co-convenors of
ISO/TC 163/WG 4 (joint TC 163 – TC 205 WG)
Energy Performance of Buildings using holistic approach

Content

Dick van Dijk:

1. Time line
2. Principle
3. Today: the pyramid
4. Under construction: Detailed modular structure
(the ISO 52000-52150 series)

Essam E. Khalil:

5. Global relevance
6. Importance of energy efficient and comfortable buildings
7. Examples new technologies

Time line

1980

2000

2020

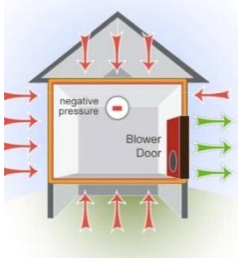
Bldng envelope & components

Bldng heating needs

Energy use for heating and cooling

Overall building energy performance

Energy producing built environment



Unique international cooperation

2000 2010 2020

CEN/TC 89, Thermal performance of buildings and building components

ISO/TC 163, Thermal performance and energy use in the built environment

ISO JOINT WORKING GROUP
Energy Performance of Buildings using holistic approach (ISO/TC 163/WG 4)

CEN/TC 371, Project Committee on Energy Performance of Buildings

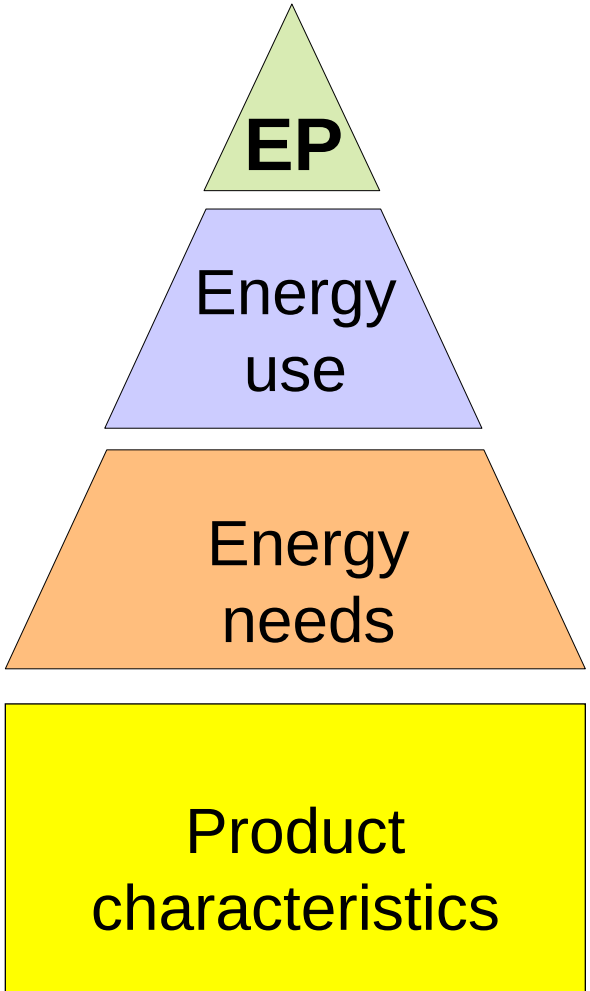
ISO/TC 205, Building environment design

ASHRAE standards

This is a simplified presentation!!

Principle

EP: Building Overall Energy Performance

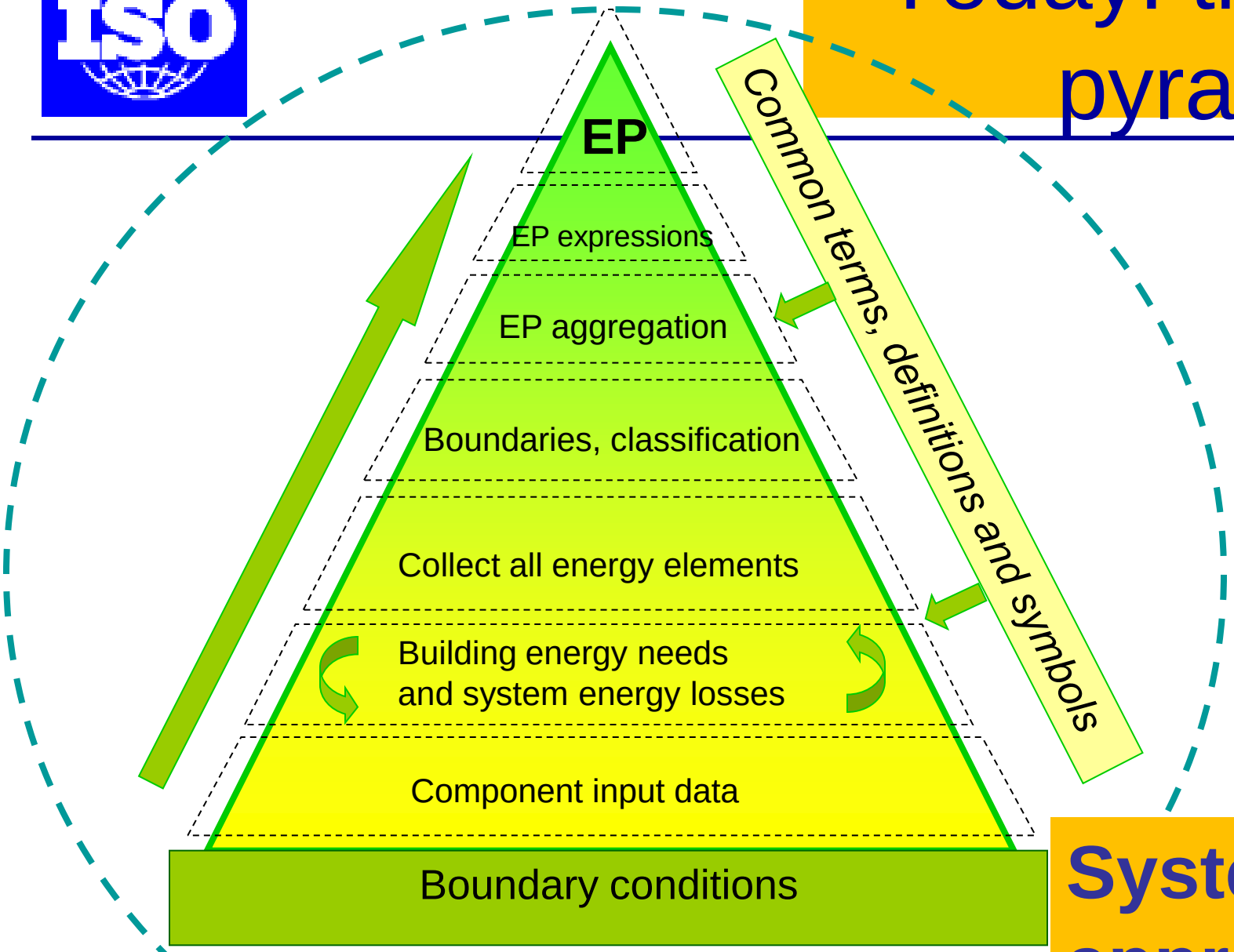


From product standards to overall energy use
incl. technical building systems

Product is not longer evaluated as a product but as part of a system

Maintain the links between product testing and system evaluation

Today: think pyramid

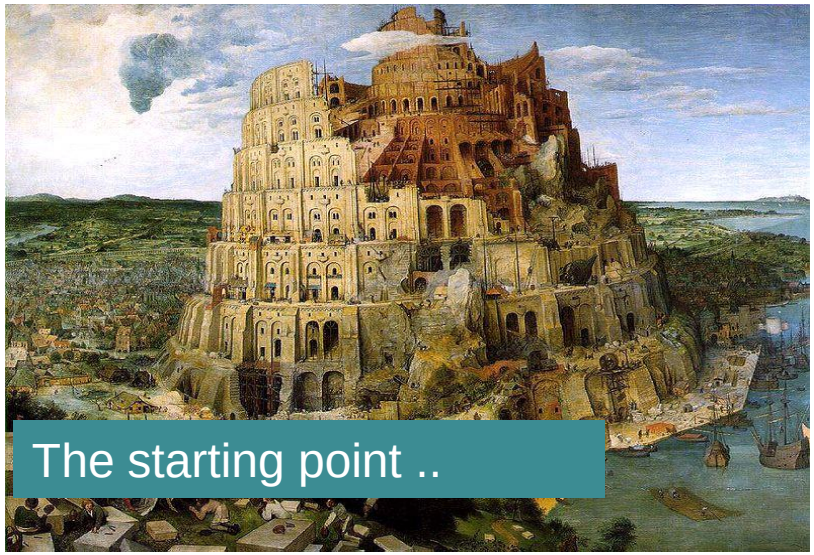


Systemic approach

First set of key ISO standards published (1)

ISO/TR 16344:2012

Energy performance of buildings -- Common terms, definitions and symbols for the overall energy performance rating and certification



The starting point ..

A few hundred harmonized terms, definitions, symbols, ..

2.1.56
energy inspection
examinati… …ems in a building

…ned area

e…gy performance of a building
calculated or measured amount of weighted net delivered energy actually
needs associated with a standardised use of a building, which may includ
cooling, ventilation, domestic hot water and lighting

2.1.59
energy rating
evaluation of the energy performance of a building based on the weighted
use of energy carriers

The result …

First set of key standards published (2)

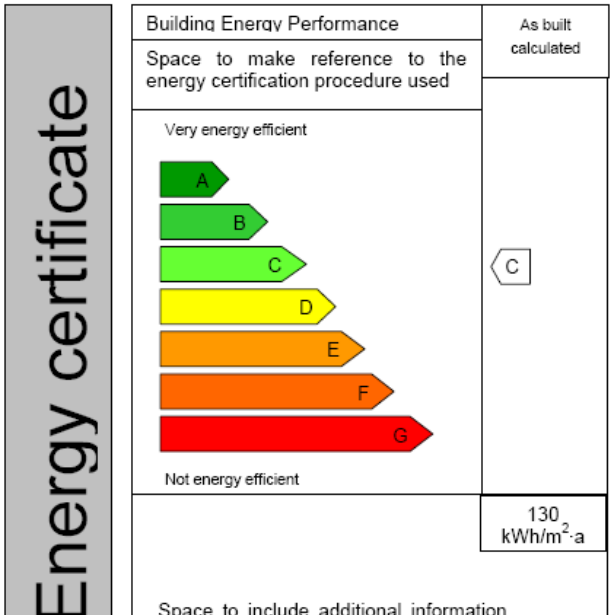
ISO 16346:2013

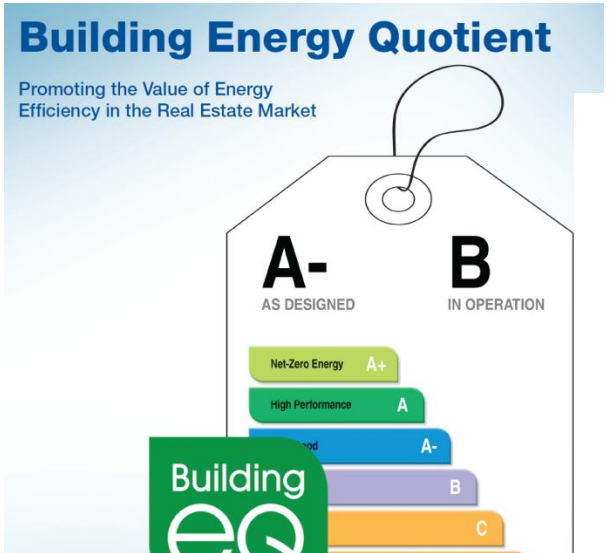
Energy performance of buildings -- Assessment of overall energy performance

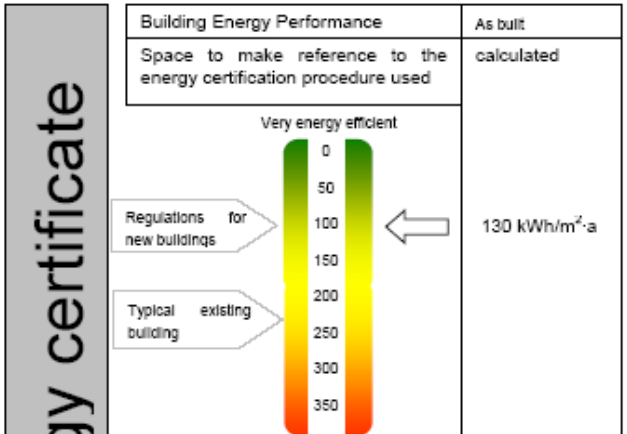
First set of key ISO standards published (3)

ISO 16343:2013

Energy performance of buildings -- Methods for expressing energy performance and for energy certification of buildings

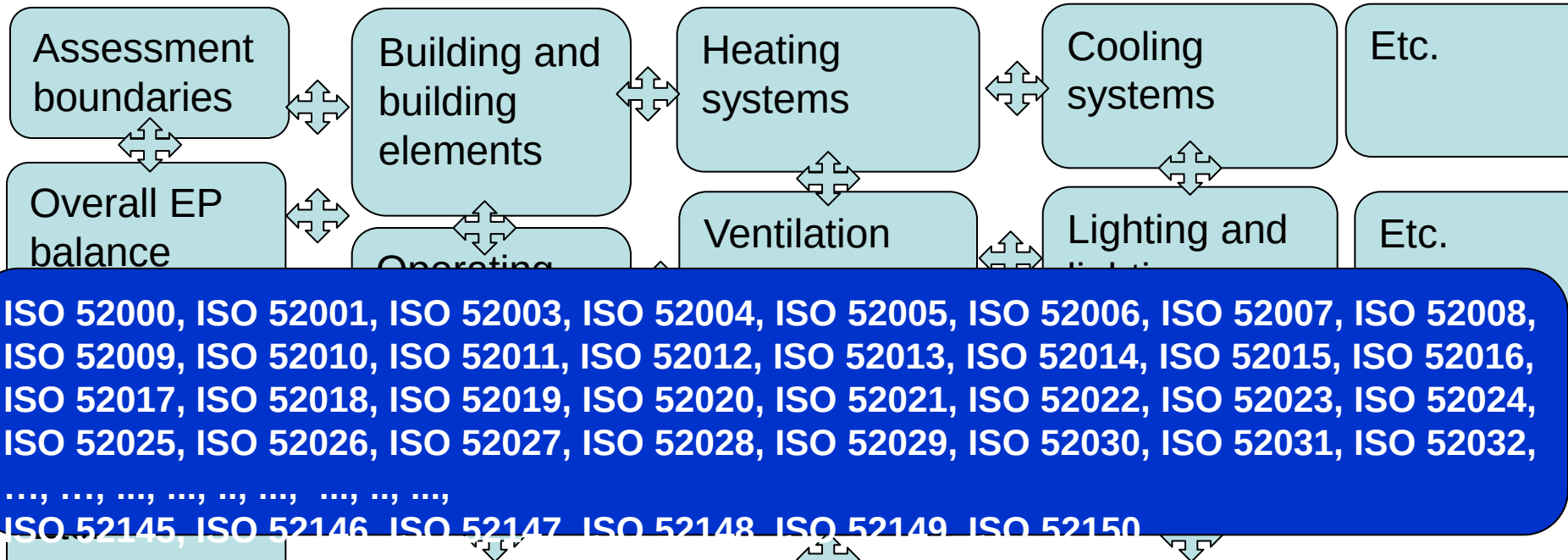






Under construction

- **Overarching modular EP assessment**
  - In collaboration with other international initiatives (2014-2017)
  - With standards (eventually > hundred) for overarching aspects, individual systems and components



Many aspects involved (1)

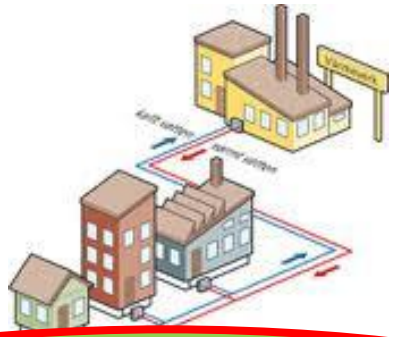
Zero Energy Buildings!!

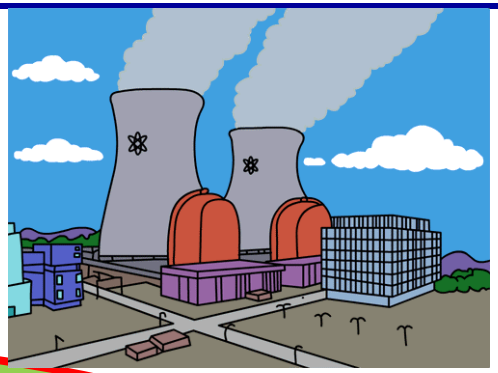
Large commercial buildings

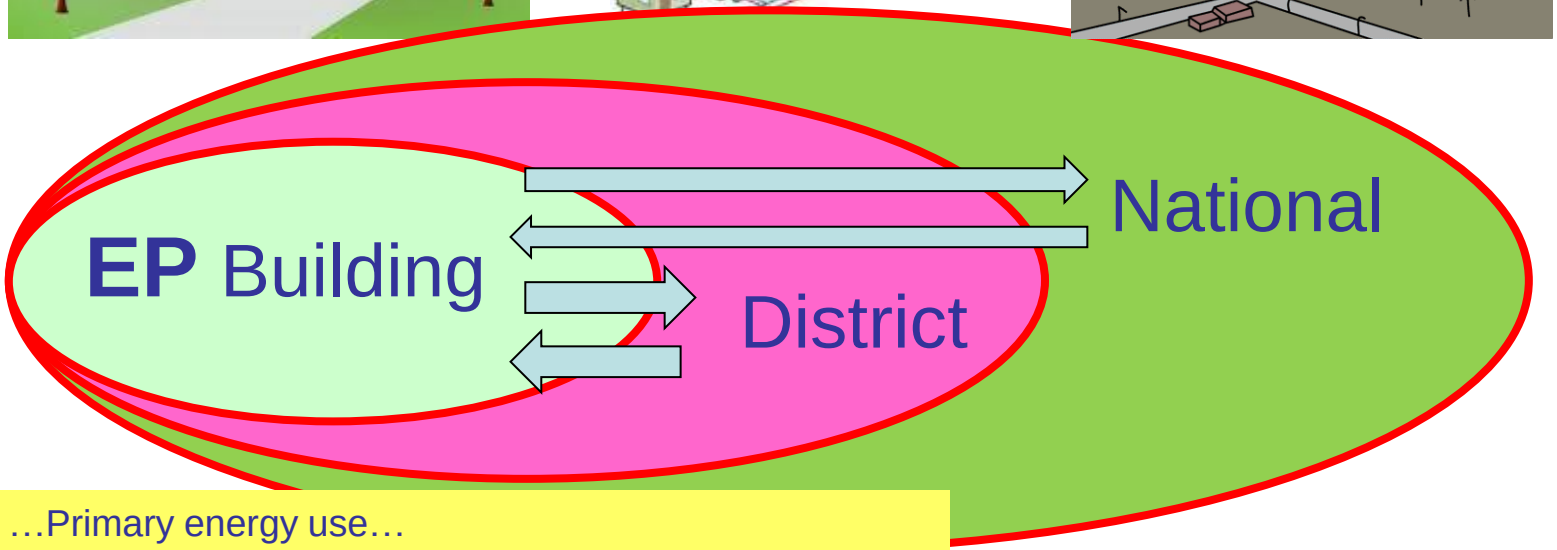
Single family houses

Existing building stock!!

Many aspects involved (2)







- …Primary energy use…
- …Renewable energy produced on site…
- …Energy producing buildings…
- …Energy neutral built environment…
- …Etc.

ISO 52000
ISO 52001
ISO 52003
ISO 52004
ISO 52005
ISO 52006
ISO 52007
ISO 52008
ISO 52009
ISO 52010
ISO 52011
ISO 52012
ISO 52013
…
ISO 52143
ISO 52144
ISO 52145
ISO 52146
ISO 52147
ISO 52148

Content

Prof. Dr.Essam E. Khalil:

5.Global relevance

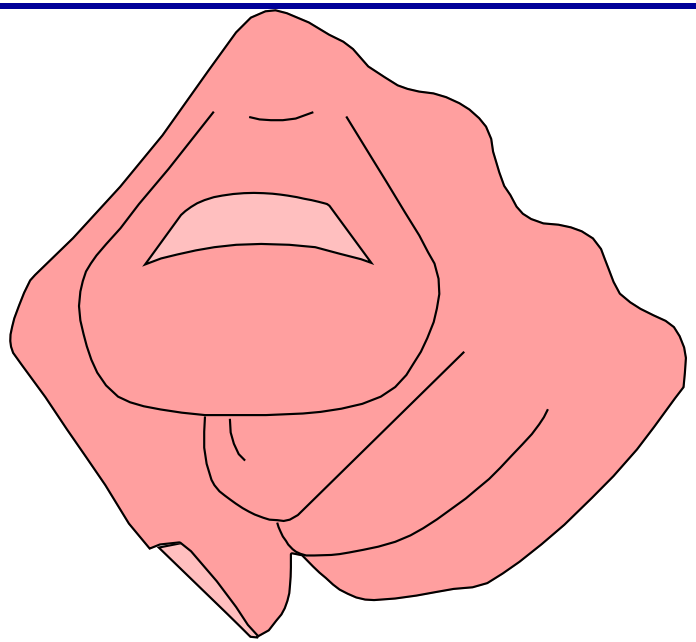
6.Importance of energy efficient and comf buildings

7.Examples new technologies

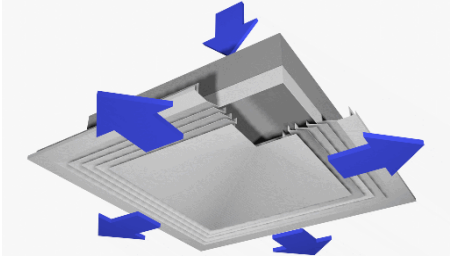
OUR GOAL

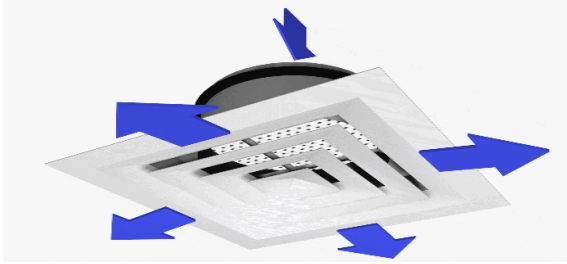
Our Task is to keep these lungs full with fresh air and comfortable by removing excessive humidity and to provide adequate amount of air at the conditions in which for health humans the lungs, and frequently the heart and lungs, are able to sufficiently oxygenate the blood and body tissue. Often, the ability to excrete CO2 as well.

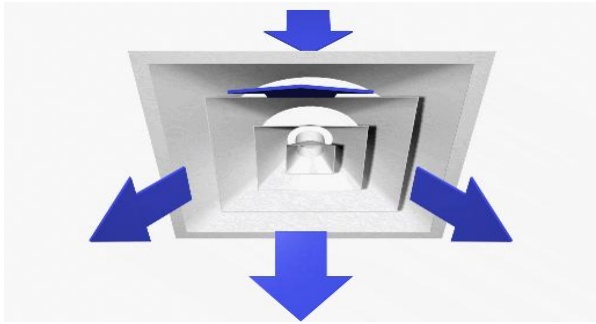
Can we make a difference?

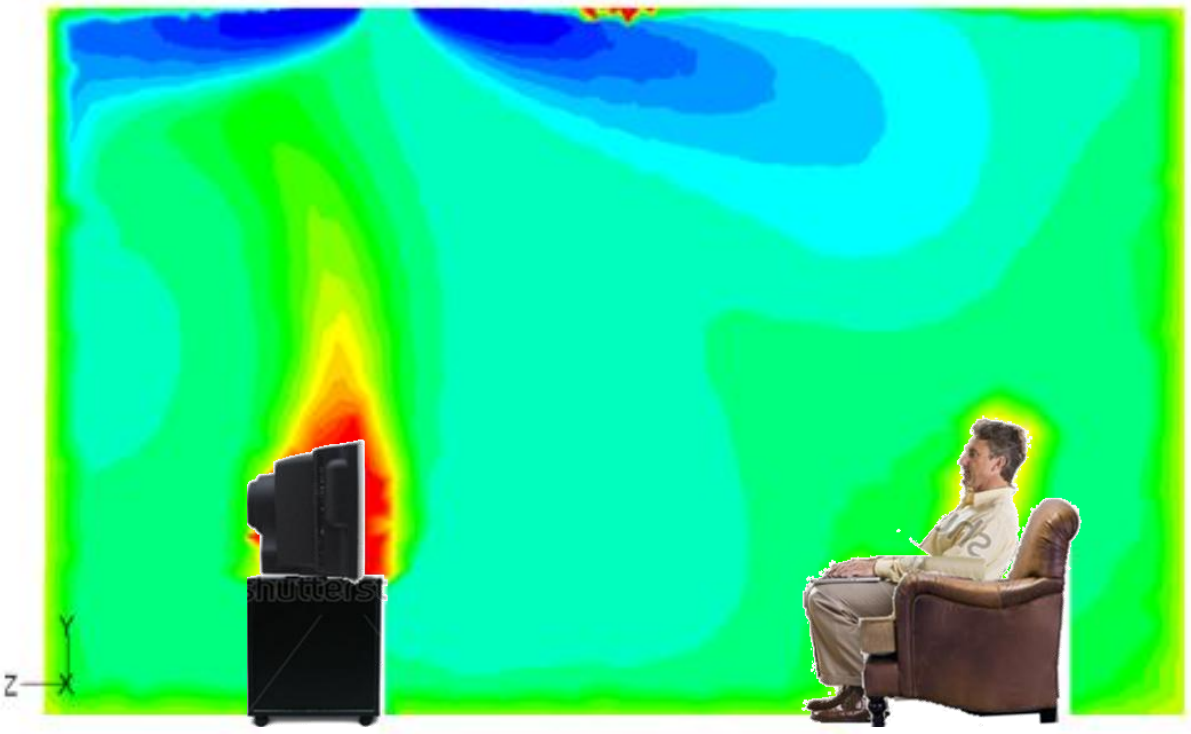


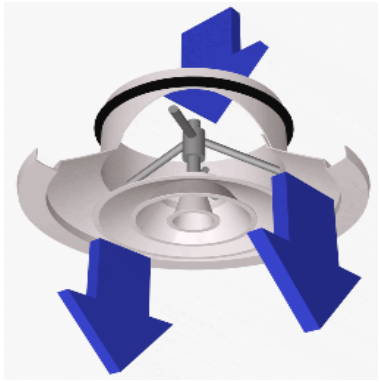
- Yes





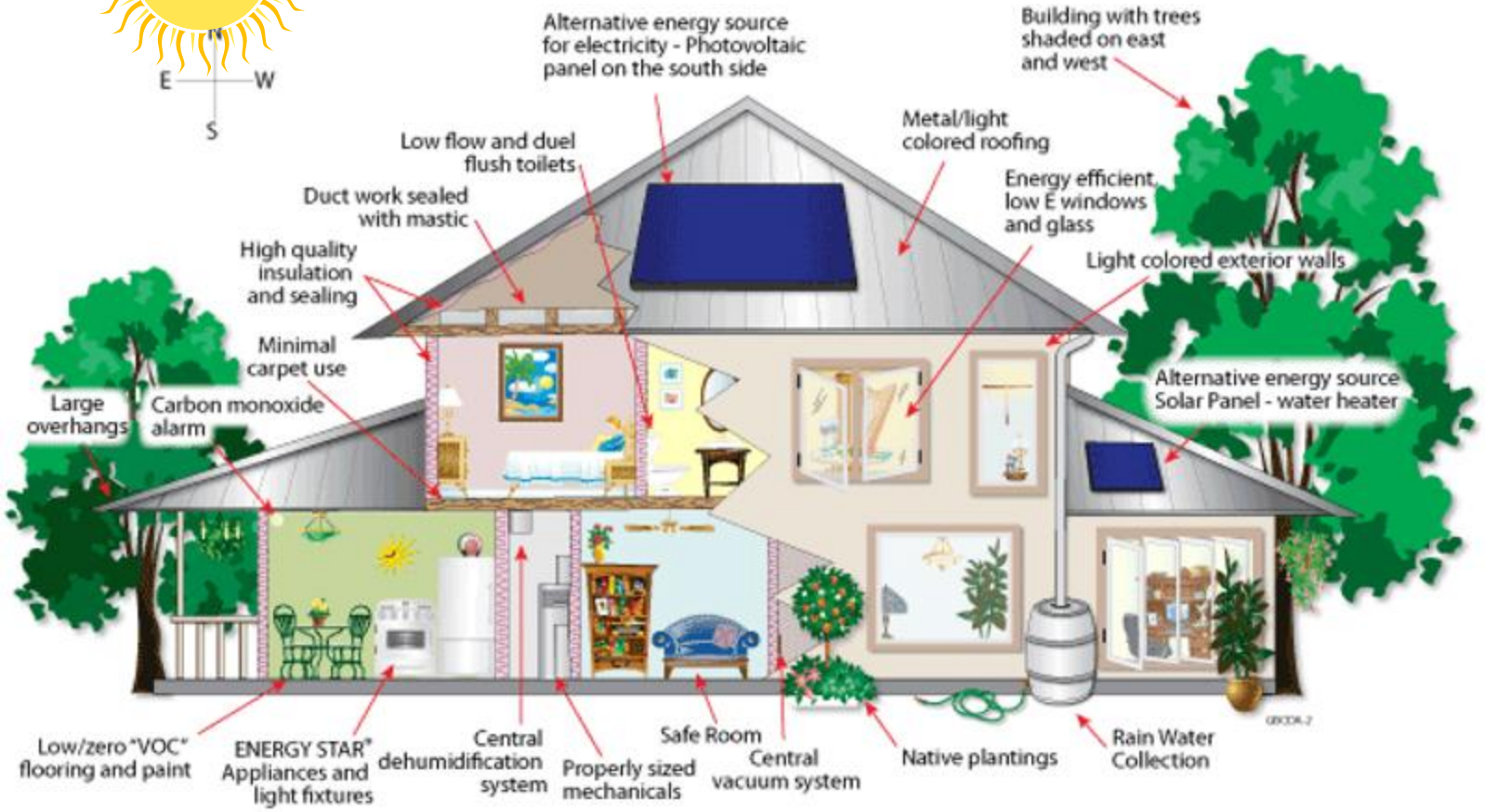


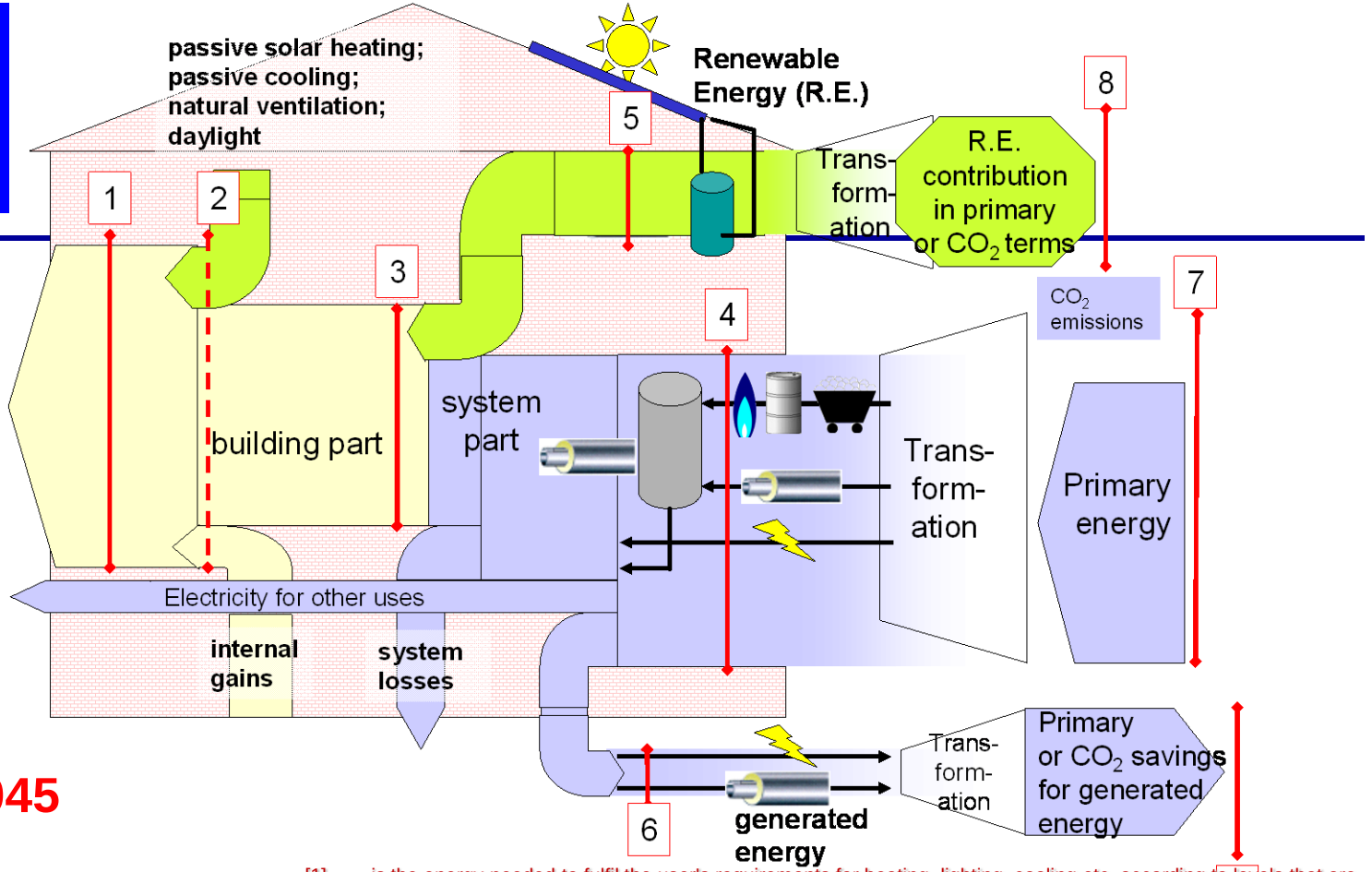




Air Distribution in Living Environment

What is Green Building





ISO 23045

Key to symbols

electricity

gas, oil, coal, biomass, etc.

heat, cold

[1] is the energy needed to fulfil the user's requirements for heating, lighting, cooling etc, according to levels that are specified for the purposes of the calculation.

[2] is the "natural" energy gains – passive solar, ventilation cooling, delighting, etc. together with internal gains (occupants, lighting, electrical equipment, etc) these "gains" reduce energy demand in winter season but increase energy demand in summer season

[3] is the building's net energy use, obtained from ref.[1] and [2] along with the characteristics of the building itself. (in winter season [2] is lower than [1] but in summer [2]is greater than [1])

[4] is the delivered energy, represented separately for each energy carrier, inclusive of auxiliary energy, used by heating, cooling, ventilation, hot water and lighting systems, taking into account renewable energy sources and co-generation. This may be expressed in energy units or in units of the energyware (kg, m³, kWh, etc).

[5] is renewable energy produced on the building premises.

[6] is generated energy, produced on the premises and exported to the market; this can include part of [5].

[7] represents the primary energy usage or the CO2 emissions associated with the building.

[8] represents the primary energy or emissions associated with on-site generation that is used on-site and so is not subtracted from [7].

[9] represents the primary energy or CO2 saving associated with exported energy, which is subtracted from [7].

What can we use to balance the whole Building

Passive Systems - Free - Maximize

- Fabric
- Thermal mass - heat store heat regulation
- Insulation preventing heat loss
- Natural ventilation
- Daylight - lighting and solar gain

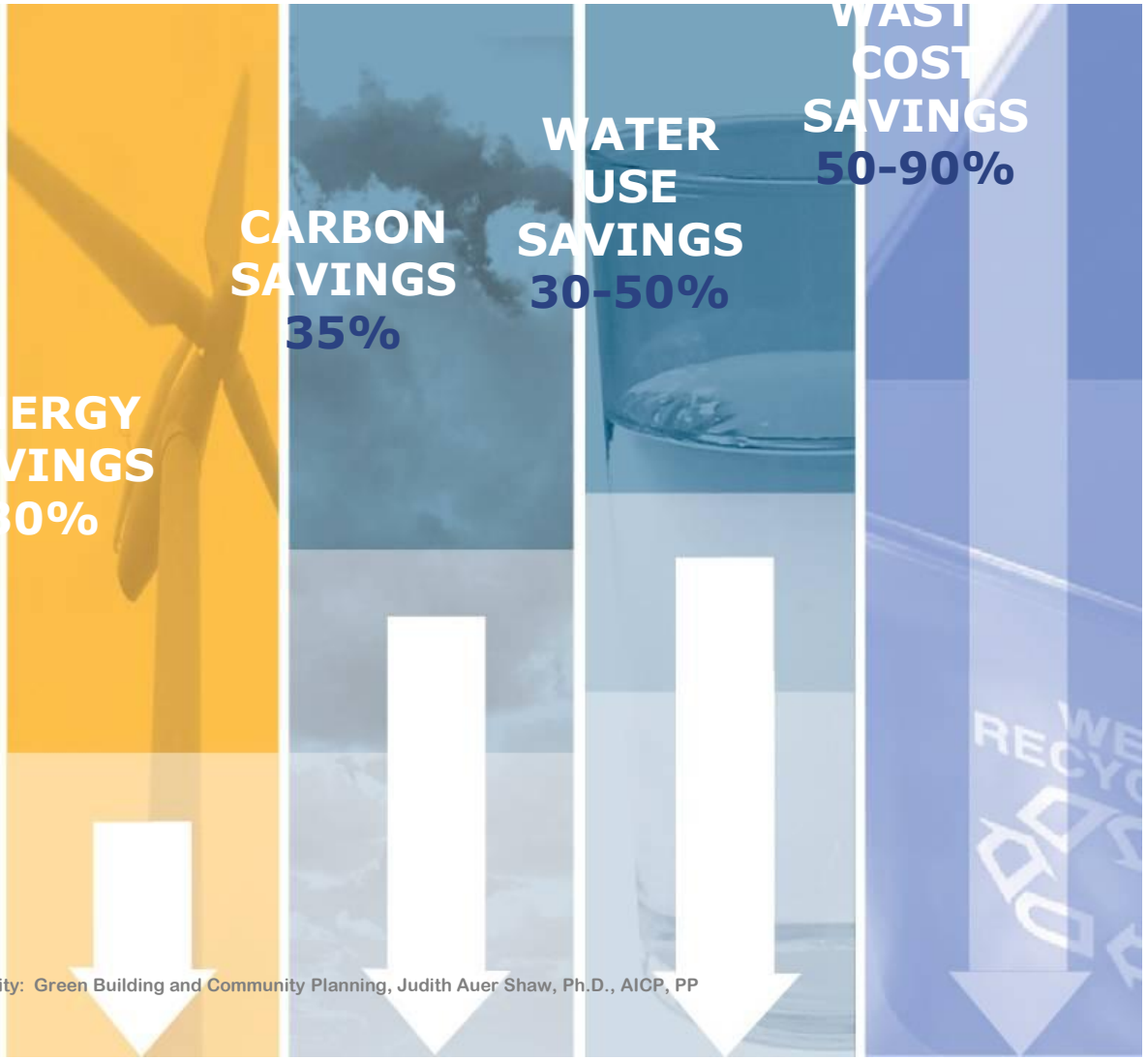
Active Systems - Energy/CO2 input - Minimize

- Heating
- Artificial light
- Ventilation
- Cooling

Renewable energy *should* helps

Benefits of Green Building

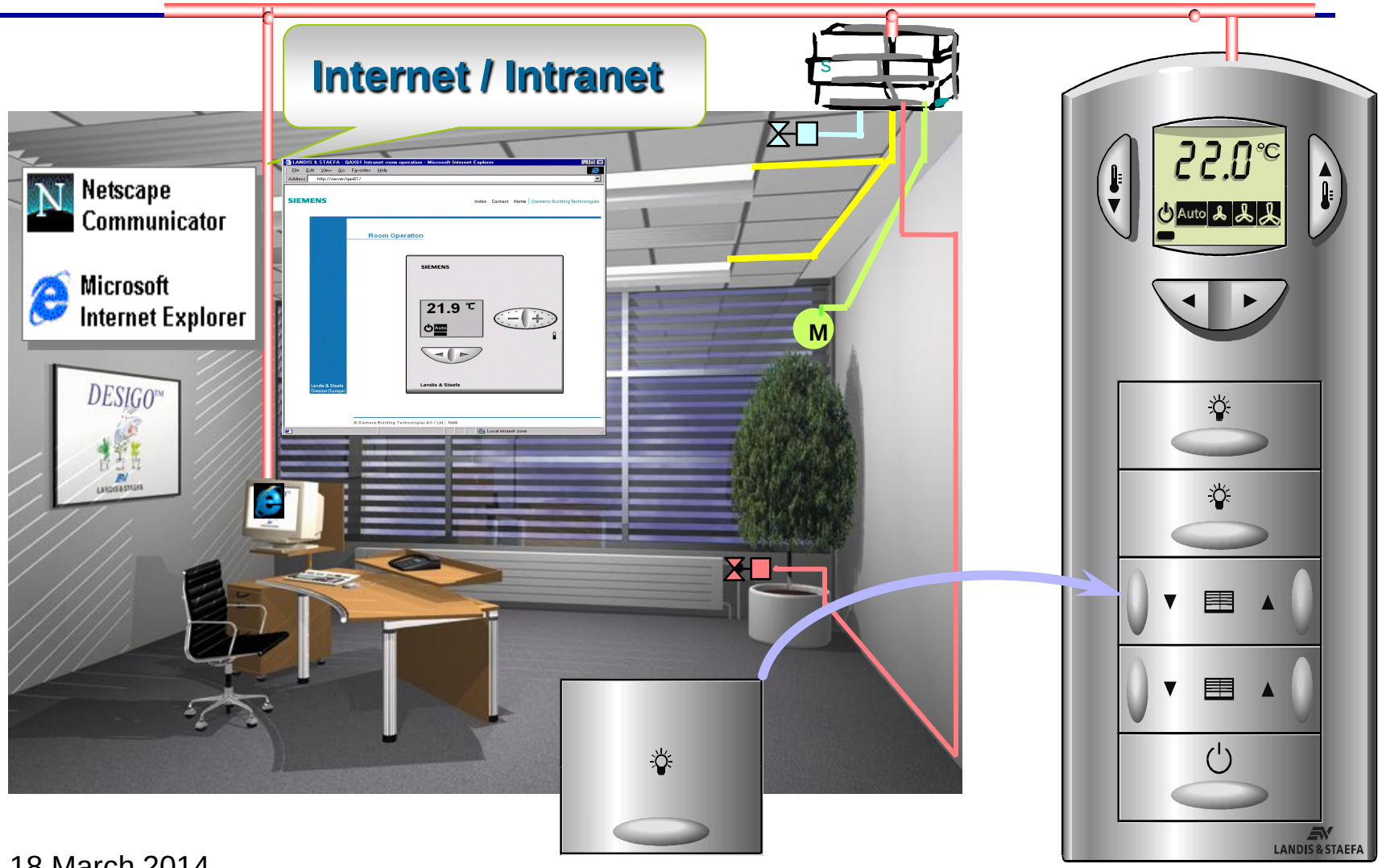
Average Savings of Green Buildings



Buildings Rating System Categories

Category 1	Sustainable Site, Accessibility and Ecology
Category 2	Energy Efficiency
Category 3	Water Efficiency
Category 4	Materials & Resources
Category 5	Indoor Environmental Quality
Category 6	Management
Category 7	Innovation and and Added Value

Integrated Room Automation



Green ICT Goals

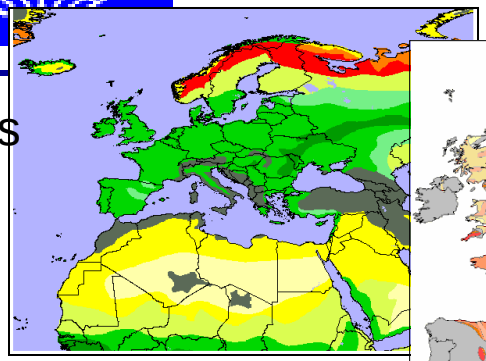
Reducing the use of hazardous materials

Maximizing energy efficiency during the product's lifetime, and

Promoting recyclability or biodegradability of defunct products and factory waste.

Use of ICT technologies with reducing all resources

Biomass



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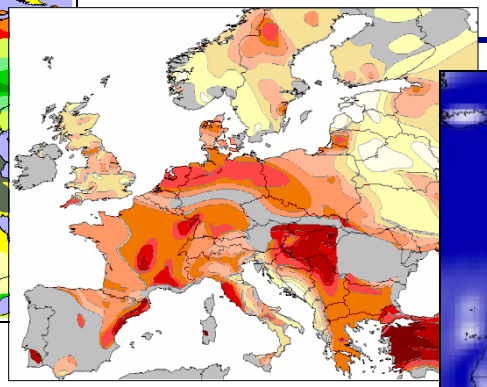
Geothermal Energy



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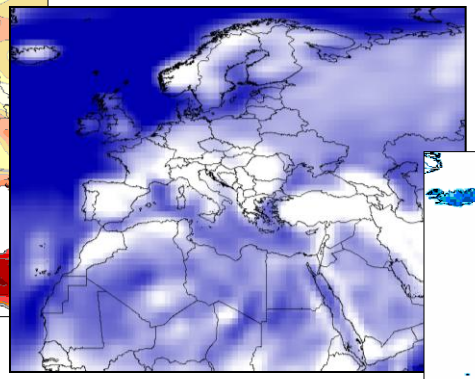
Wind Energy



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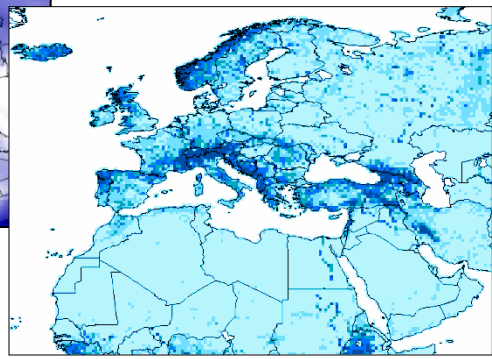
Hydropower



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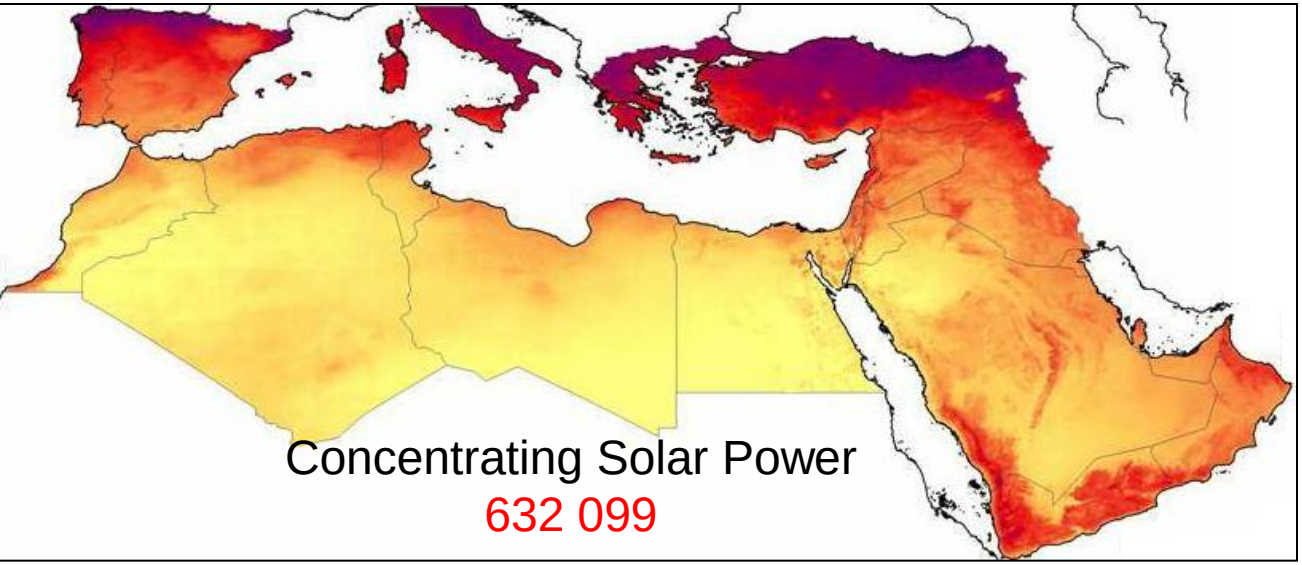
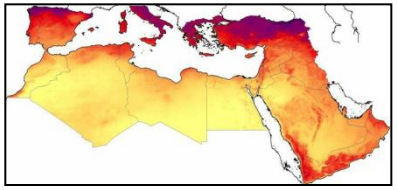
Economic Potential TWh/y
(Demand 2050 ≈ 4000 TWh/y)



Concentrating Solar Power
632 099

PV



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What next

Energy, Buildings and the Environment

Energy Flows To and From Buildings

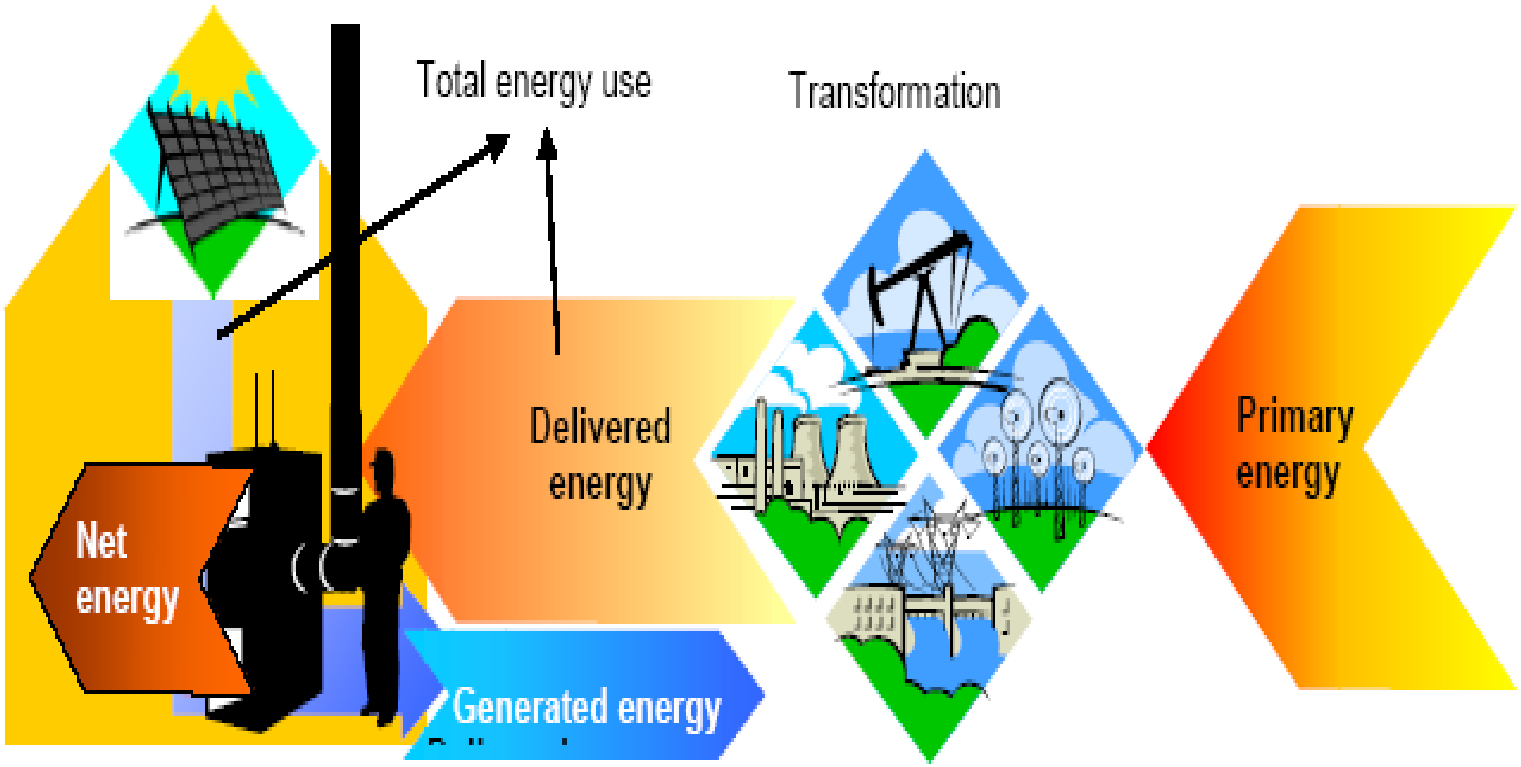
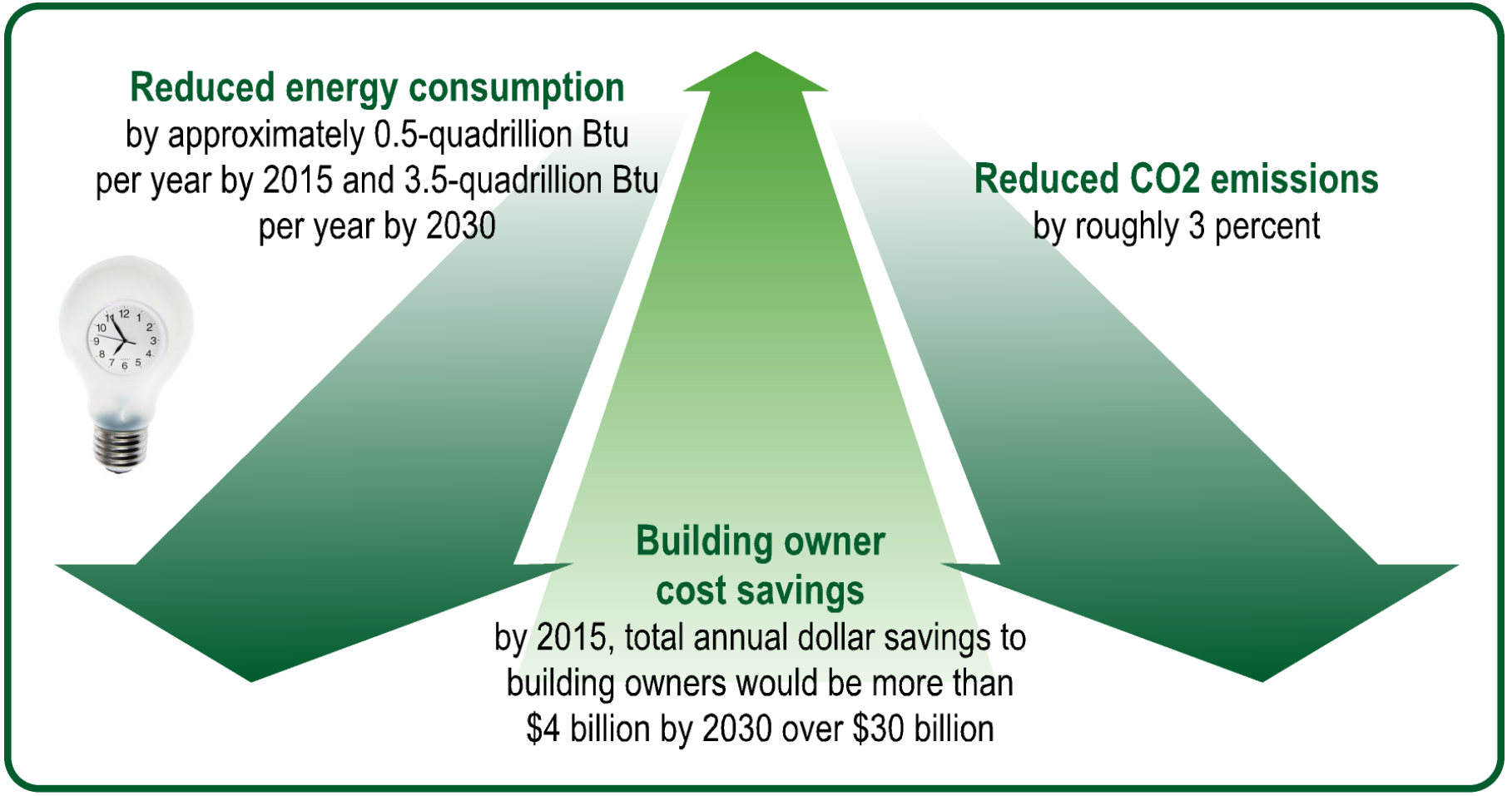


Figure 1 — Energy flows to and from buildings

Code benefits and challenges



Building envelope

Local climate plays a role in the energy code requirements for the material selection and techniques used to construct the building envelope. Code requirements specify the insulation levels in the floor, ceiling, and walls and are intended to seal the building against air leakage and moisture migration. The defined energy-efficiency levels of doors and windows take into consideration heat loss and gain, depending on whether heating or cooling of the building is the predominant concern, and daylighting. Designers and contractors must make sure that the building materials and installation are completed as specified for the building to comply with the code.

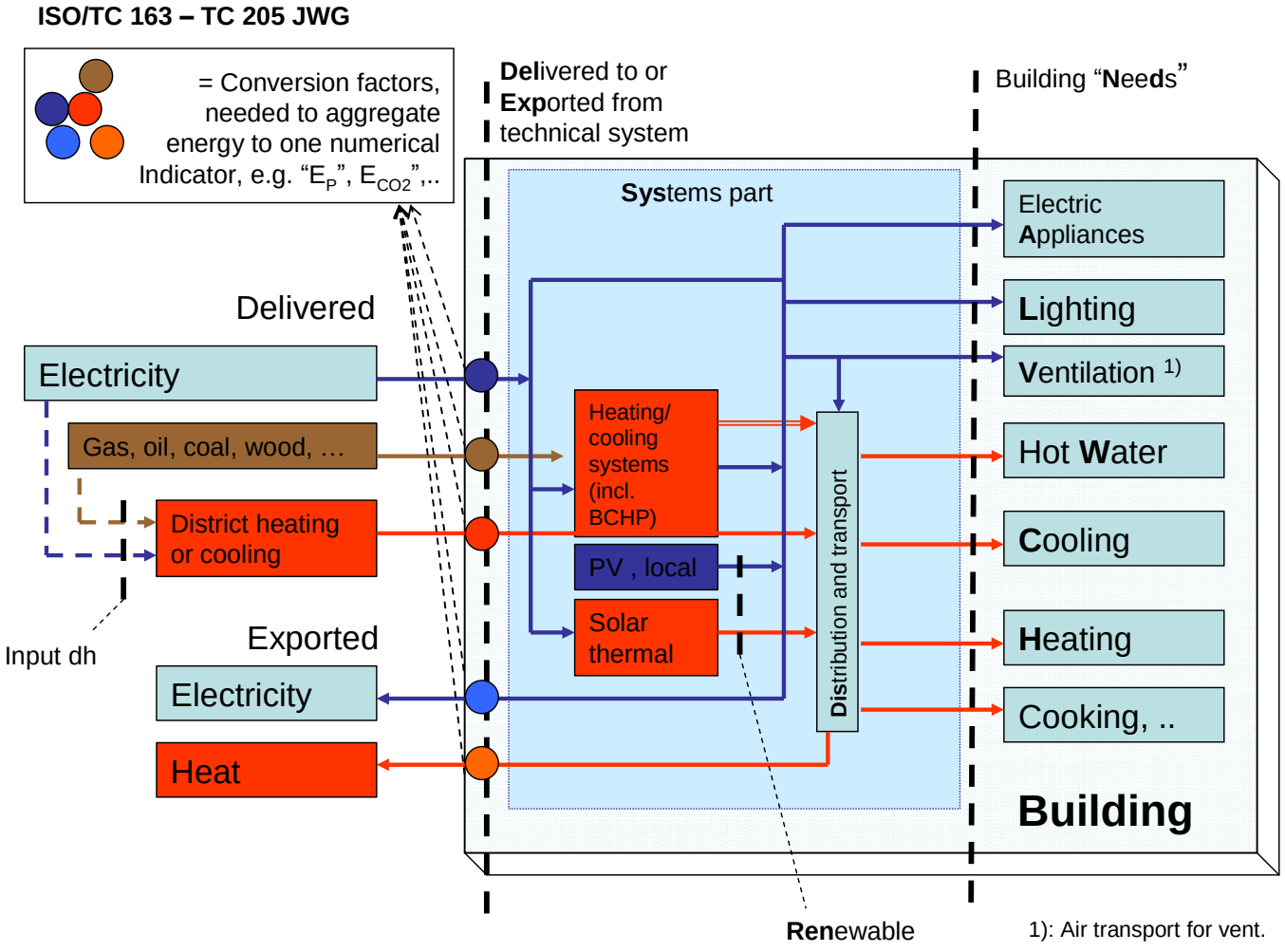
Heating, ventilating, and cooling

HVAC systems are composed of equipment that creates conditioned air or tempered liquid, conveys air or liquid through passageways (ducts and plenums) or pipes, and automatically regulates the amount to be conveyed via recirculation or exhausting. HVAC system efficiency can be improved by adding equipment that can convert delivered gas or electric power efficiently or by using economizers, which allow the automatic use of outside air or allow users to regulate space conditions. Energy codes provide minimum criteria for the size of HVAC systems and equipment, taking into consideration the energy demands of the building space.

Lighting and electrical

Energy efficiency for lighting is gained by using efficient sources of illumination, considering the number and location of lights throughout the space, and considering the control systems for appropriate operation. The energy codes provide minimum criteria to provide effective lighting control.

Motor and transformer efficiency is also covered in this area

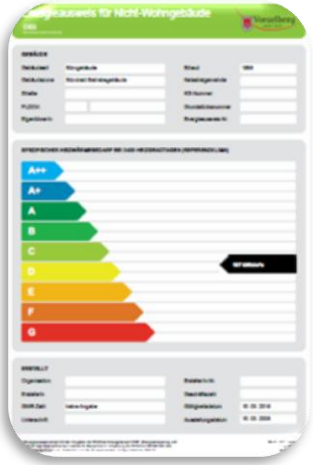


Needed Energy Standards

What's Your Building EQ

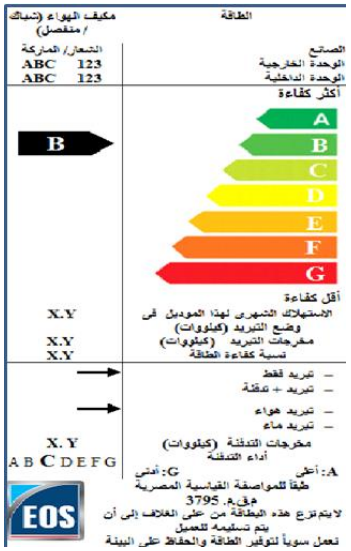
Building Energy Quotient
ASHRAE's Building Energy Labeling Program

AUSTRIA

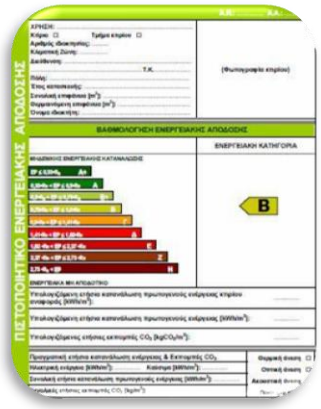


ITALY

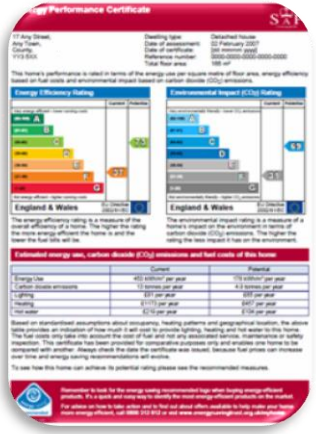
EGYPT

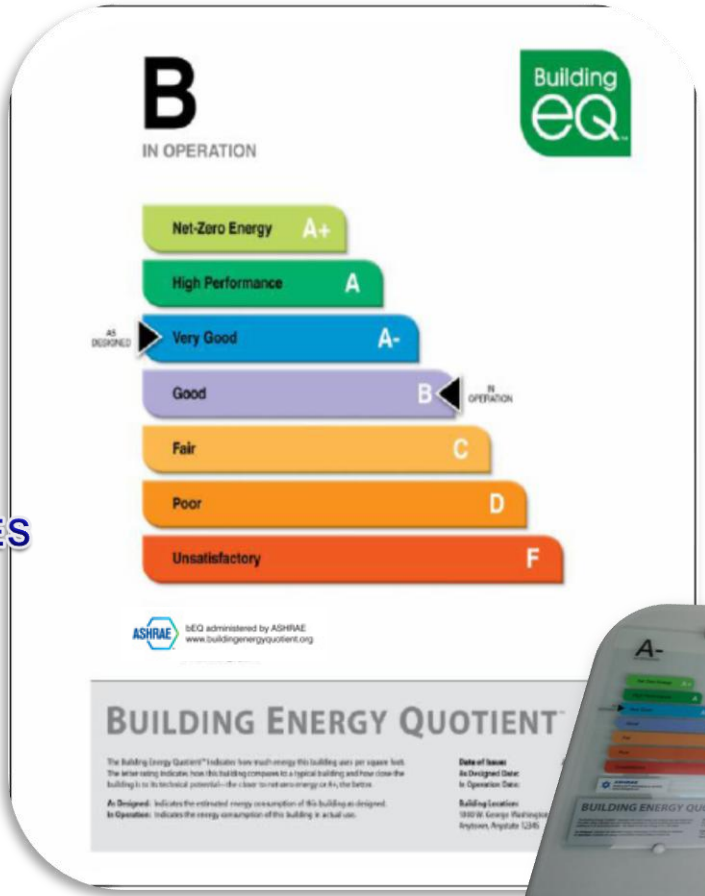


GREECE

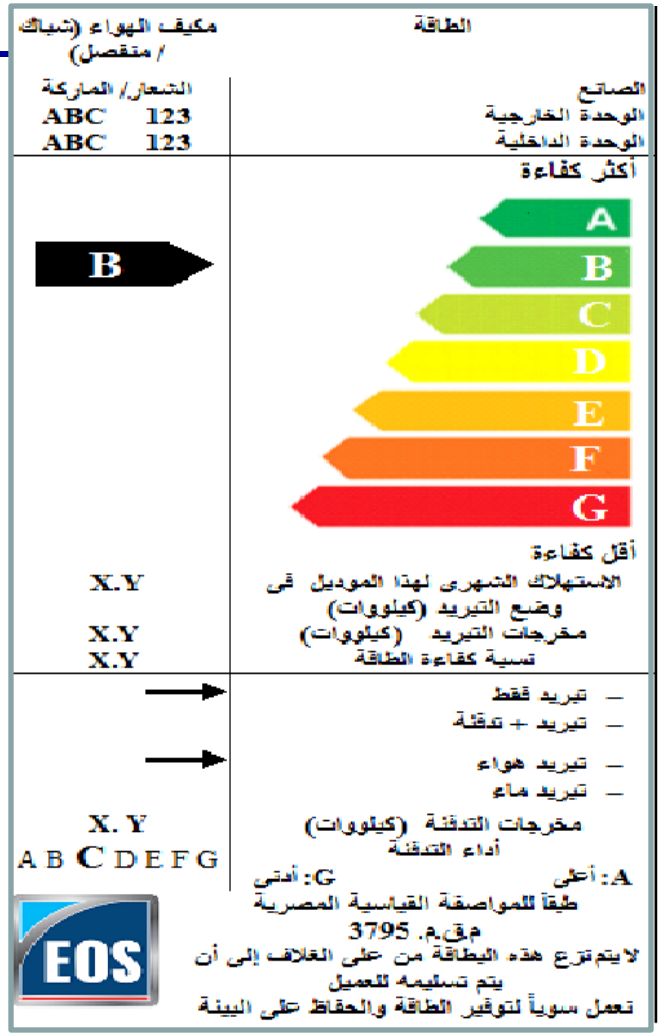


ENGLAND & WALES





مستويات نسبه كفاءه الطاقه	نسبة كفاءة الطاقة لمكيف هواء الغرفة (المنفصل)
A	أعلى من أو تساوى 12
B	أعلى من أو تساوى 11.5 وأقل من 12
C	أعلى من أو تساوى 11 وأقل من 11.5
D	أعلى من أو تساوى 10.5 وأقل من 11
E	أعلى من أو تساوى 10 وأقل من 10.5
F	أعلى من أو تساوى 9.5 وأقل من 10
G	أعلى من أو تساوى 9 وأقل من 9.5



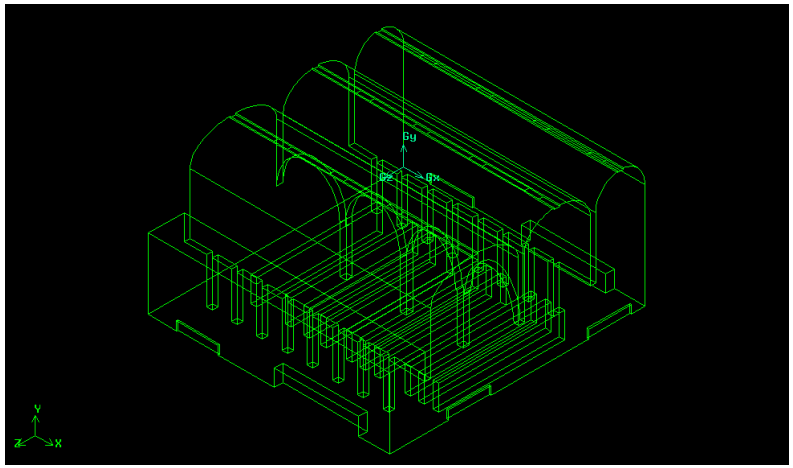
Egypt -2014

نموذج لمكيف هواء الغرفة (تبريد فقط) 2014

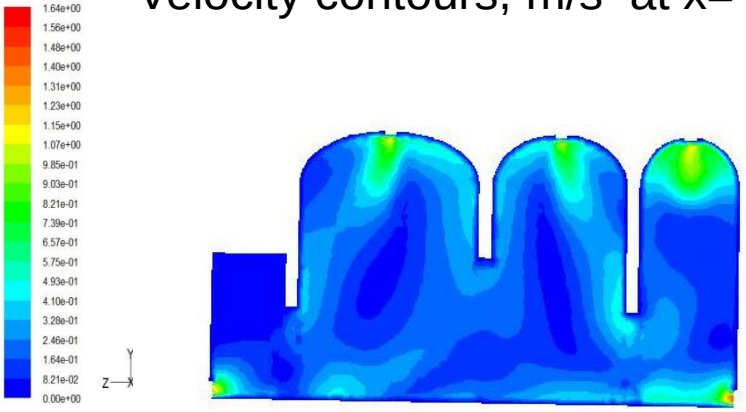
Numerical Model

Tomb Architecture, KV62:

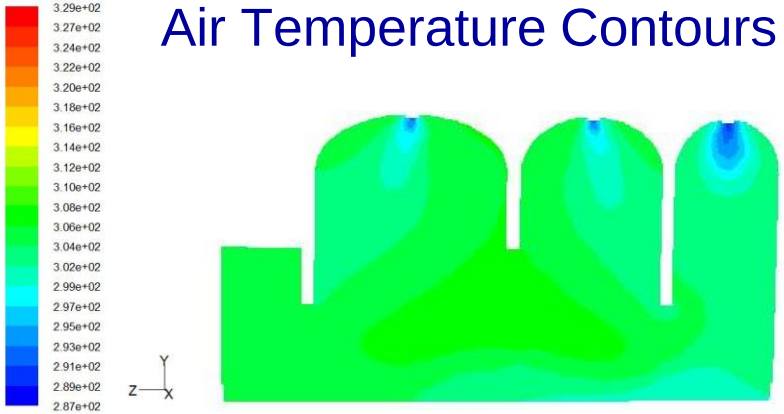
Christ Church (Hanging Church)
St Mary's Orthodox Church , Cairo



Velocity contours, m/s at x= 4 m

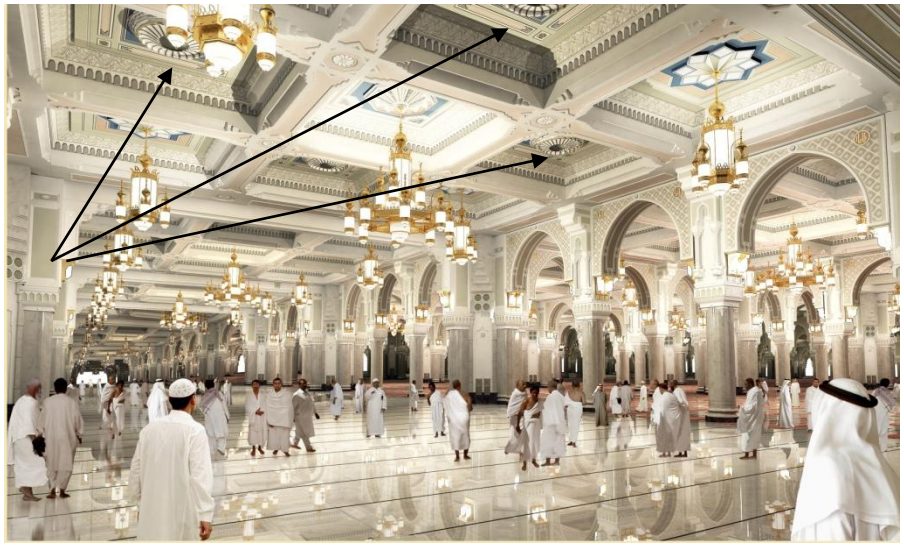


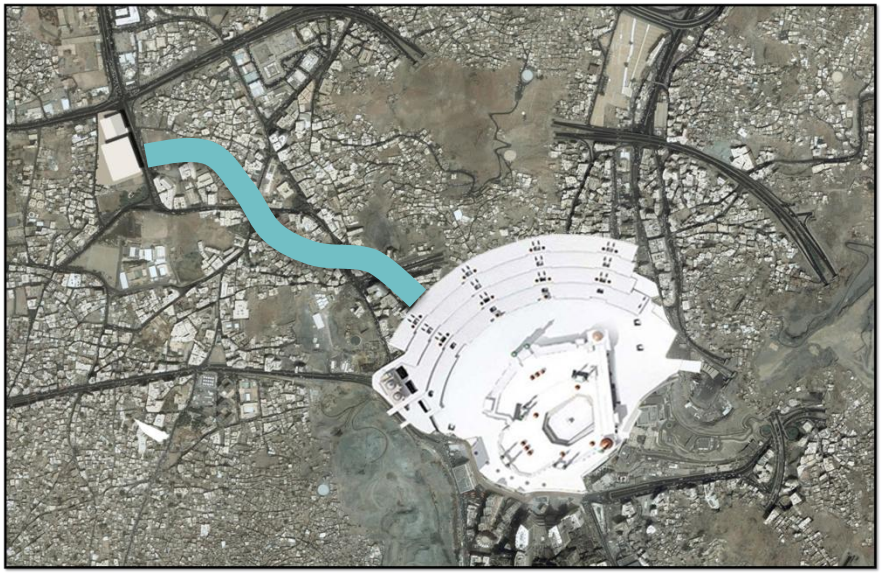
Air Temperature Contours

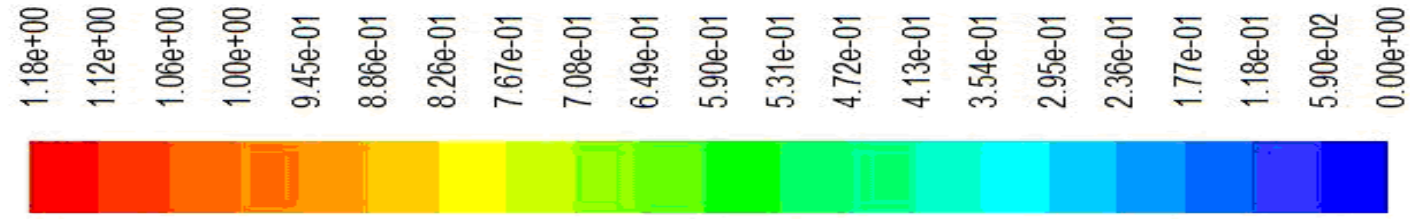


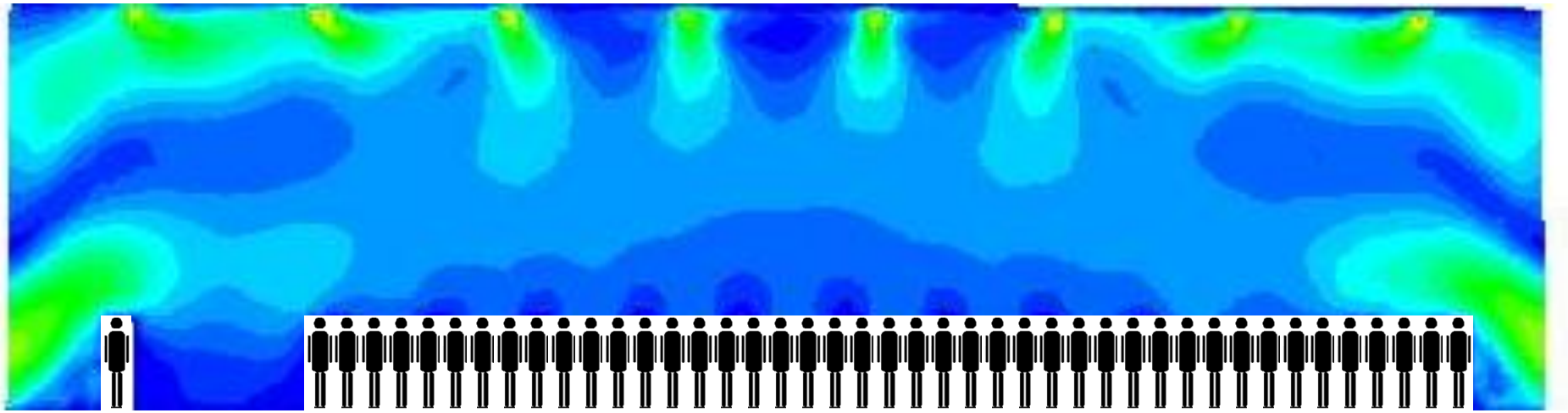
Rh % Contours

GRAND MOSQUE, MECCA,KSA
100000 TR







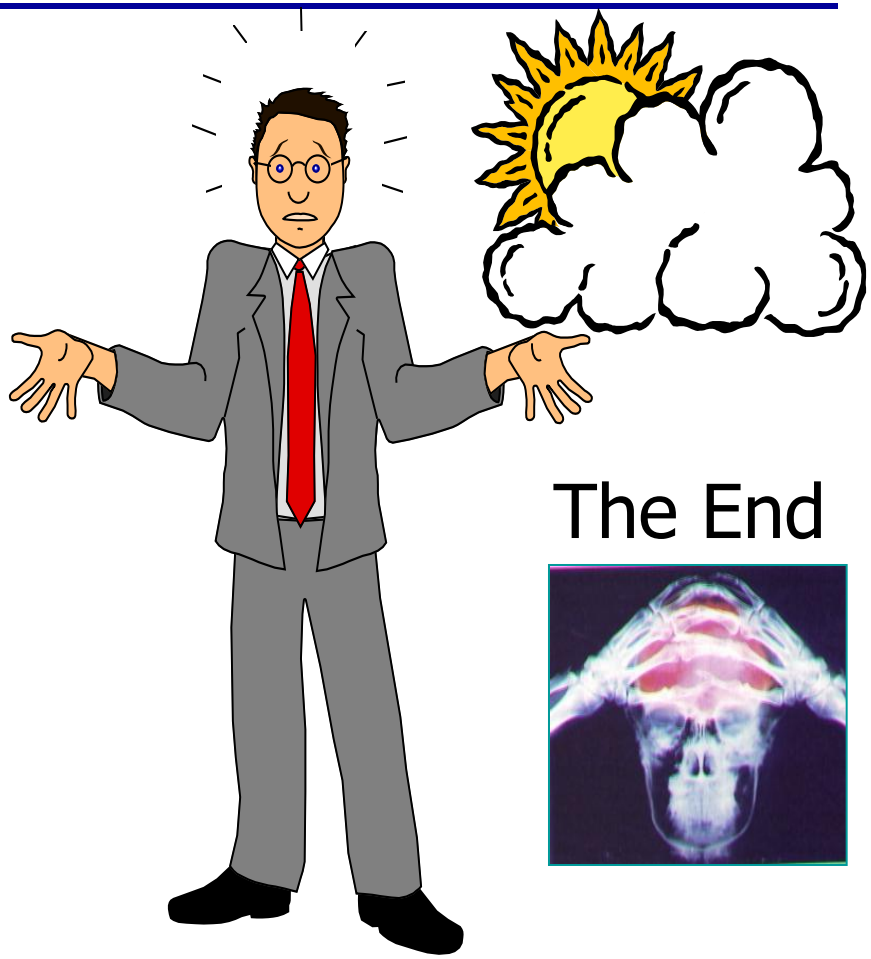


Velocity distribution at a vertical x-y plane, m/s

Velocities should not exceed 0.2 m/s at occupancy levels to maintain comfort.

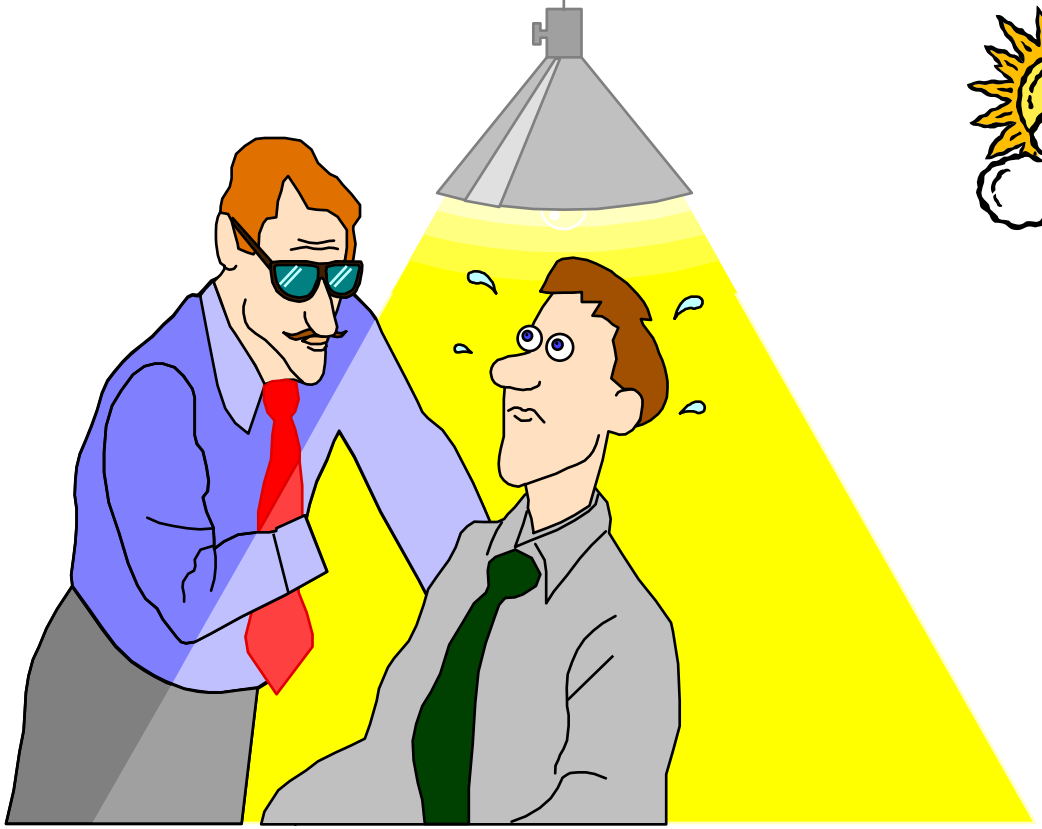
It is very gratifying to find some one that silently appreciates your efforts

I REST MY CASE YOUR HONOURS



Thank You

The End



QUESTIONS !!

Yes ……. I have two hands