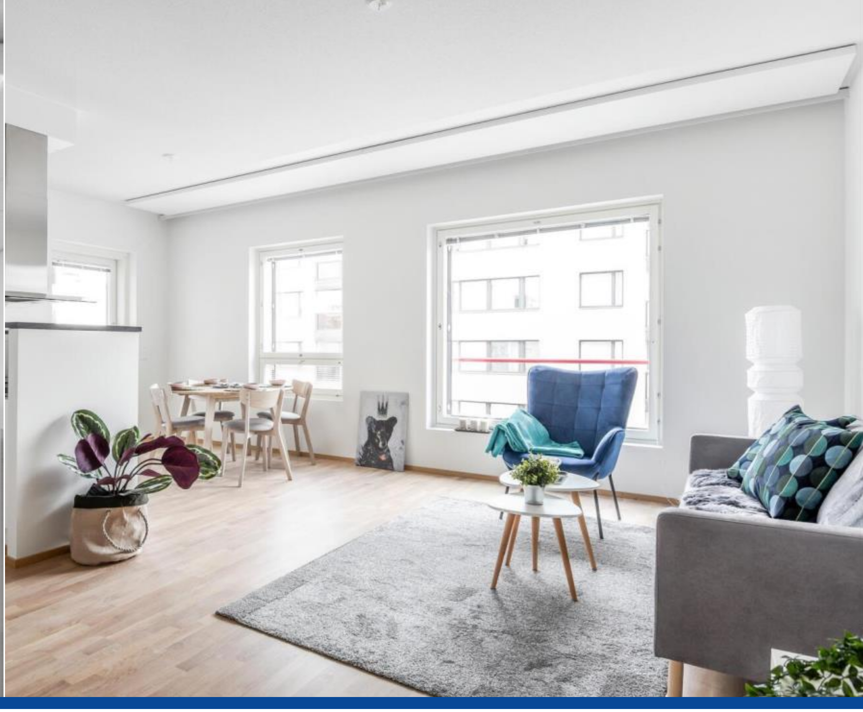




ENERGY-EFFICIENT HEATING AND COOLING WITH RADIANT CEILING SYSTEMS

itula

Quality Heating - www.itula.com

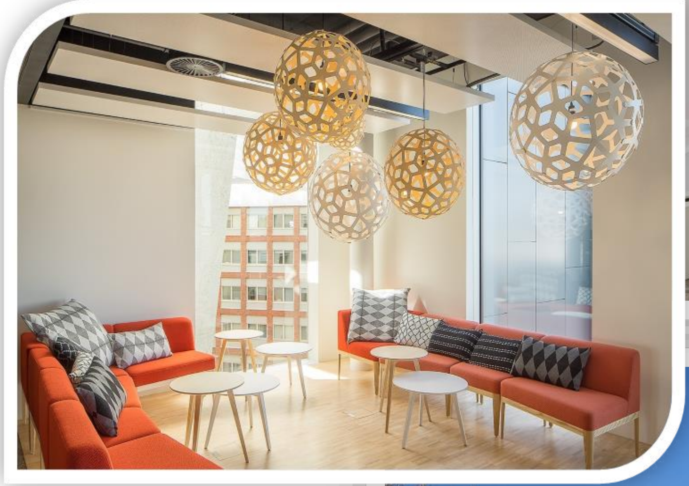
itula

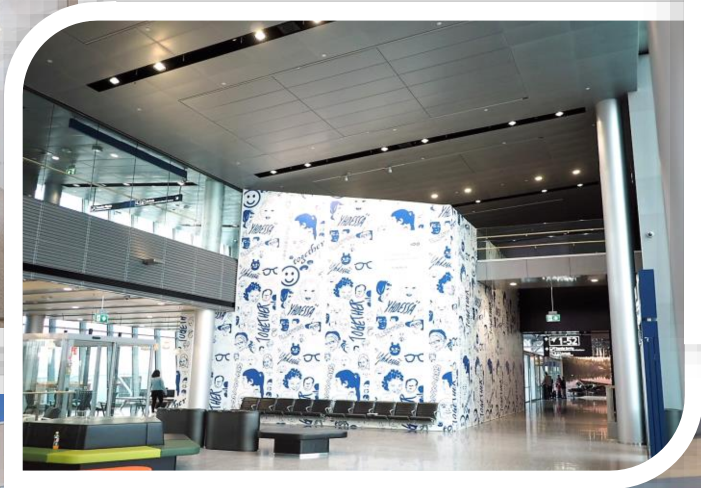
Itula Oy

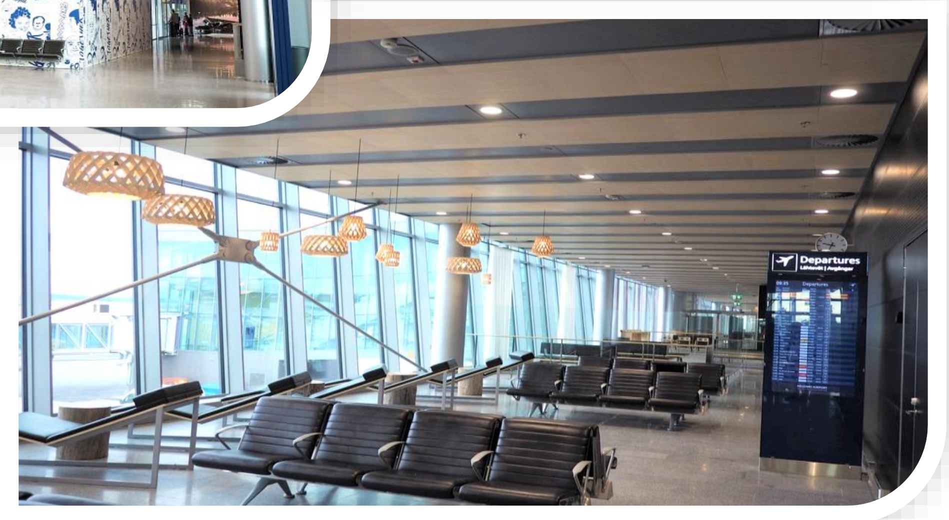
- Established: 1990
- Business premises:
  - Puntala H.Q. and Factory
  - Helsinki//Vantaa Sales Office
  - Turku Sales Office
- A Family owned Company

FINLAND'S LEADING SUPPLIER OF RADIANT HEATING AND COOLING SYSTEMS

Over 1 500 000 m2 buildings with Itula panels







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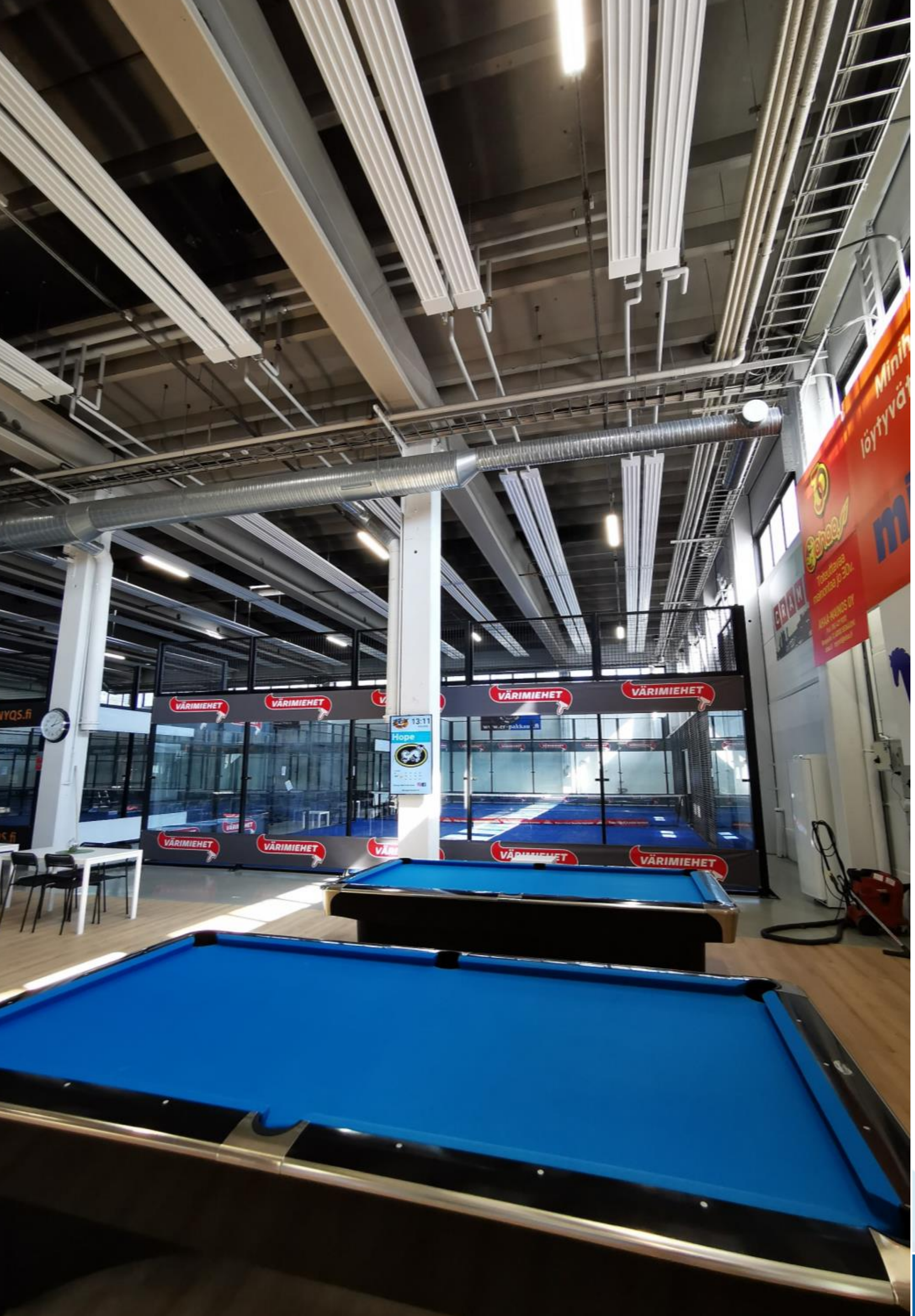
Why Radiant Heating and Cooling now?

Megatrend in the heating and cooling market in Europe

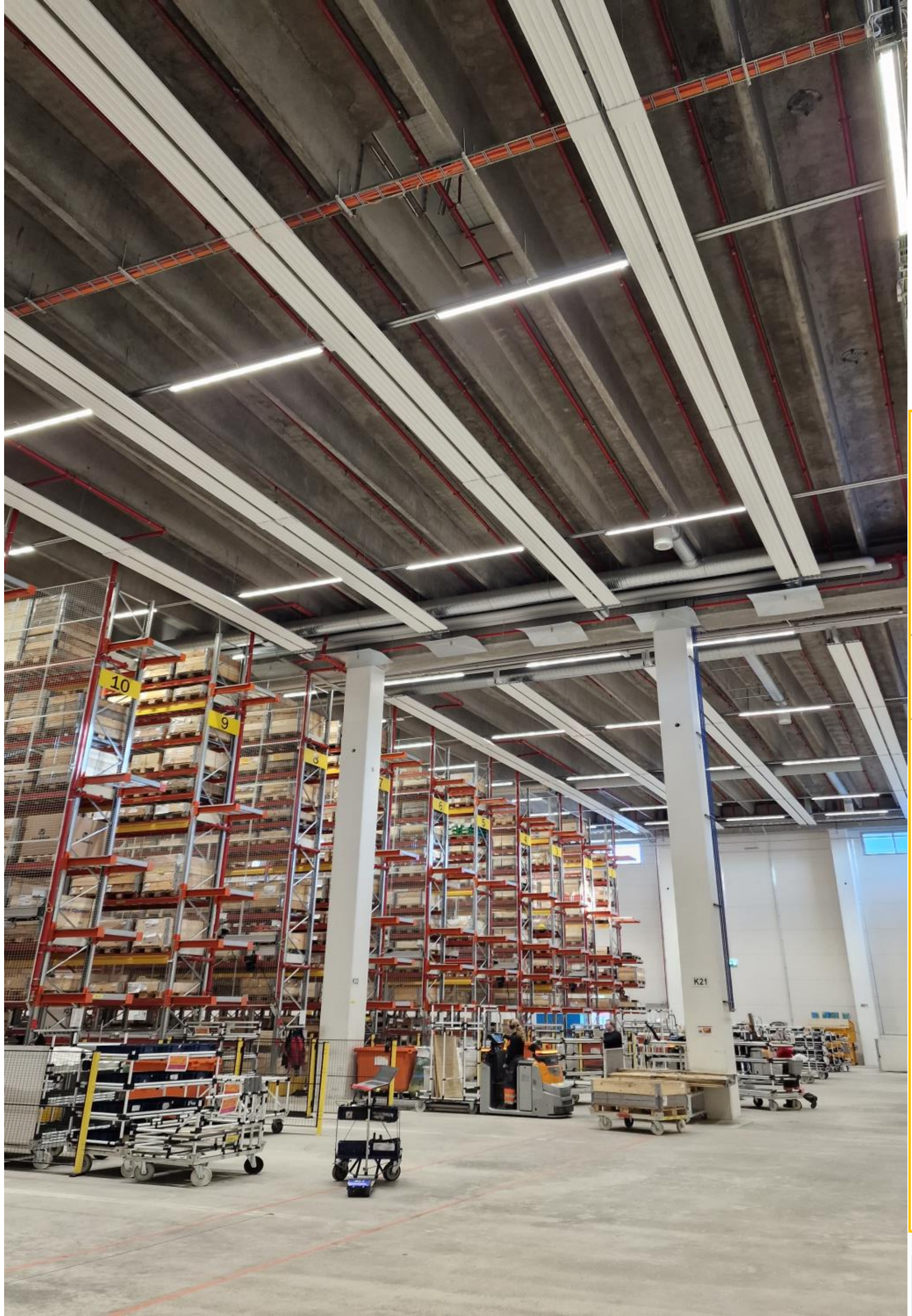
- Demand for low temperature systems
- Housing business opened in Finland → we have moved from apartments to whole house blocks delivered with ItuGraf -panels
- Hospital sector brake through with panels in Finland → all private hospitals delivered by Itula and several public hospitals
- Construction methods are changing from building site to factories with prefab module constructing. Itula does have facilities to answer that kind of customer demands.
- Delivery limits are changing - there are already demands to integrate lights, sensors, sprinklers, electric and data sockets into the panel systems – ItuGraf multipurpose panels



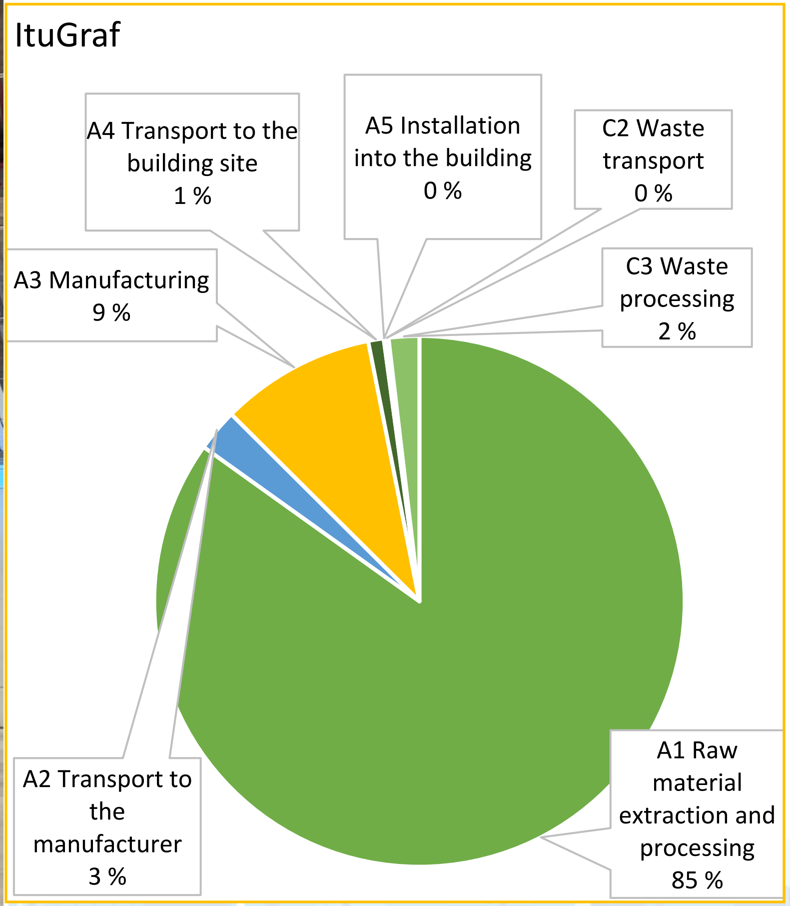
Why Radiant Heating and Cooling now?

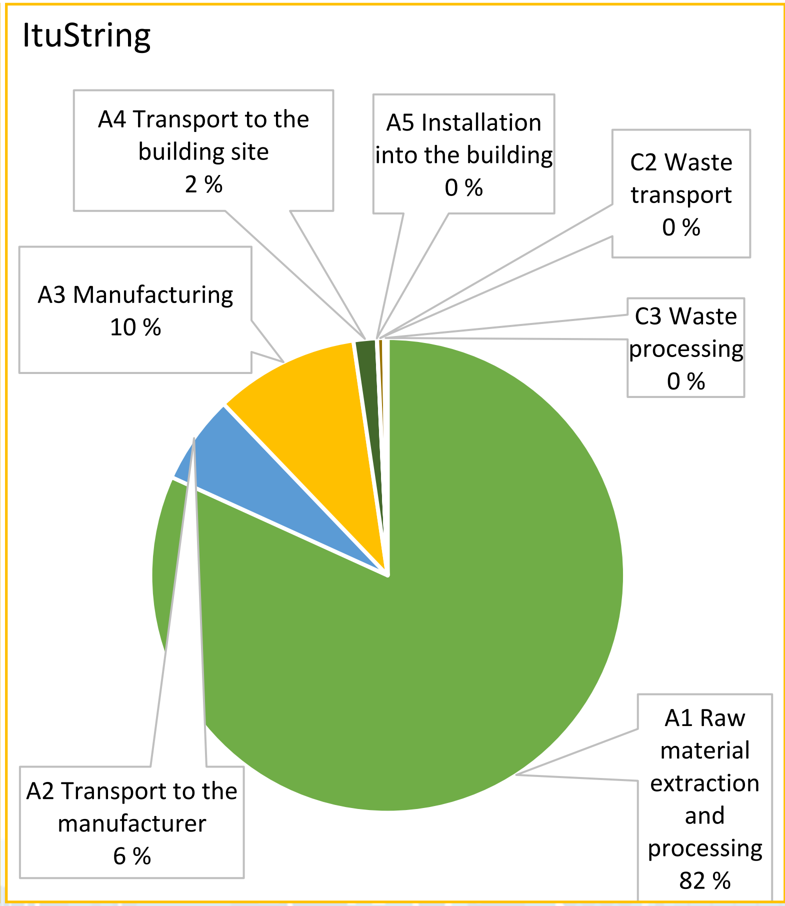
Megatrend in the heating and cooling market in Europe

- Radiant Ceiling Panels (RCPs) are widely accepted by leading HVAC specifier companies
- RCPs are easy to integrate/combine with other building technology systems
- By our experience the RCPs are more and more popular in central Europe because of the green building trend
- Global need for energy savings in buildings to reduce the climate change!

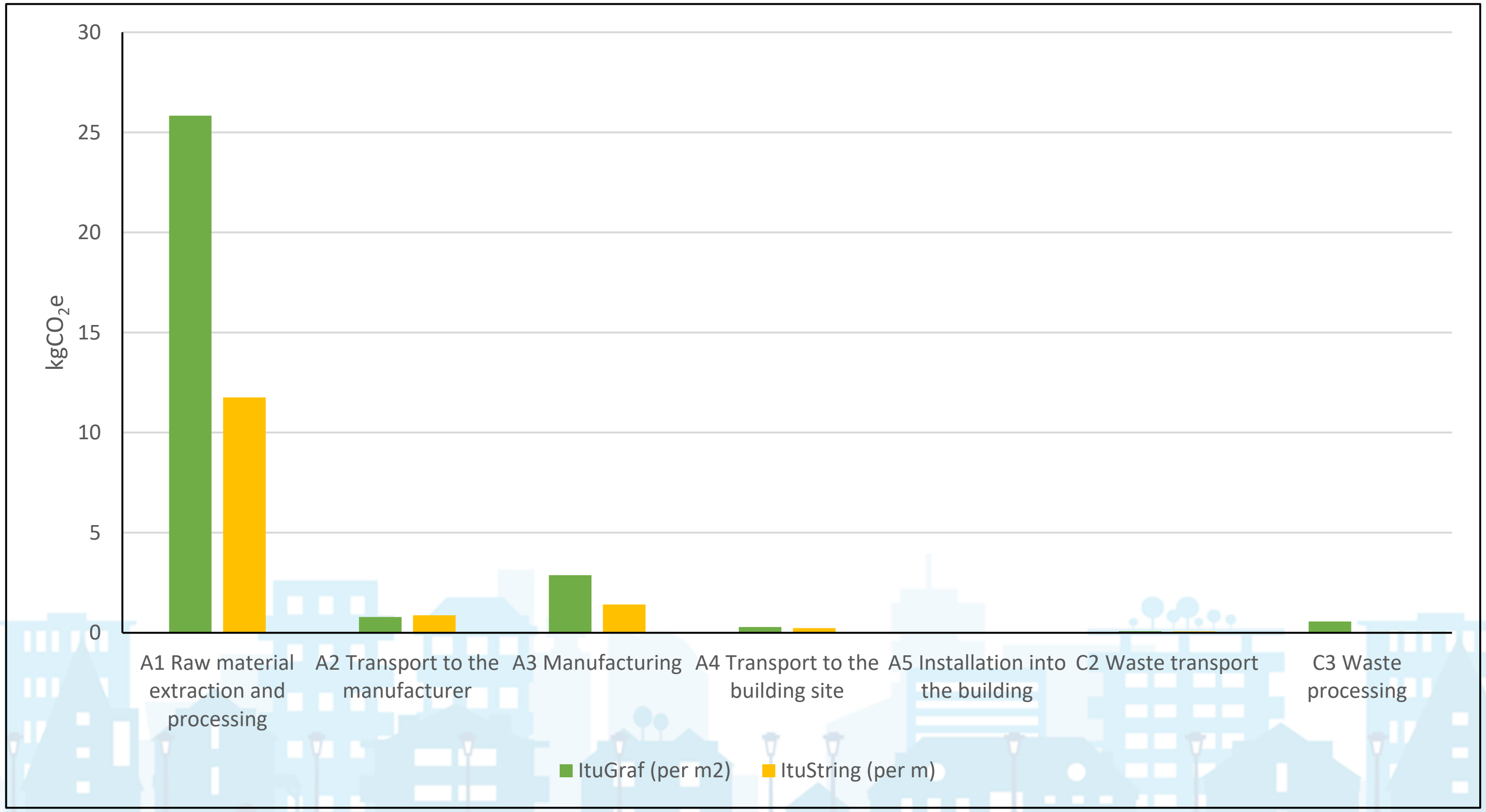


Carbon footprint of Itula products





Global warming impact



RHC basics and generalities

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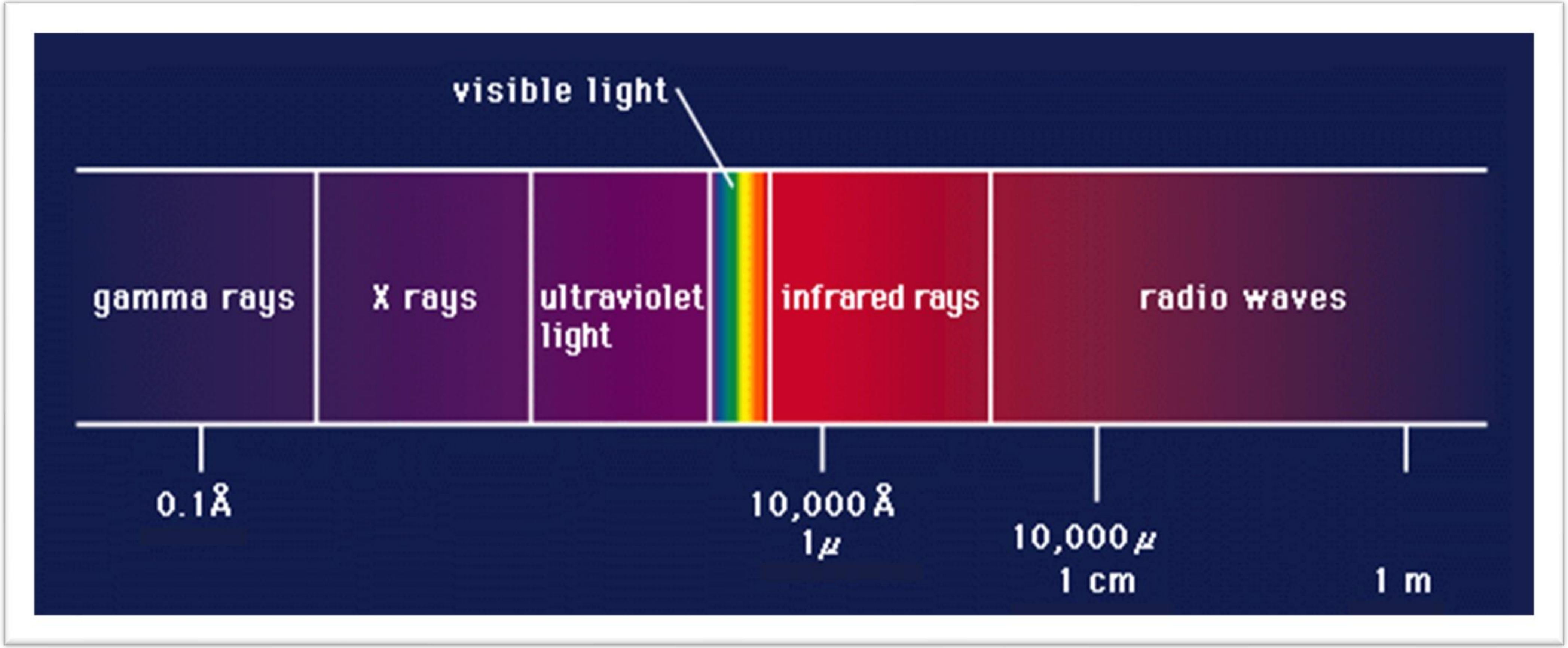
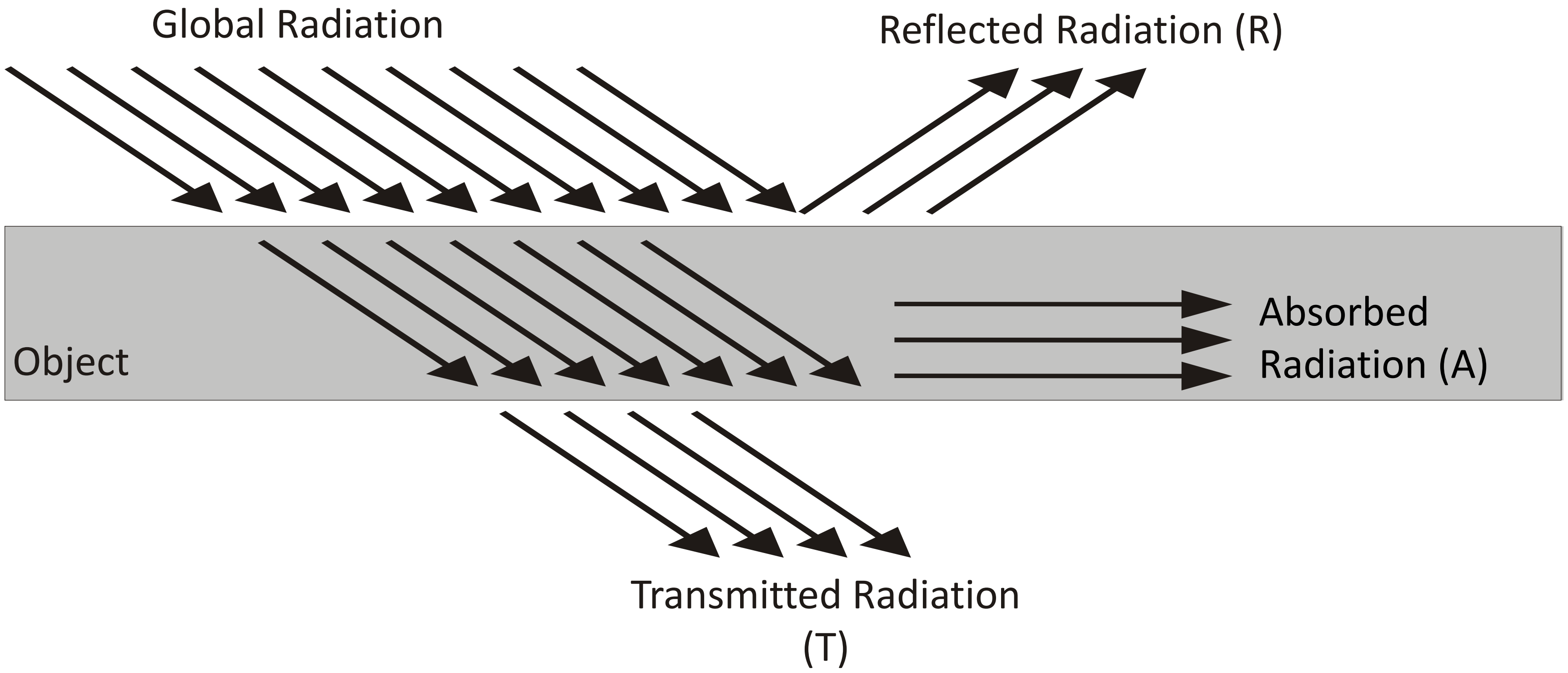
The sun – our inspiration

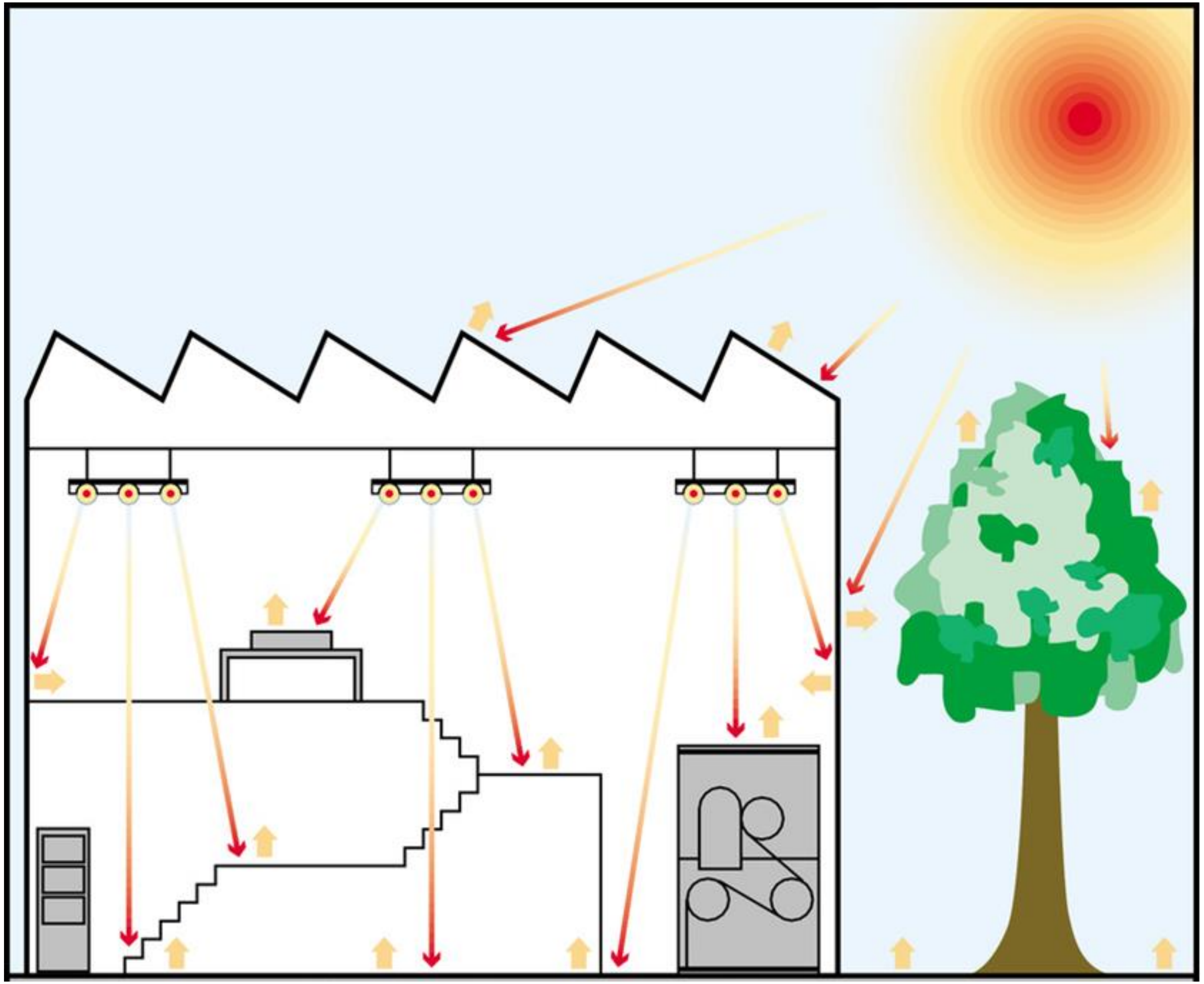
The range of electromagnetic waves



Energy conservation

Global Radiation =
R + A + T = 1





The sun – our inspiration

Thermal output differences between rads and RCPs

Radiant Ceiling Panels
EN 14037

Radiators
EN 442

Theoretical radiant output

$$\dot{Q} = A \cdot C \cdot \varphi \cdot \left(\left(\frac{T_1}{100} \right)^4 - \left(\frac{T_2}{100} \right)^4 \right)$$

$\dot{Q}$ = Heat flux from thermal radiation
A = Radiation surface (m^2)
C = Radiation factor $\left(\frac{W}{m^2 K^4} \right)$
φ = Angle factor
T_1 = Medium surface temperature of the radiative body (K)
T_2 = Room temperature ($K = t°C + 273.15$)

Comfort conditions DIN EN 1946 part 2

Thermal comfort is achieved when a human perceives the:

- air temperature
- air humidity
- movement of the air
- heat radiation

in the surrounding as ideal.

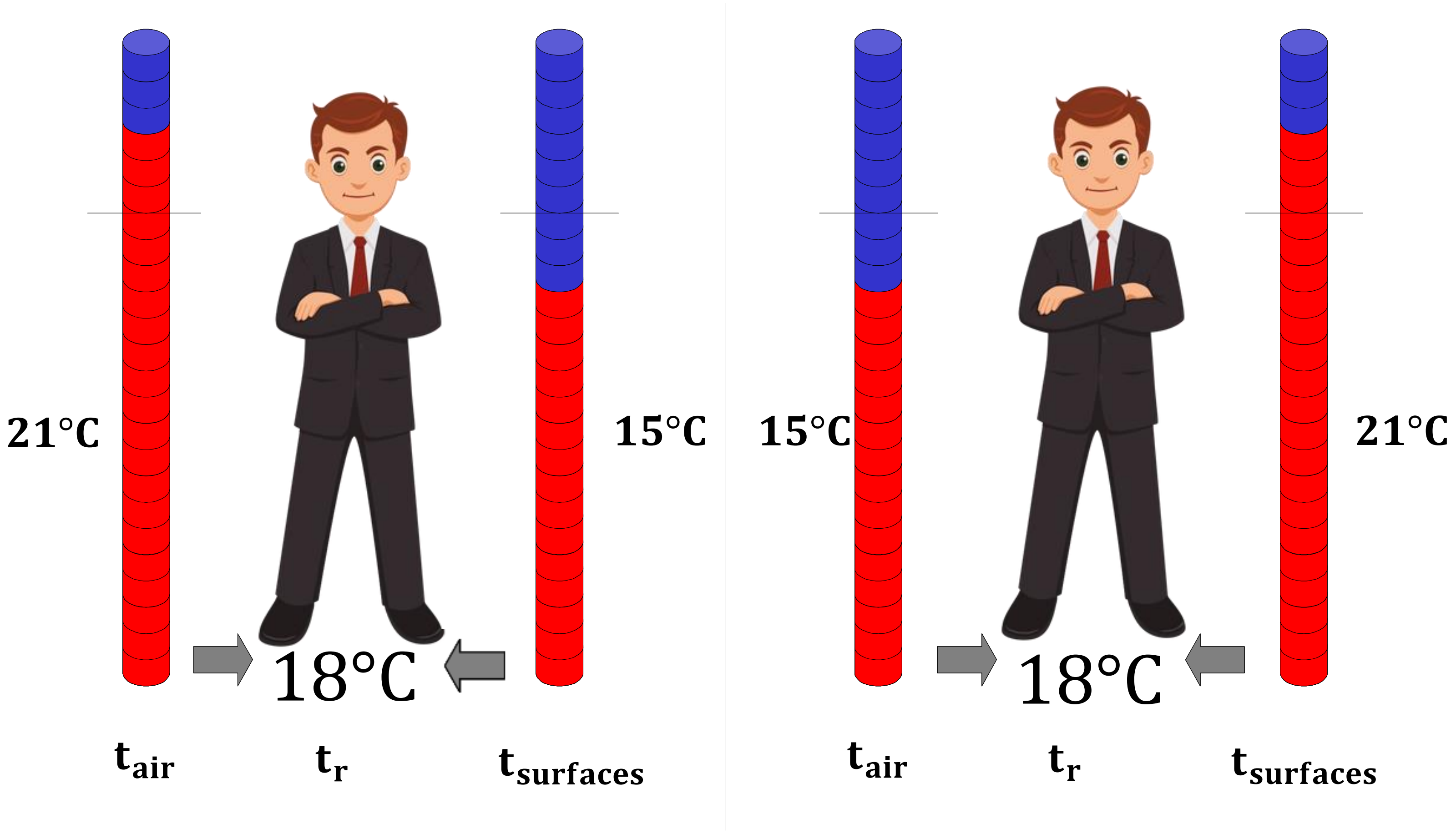
Our comfort depends on the temperature of the air and the surrounding surfaces

$$T_{resulting} = \frac{(T_{air} + T_{surrounding\,surfaces})}{2} \qquad (= T_i)$$

Perceived temperature equals:

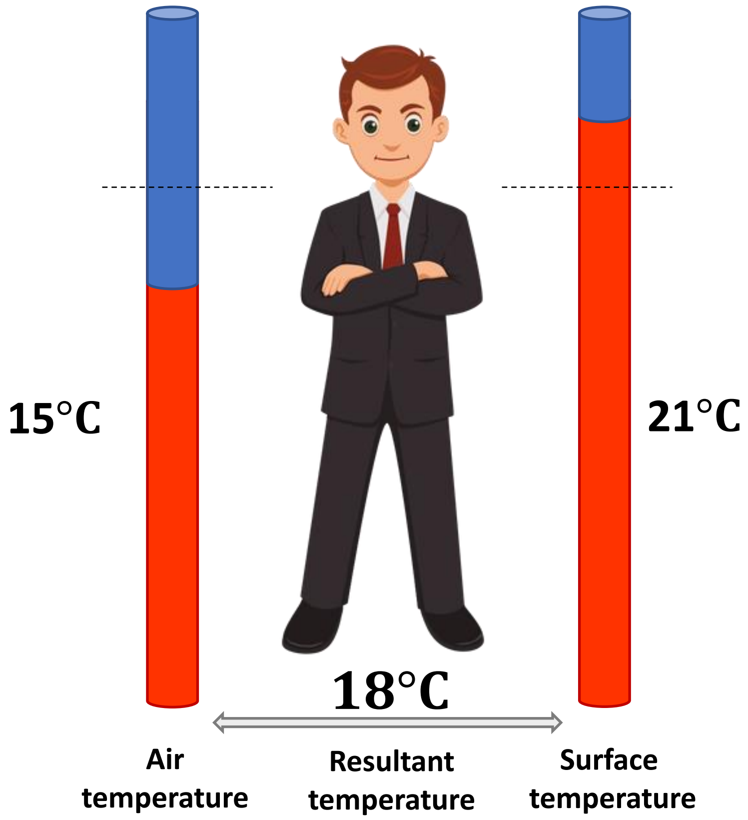
- resulting temperature
- operative temperature
- globe temperature

Perceived temperature heating

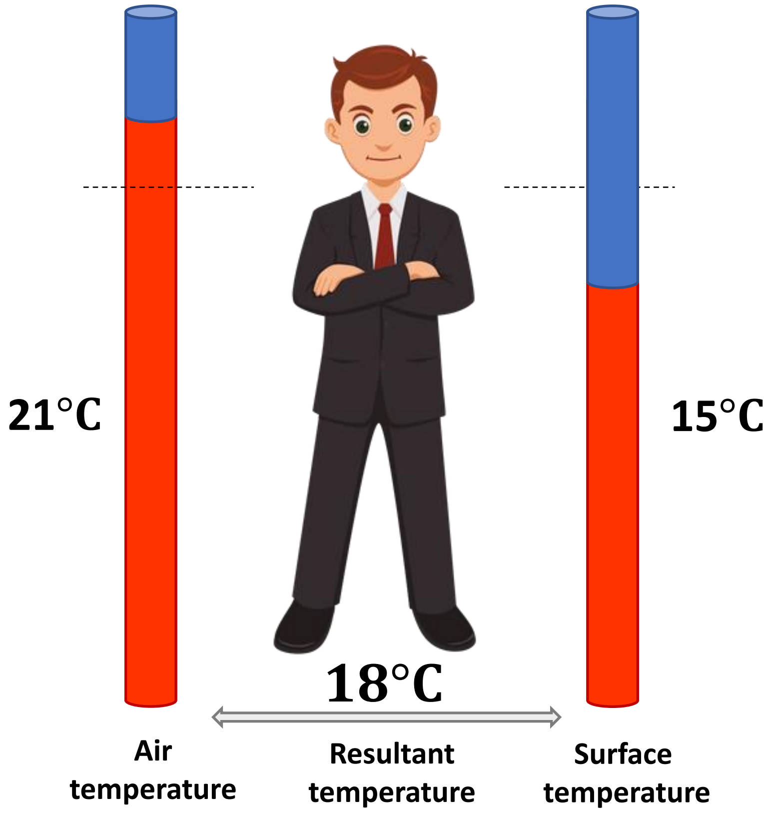


Perceived temperature heating

Ceiling panels



Warm air system



Perceived temperature heating

Ceiling panels

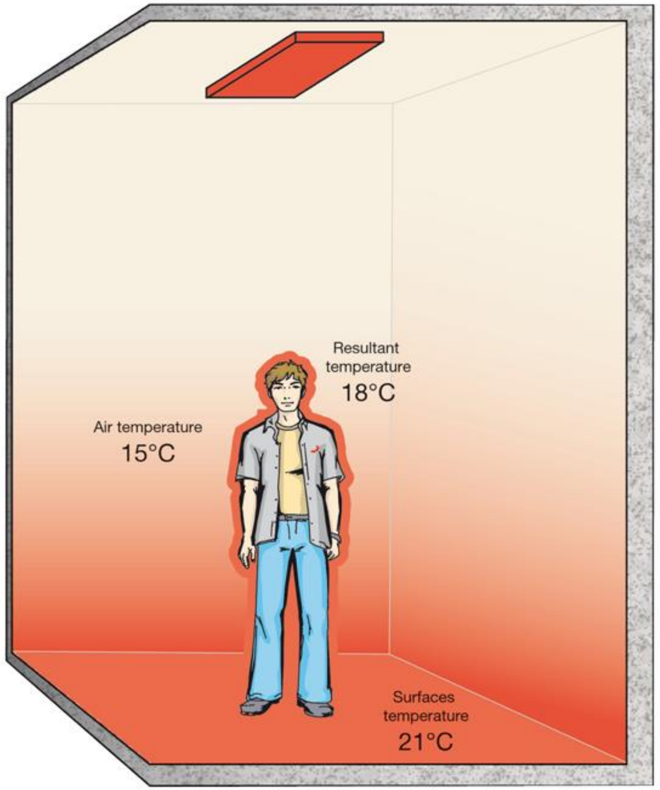


Fig. 4a: Radiant ceiling panels

Warm Air System

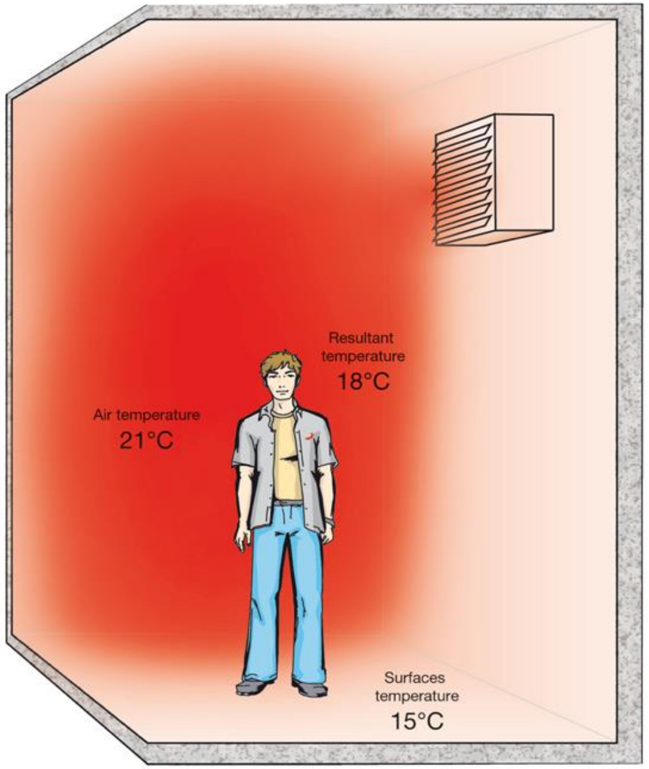


Fig. 4: Air heating

Different types of radiant heaters

Radiant ceiling panels:

According to EN 14037

Flow temperatures: **14℃ - 120 ℃**

Luminous gas radiant heaters – ceramic:

Open flame

According to DIN 3372 – 1

Surface temperatures: **500 ℃– 900 ℃**

Hot radiant tubes – **infrared tubes:**

Hot air or gas

According to DIN 3372 - 2

Surface temperatures: **150 ℃ - 400 ℃**

report no. H.0906.S.633.EMCP

Heating of industrial halls - Computed comparison of heat emissions into the ground from ceiling radiant panels or industrial floor heating systems

Contractor: HLK Stuttgart GmbH Pfaffenwaldring 6A 70550 Stuttgart

Purchaser: EMCP Gartenstraße 69
64823 Groß-Umstadt

Stuttgart, 12 June 2009

Prof. Dr.-Ing. M. Schmidt Dr.-Ing. Chr. Beck

Comparison UFH with RCP-system in industrial halls

UFH

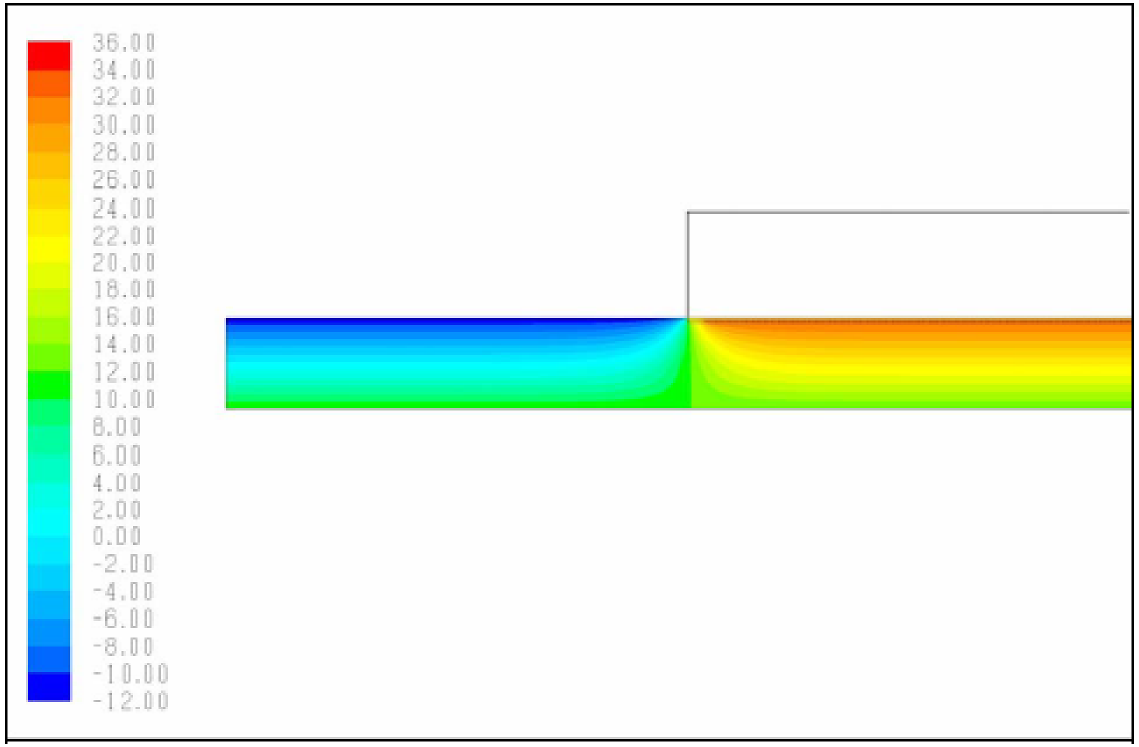


Figure A1: Industrial floor heating,
hall floor without insulation

RCP

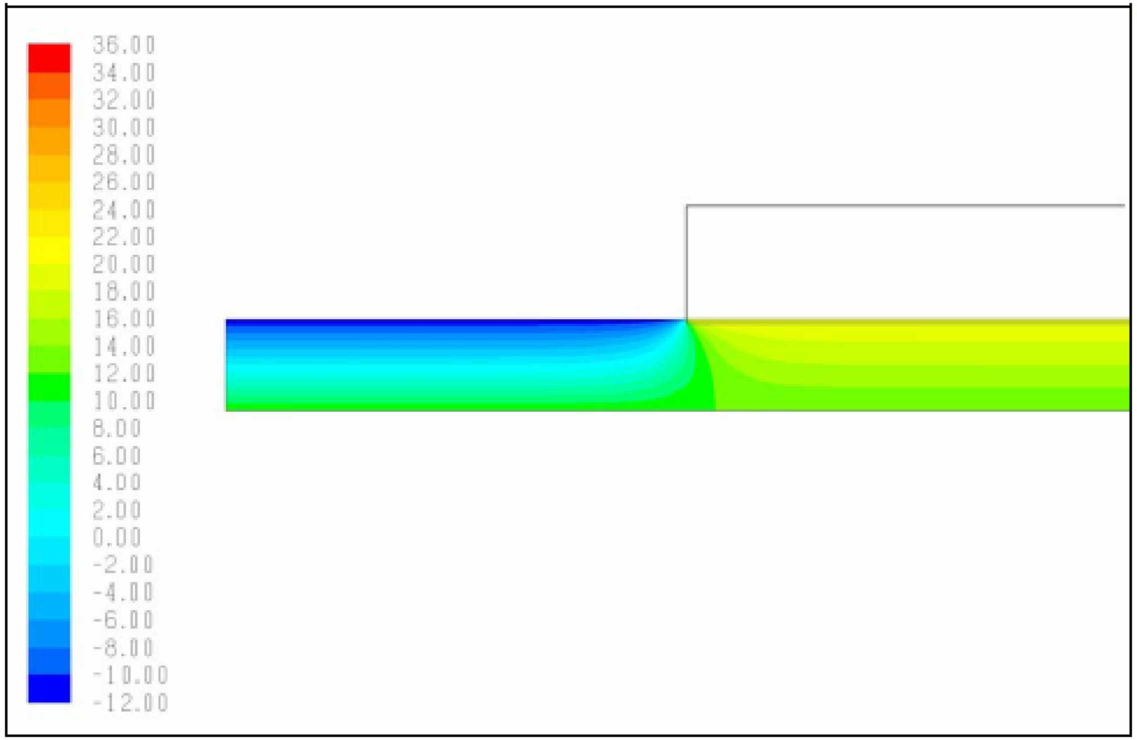


Figure A3: Ceiling radiant panel heating,
hall floor without insulation

Comparison UFH with RCP-system in industrial halls

UFH

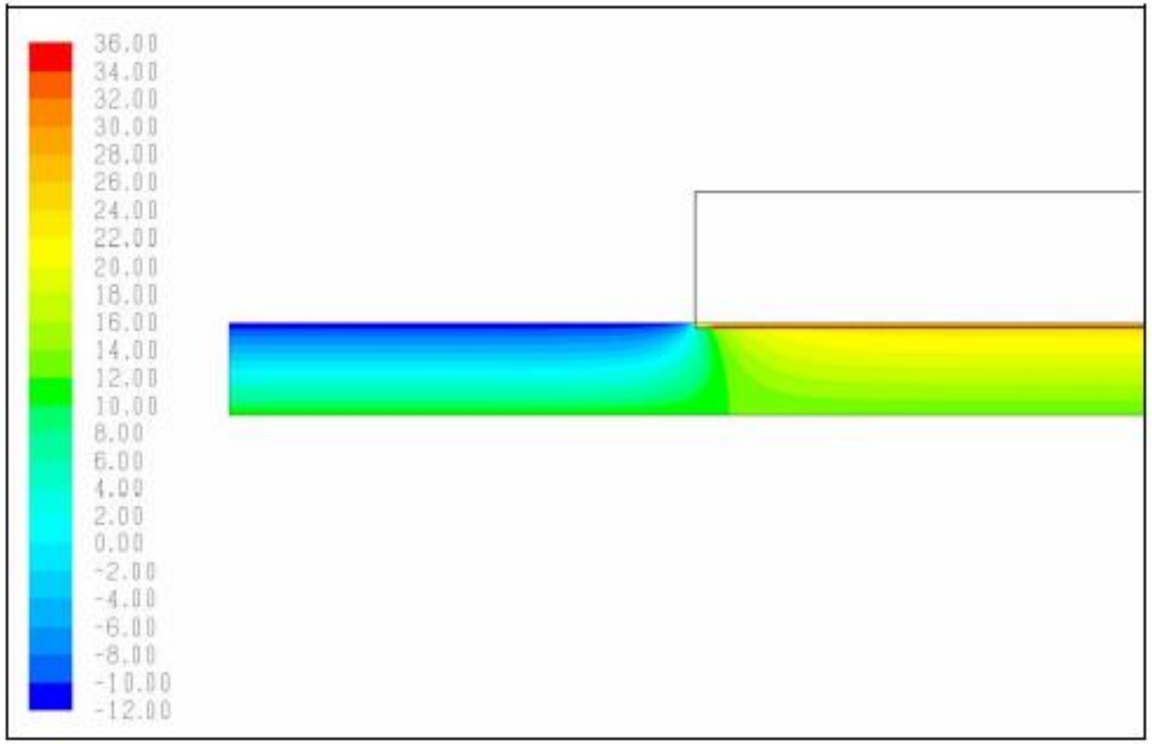


Figure A2: Industrial floor heating,
hall floor with insulation

RCP

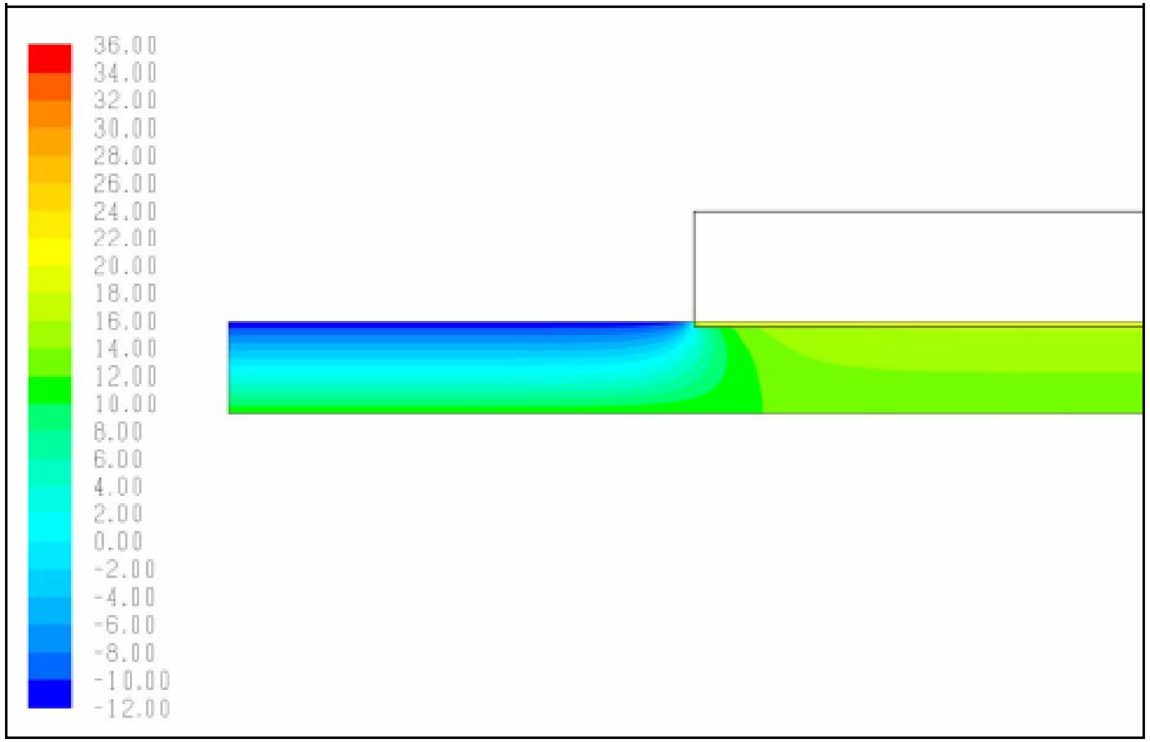


Figure A4: Ceiling radiant panel heating,
hall floor with insulation

Underfloor heating system for industrial halls

4 Summary

The calculated heat flows vary between 20 kW and approx. 90 kW according to the heating system and the properties of the ground (thermal conductivity and deepness of the ground water).

The results show that the heat flow into the ground is significantly lower when heating by radiant ceiling panels than by floor heating.

When using the radiant ceiling panel heating, the heat flow values are even smaller without heat insulating under the floor than those for the industrial floor heating with heat insulation.

The example with typical ground (λ = 2,1 W/mK) and ground water deepness of 5 m reveals the following:

Radiant ceiling heating, without heat insulation: 37350 W
Industrial floor heating, with heat insulation: 55698 W

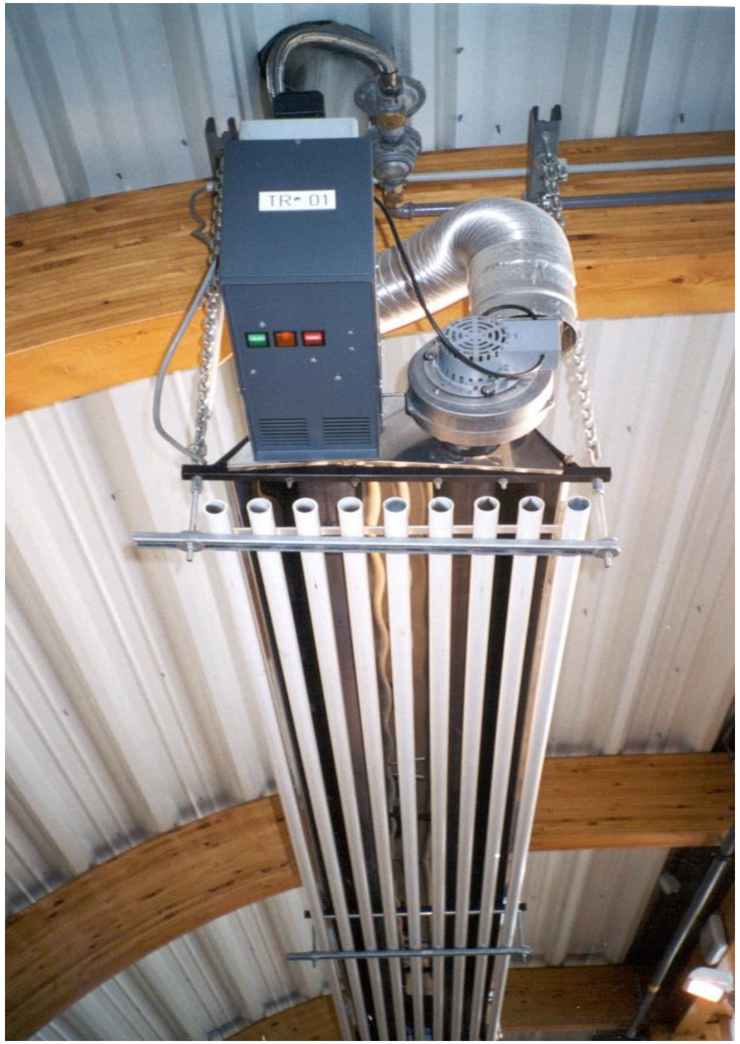
In spite of additional heat insulation, the additional effort amounts to approx. 50% for the industrial floor heating.

Theoretical radiant output

$$\dot{Q} = A \cdot C \cdot \varphi \cdot \left(\left(\frac{T_1}{100} \right)^4 - \left(\frac{T_2}{100} \right)^4 \right)$$

$\dot{Q} =$ Heat flux from thermal radiation
$A =$ Radiation surface (m^2)
$C =$ Radiation factor $\left(\frac{W}{m^2 K^4} \right)$
$\varphi =$ Angle factor
$T_1 =$ Medium surface temperature of the radiative body (K)
$T_2 =$ Room temperature $(K = t°C + 273.15)$

Gas radiant heater in Brussels (B)



High temperature /discomfort

High energy consumption

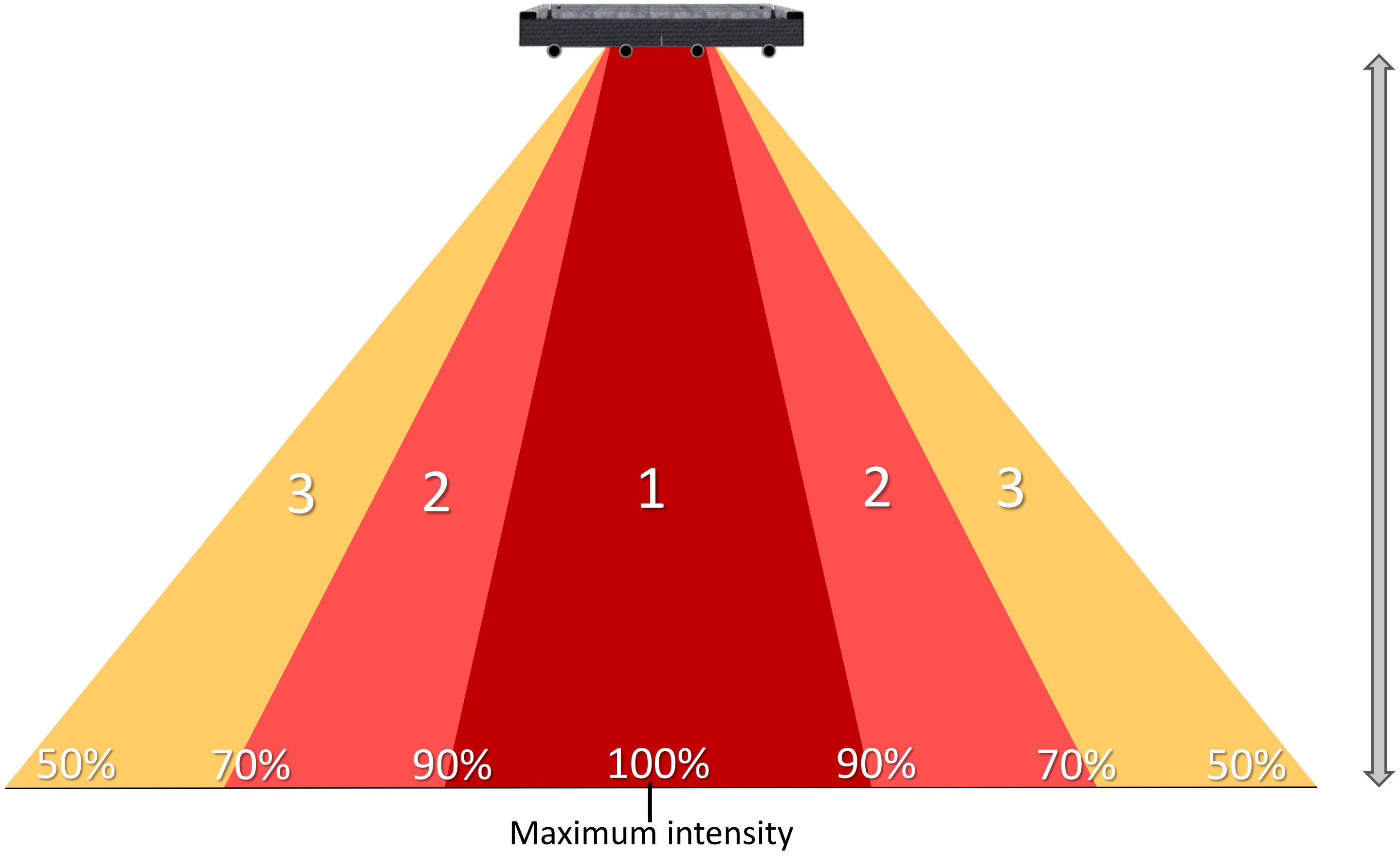
High maintenance costs

Risk of explosion

Uneven temperature profile

Short life cycle

The intensity of Ceiling Panels

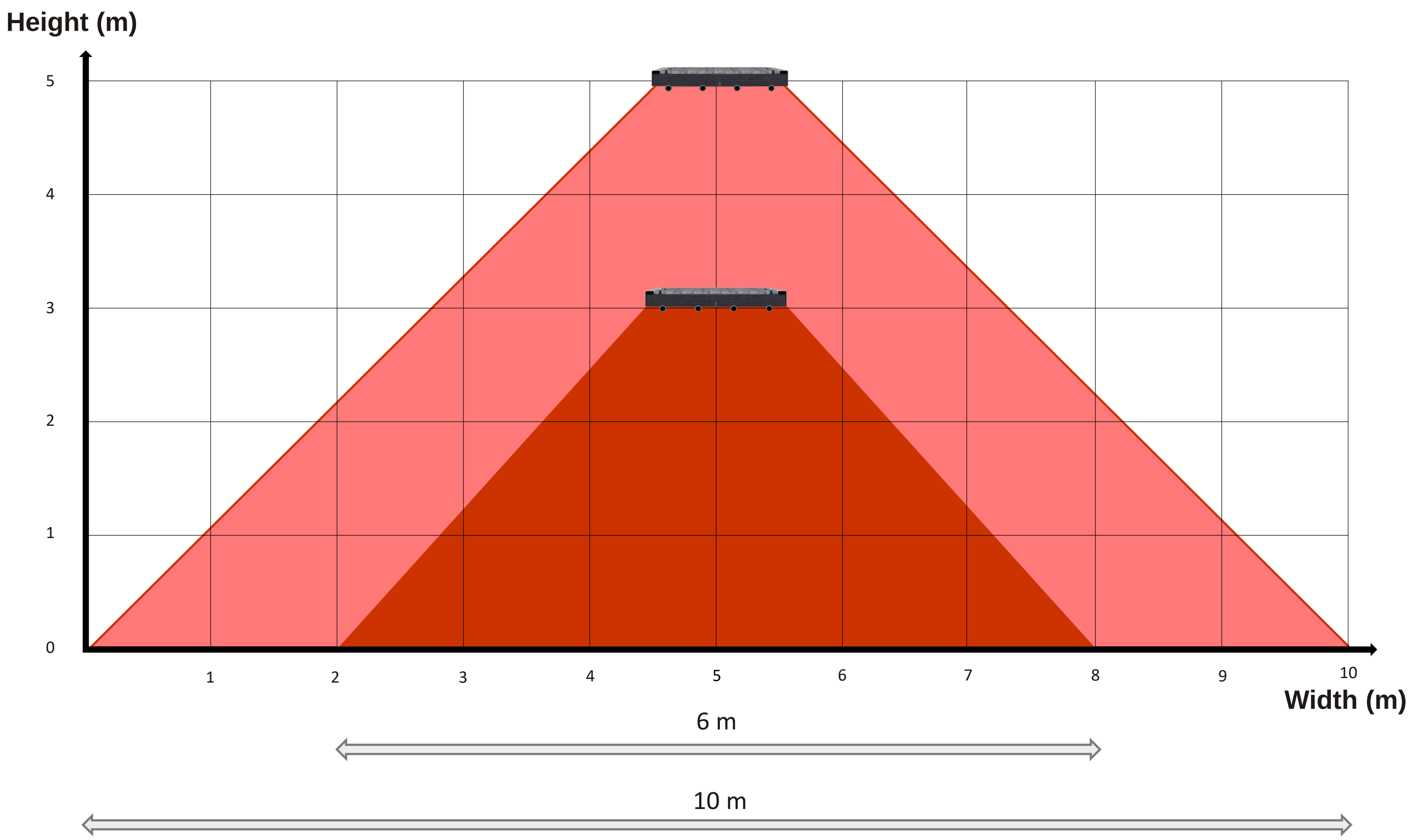


1 = min. 90% = MH x 0.5

2 = min. 70% = MH x 1.0

3 = min. 50% = MH x 1.5

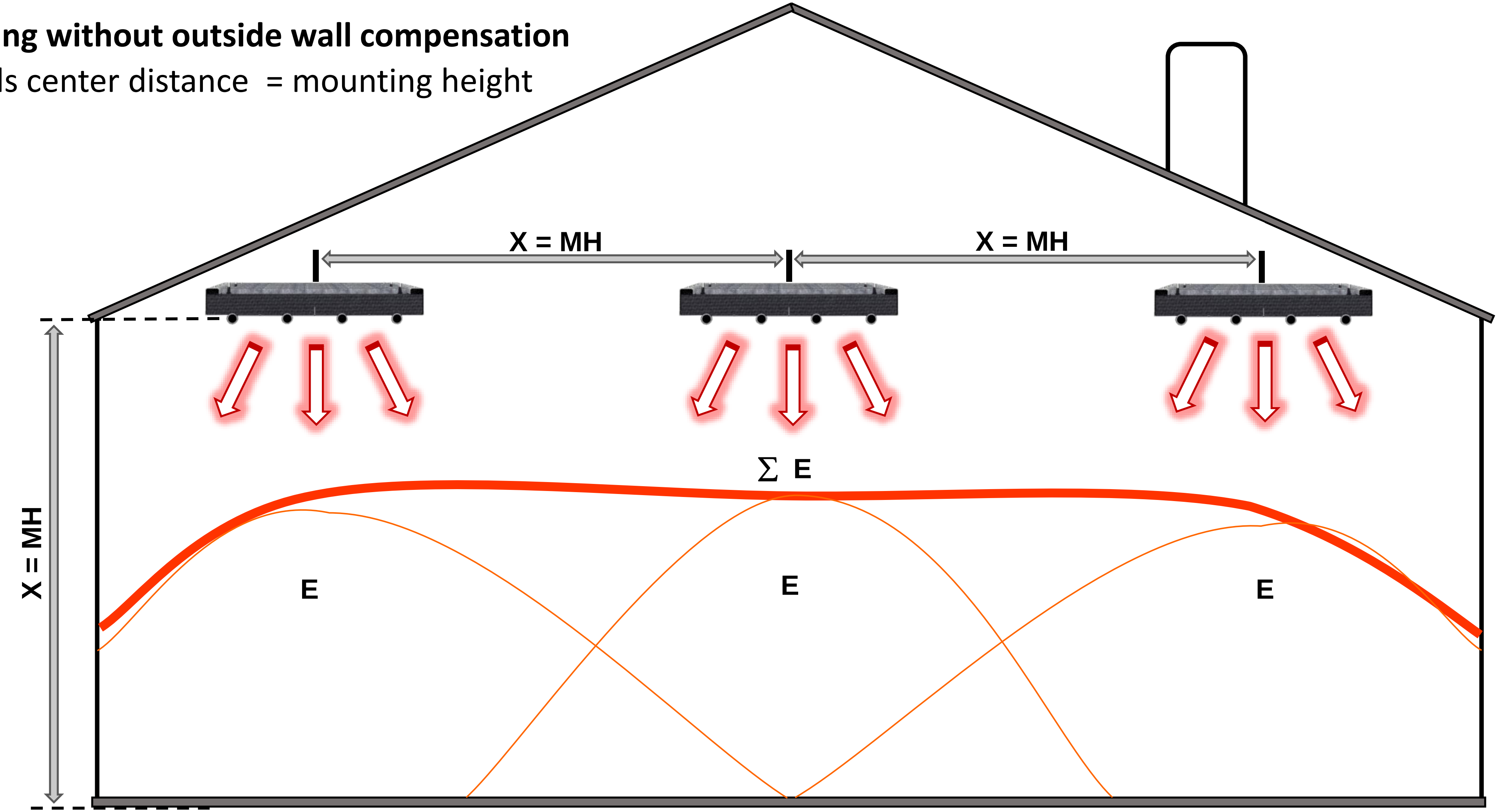
The action field of ceiling panels



Optimum layout of ceiling panels

Building without outside wall compensation

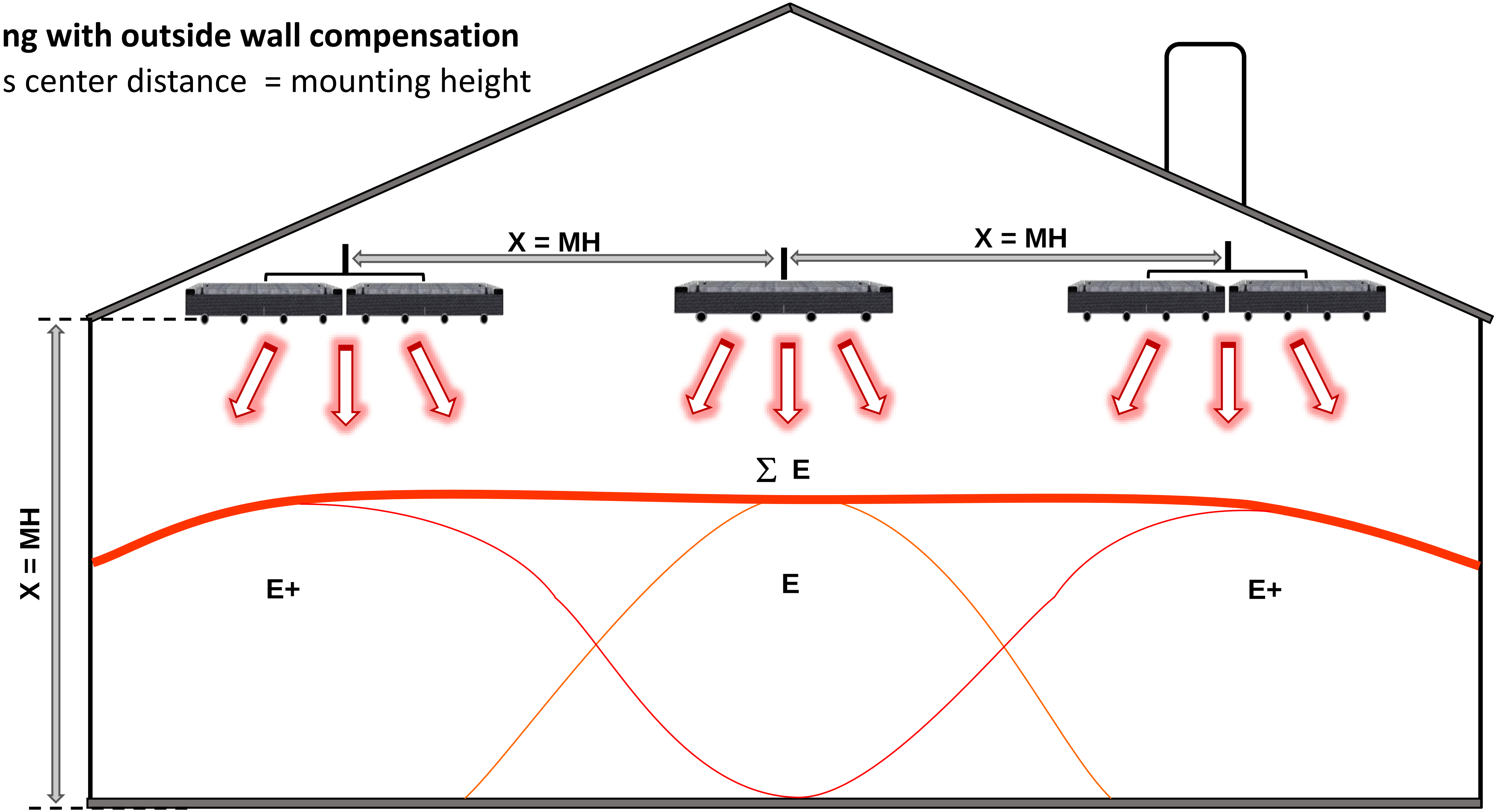
Panels center distance = mounting height



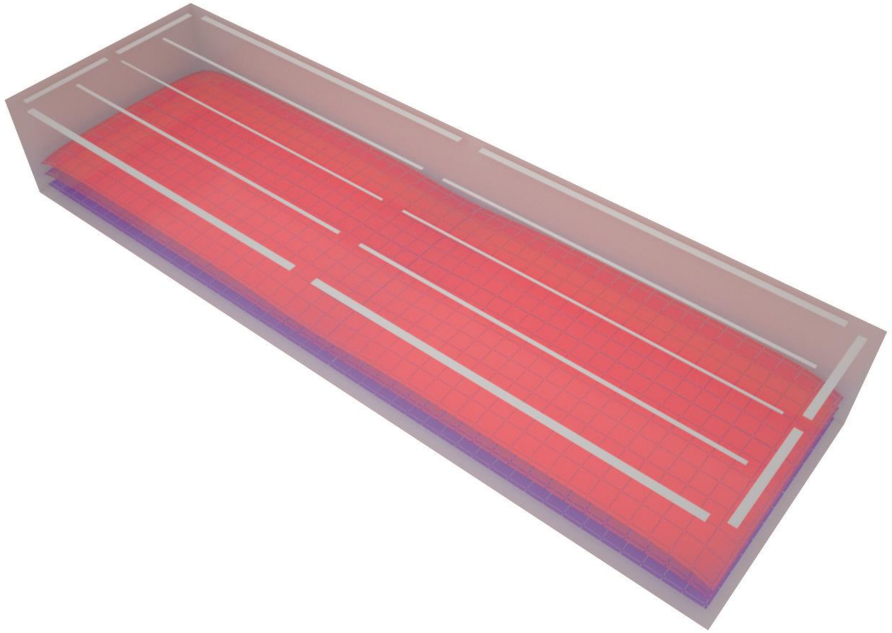
Optimum layout of ceiling panels

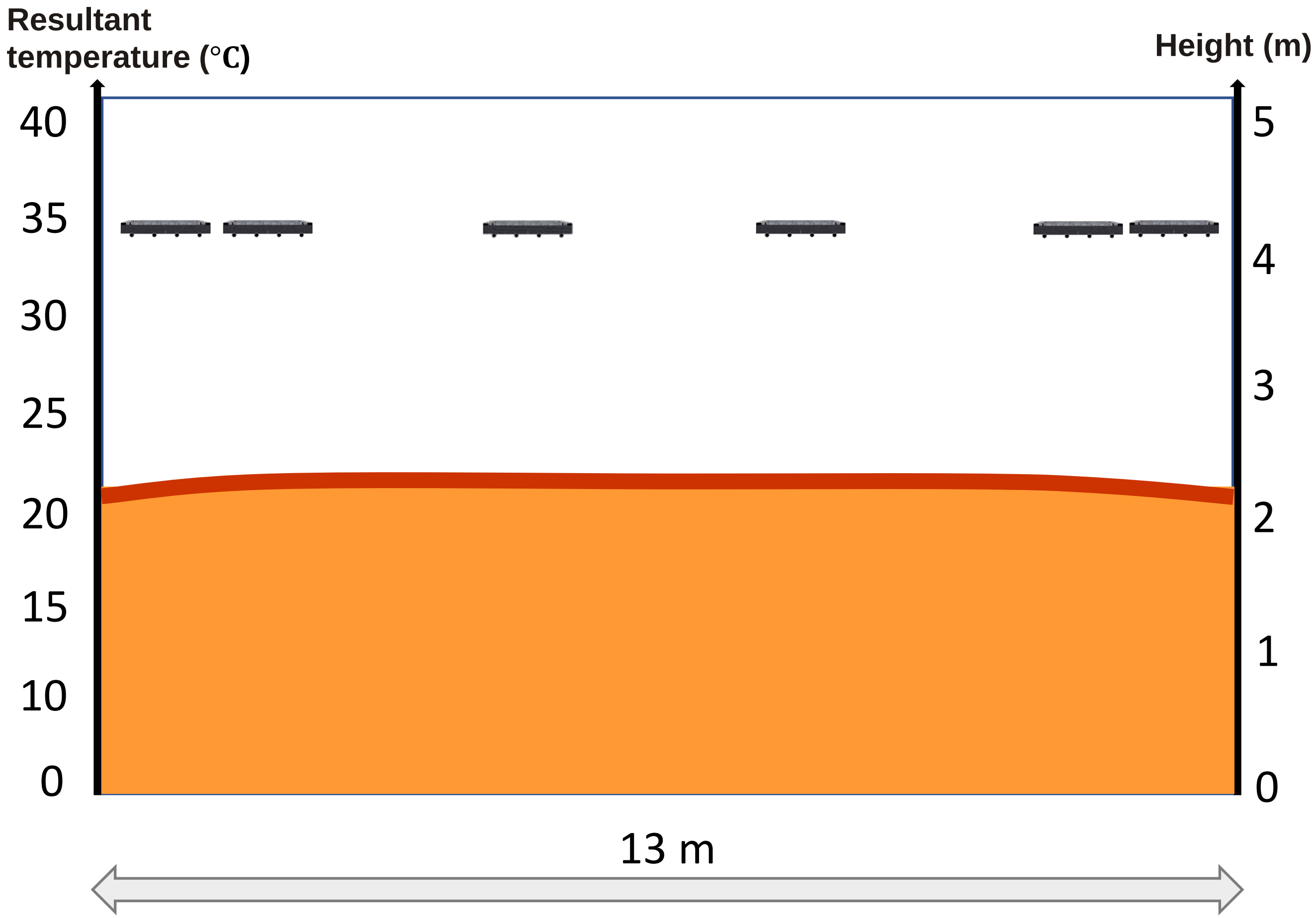
Building with outside wall compensation

Panels center distance = mounting height



Optimum layout of ceiling panels

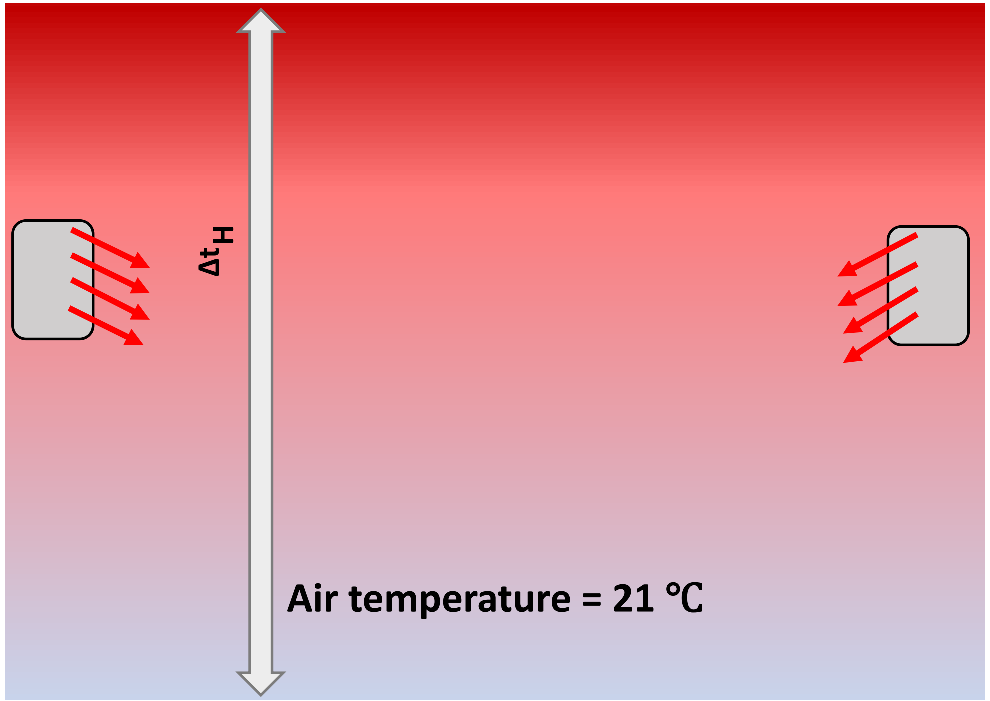




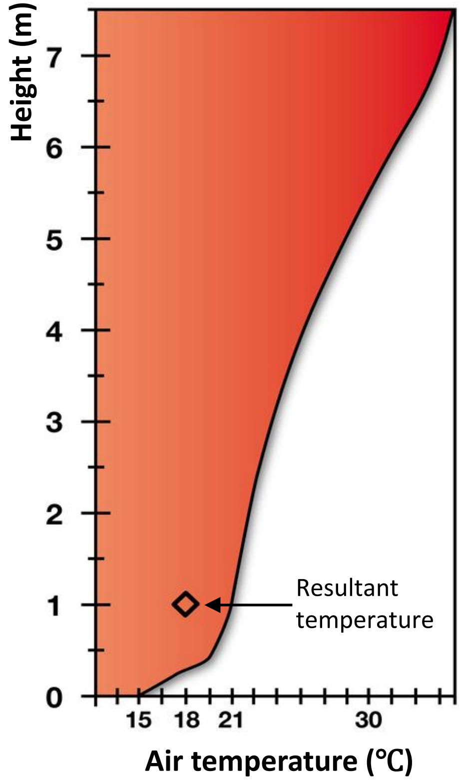
Comparison RCP with warm air system: air stratification

(vertical air temperature gradient: RCP 0,3 K/m   WAS mini 1,0 K/m)

Warm air system



Vertical air temperature gradient Δt_H = 1.0 – 1.4 K/m

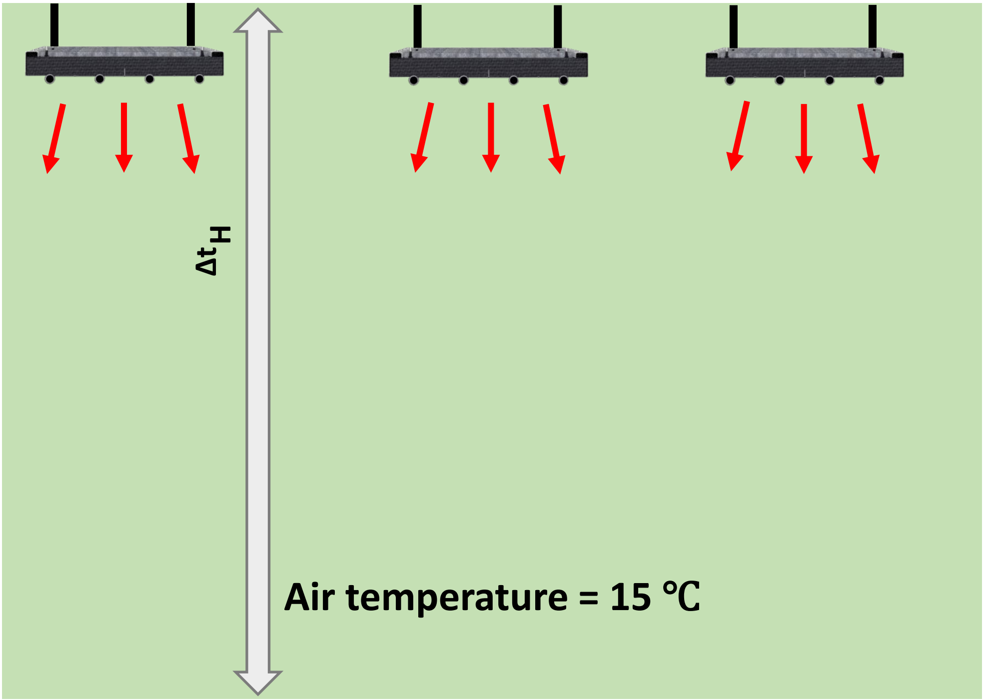


Hot head, cold feet!

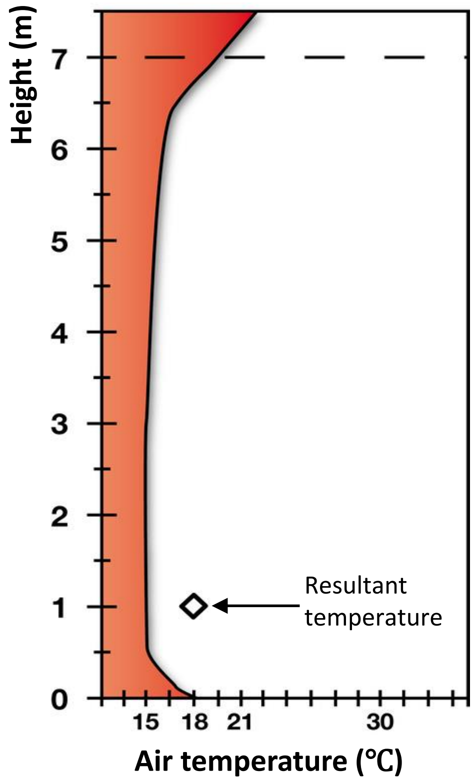
Comparison RCP with warm air system: air stratification

(vertical air temperature gradient: RCP 0,3 K/m   WAS mini 1,0 K/m)

Ceiling panels

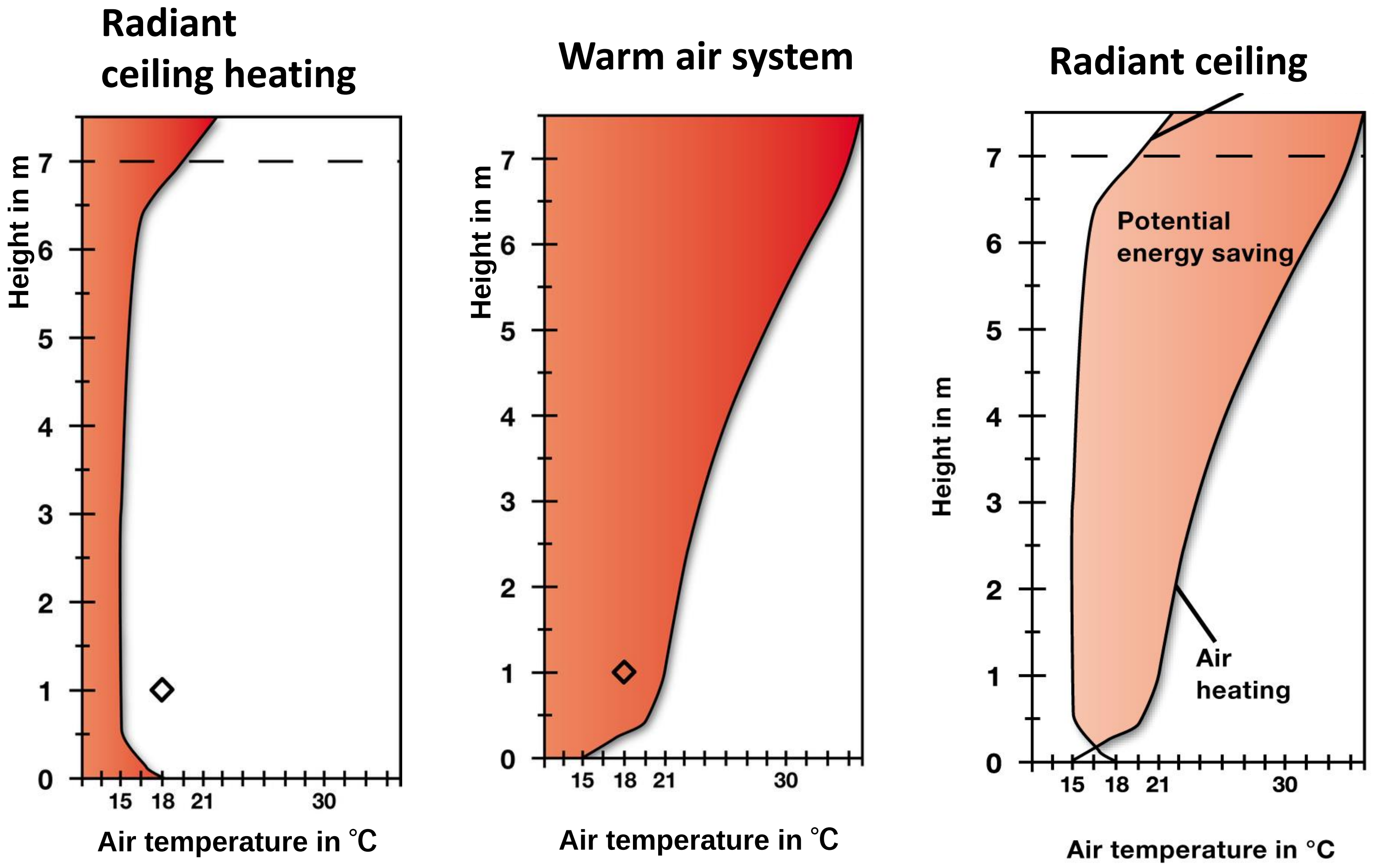


Vertical air temperature gradient Δt_H = 0,1 – 0.4 K/m



Even temperature!

Comparison RCP with WAS – Energy saving potential



EN 12831 – Annex B – Ceiling height correction factors

ANNEX B
(INFORMATIVE)

INSTRUCTIONS FOR DESIGN HEAT LOSS CALCULATION FOR SPECIAL CASES

B.1 Ceiling height and large enclosure

For the basic case, the heat losses are calculated assuming a uniform temperature of heated spaces with height of 5 m or less. This assumption is not valid if the room height exceeds 5 m, as the vertical air temperature gradient, which enhances the heat losses particularly through the roof, in this case cannot be neglected.

The vertical air temperature gradient increases with increasing room height and is also considerably dependent on the total design heat losses (insulation level of the building envelope and external design temperature) and on the type and location of heaters.

These effects should be taken into account by additions to the design heat losses. These additional design heat losses are best determined using the results of dynamic simulation calculations, as these take into account the individual properties of the building.

For buildings with design heat losses less than or equal to 60 Watts per square metre of floor area, the total design heat loss, Φ_i, for spaces with high ceilings can be corrected by introducing a ceiling height correction factor, $f_{h,i}$, as follows:

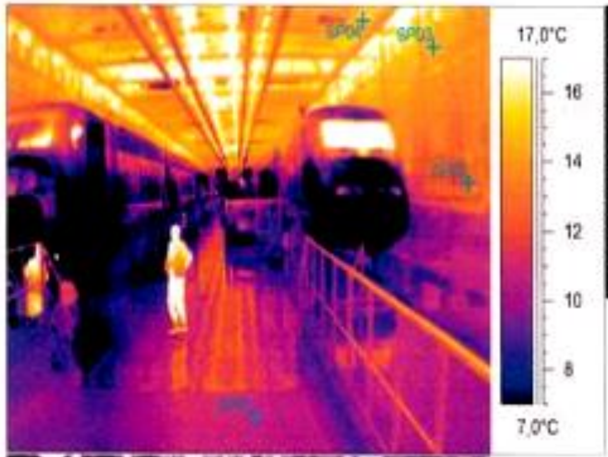
$$\Phi_i = (\Phi_{T,i} + \Phi_{V,i}) \cdot f_{h,i} \qquad [W] \qquad (30)$$

where values of $f_{h,i}$ are given in Table B.1.

Table B.1 - Ceiling height correction factor, $f_{h,i}$

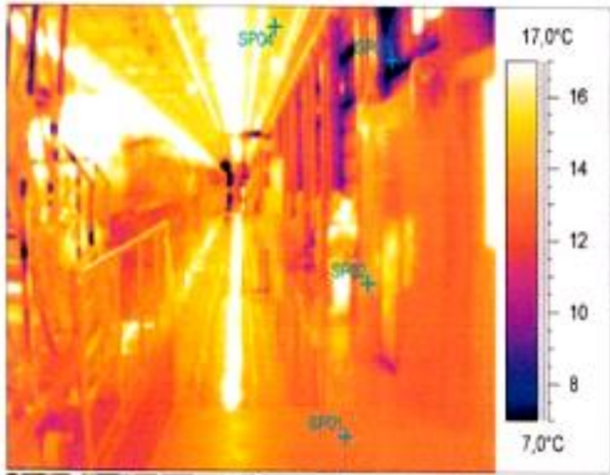
Method of heating and type or location of heaters	$f_{h,i}$ Height of heated space 5 to 10 m	10 to 15 m
MAINLY RADIANT		
Warm floor	1	1
Warm ceiling (temperature level < 40°C)	1,15	not appropriate for this application
Medium and high temperature downward radiation from high level	1	1,15
MAINLY CONVECTIVE		
Natural warm air convection	1,15	not appropriate for this application
FORCED WARM AIR		
Cross flow at low level	1,30	1,60
Downward from high level	1,21	1,45
Medium and high temperature cross air flow from intermediate level	1,15	1,30

The proof



IR-Daten	Wert
Erstellungsdatum	10.12.2002
Erstellungszeit	10:51:54
Objekt-Parameter	**Wert**
Emissionsgrad	0,98
Bezeichnung	**Wert**
SP01	11,1°C
SP02	12,2°C
SP03	14,3°C
SP04	15,1°C

Ort	neue Halle; Luftheizung
Bemerkung	*



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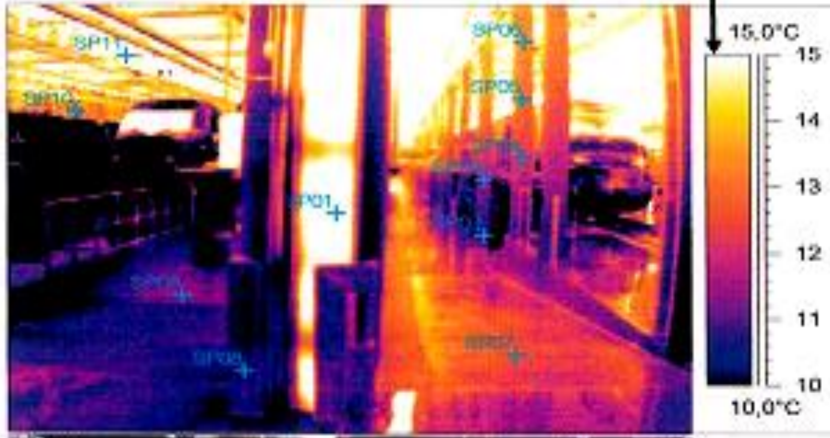
Erstellungszeit	10:42:15
Objekt-Parameter	**Wert**
Emissionsgrad	0,98
Bezeichnung	**Wert**
SP01	13,2°C
SP02	14,2°C
SP03	9,0°C
SP04	15,2°C

Ort	neue Halle; Strahlungsheizung
Bemerkung	*

The proof

geänderte Temperaturskala!



IR-Daten	Wert
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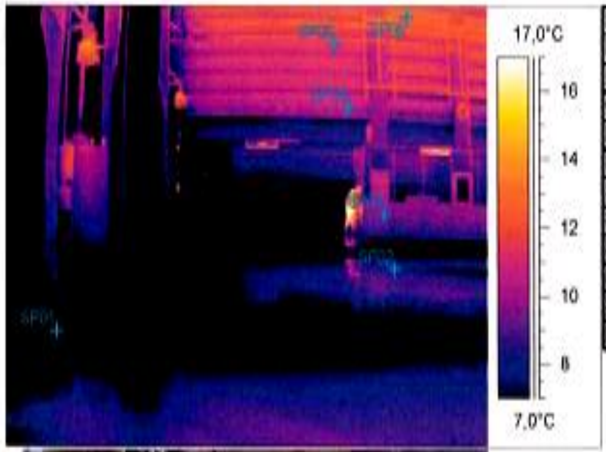
Erstellungszeit	10:57:13
Objekt-Parameter	**Wert**
Emissionsgrad	0,98
Bezeichnung	**Wert**
SP01	17,2°C
SP02	10,9°C
SP03	11,7°C
SP04	12,3°C
SP05	12,8°C
SP06	13,1°C
SP07	12,8°C
SP08	10,7°C
SP09	11,4°C
SP10	12,9°C
SP11	16,3°C

Ort	neue Halle: Luft- und Strahlungsheizung
Bemerkung	*

The proof



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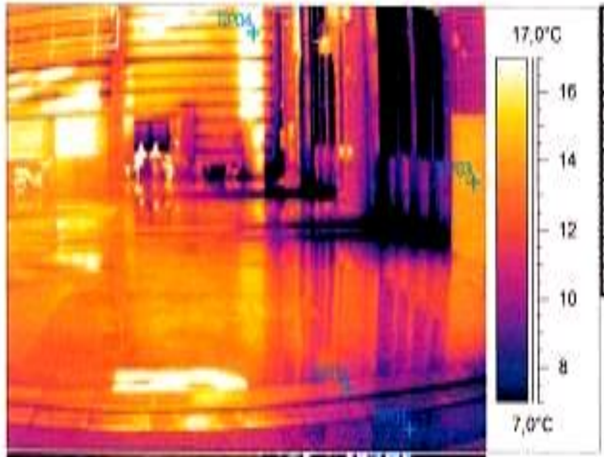
Erstellungsdatum	10.12.2002
Erstellungszeit	11:11:40
Objekt-Parameter	**Wert**
Emissionsgrad	0,98
Bezeichnung	**Wert**
SP01	1,5°C
SP02	7,6°C
SP03	9,6°C
SP04	10,7°C
SP05	11,6°C
SP06	12,5°C

Ort	neue Halle; Luftheizung
Bemerkung	*



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Erstellungszeit	11:11:23
Objekt-Parameter	**Wert**
Emissionsgrad	0,98
Bezeichnung	**Wert**
SP01	8,3°C
SP02	11,3°C
SP03	14,8°C
SP04	18,0°C

Ort	neue Halle; Strahlungsheizung
Bemerkung	*

Basic principles of radiant heating and cooling

- **In heating mode** panels are heated by warm water. They will emit energy into the room space.
- Energy is distributed mainly with low intensity infrared waves, which will heat surfaces not air.
- Objects with a surface temperature between 20 and 100°C will emit infrared waves with a length wave between 8 and 10 µ.
- This thermal radiation is blocked by windowpanes.
- Heating feeling is very natural - similar to sunshine with lower intensity.

Basic principles of radiant heating and cooling

- **In cooling mode** cooled water flows through the panels.
- People and objects in the room exchange their surplus of heat with the cooler panel via radiant heat transfer. Additionally, warm air will rise up to the ceiling and hit the cooling panel.
- Heat energy transfers into the panel. Cooled air will flow down with very slow air speed. This is the natural cooling convection part.

Always the best indoor climate

- RCPs create a comfortable room temperature and significantly improve indoor climate
- The presence of the radiant ceiling system is hardly noticeable:
  - Noiseless
  - Draught-free
  - No dust dispersal
  - Constant heat distribution ⟷ ↕
  - Hygienic
- Ceiling installation creates more space on the floor and walls

Always the right temperature means energy and environmental savings

- High heating and cooling output
- Extremely short reaction time
- Minimal maintenance costs:
    - No fans or filters that require cleaning and replacement
    - No need for condensate drainage
- Suitable to use with all energy sources
- Ideal for the buildings of all sizes, for both new buildings and renovation projects
- Finnish quality products with long life cycle
- Materials can be recycled to 100%

ituGraf®

For residential and commercial buildings

ituString+®

For sport halls, show rooms, industrial and logistic buildings

ItuGraf heating and cooling panel

- The most effective heating and cooling panel on the market!
- Graphite filling ensures efficient thermal conductivity
- Applications
  - Offices and business premises
  - Hotels
  - Hospitals
  - Apartments
  - Schools and other public buildings

- CE-marked ItuGraf panels are tested in accordance with the EN14037 standard

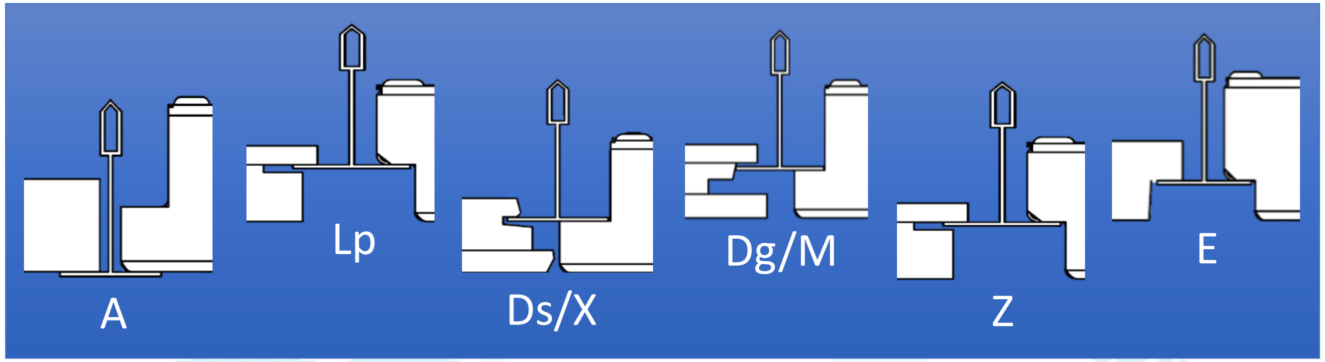
ItuGraf heating and cooling panel

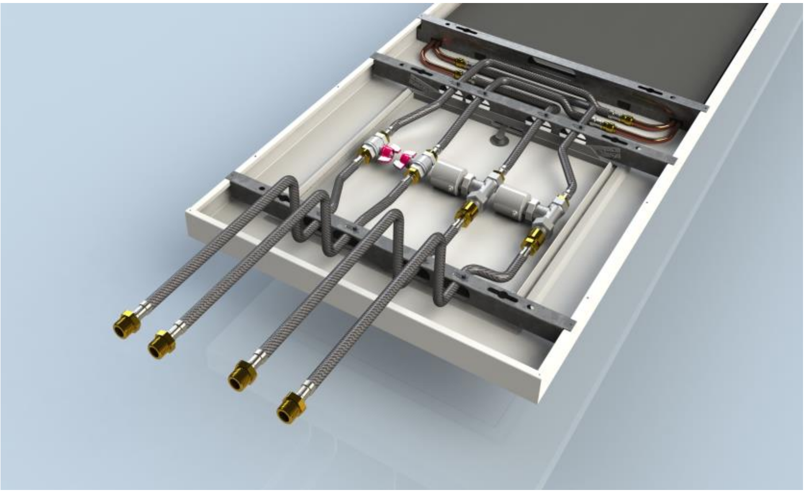
- Standard models
  - Width 600 - 1200 mm,
  - Length 600 - 3600 mm
  - Standard white RAL9016 (all RAL-colors available)
  - Standard surface smooth (perforated surface for better acoustics available)
- Installation options
  - Free hanging
  - Integrated in the suspended ceiling
  - Patented surface bracket

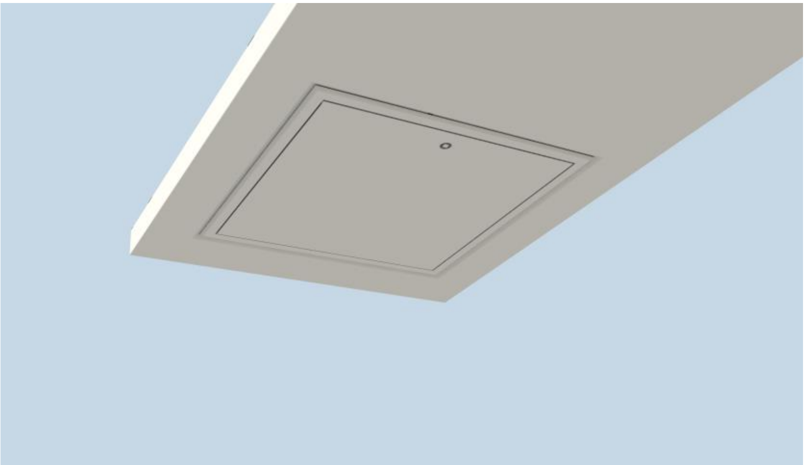
ituGraf®

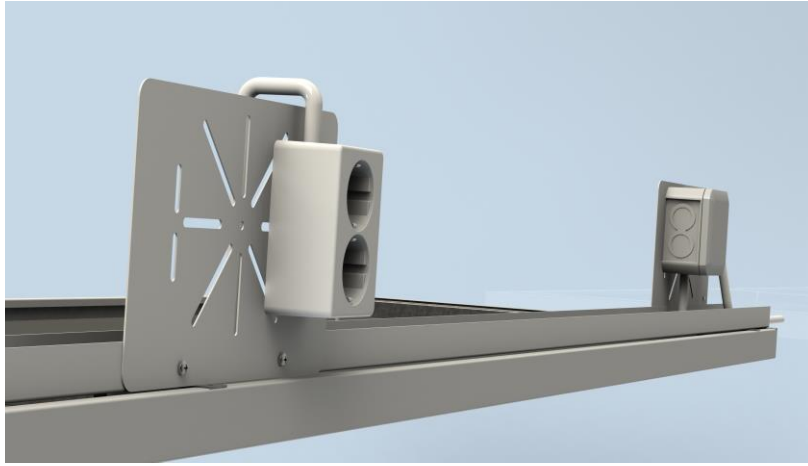
ItuGraf ceiling models

- ItuGraf ceiling models ensure a consistent look and color scheme with the desired suspended ceiling
- Compatible with St.Gobain's Ecophon Focus/Master and with Rockfon acoustic ceiling systems





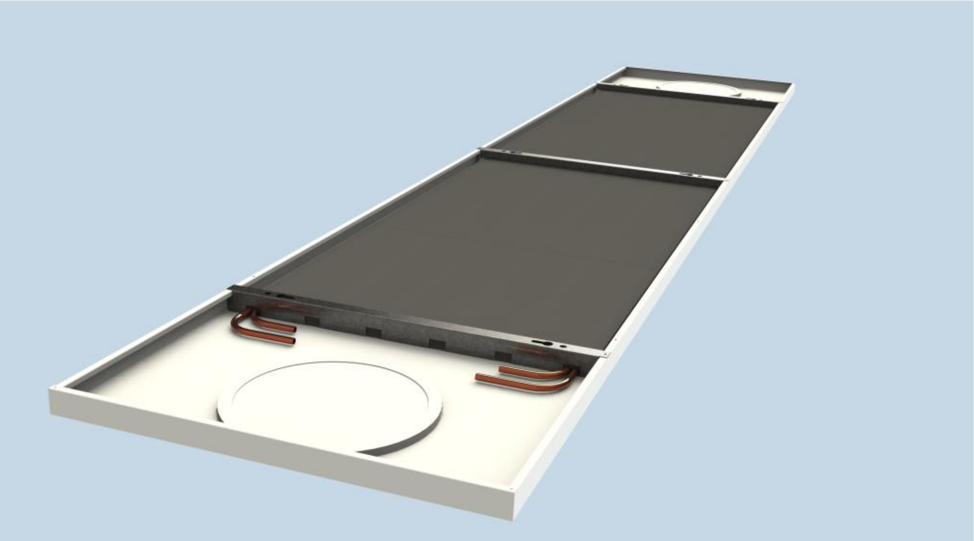


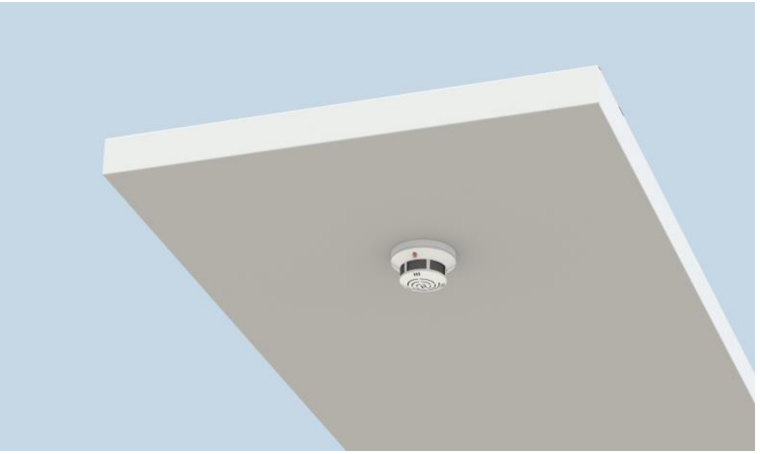


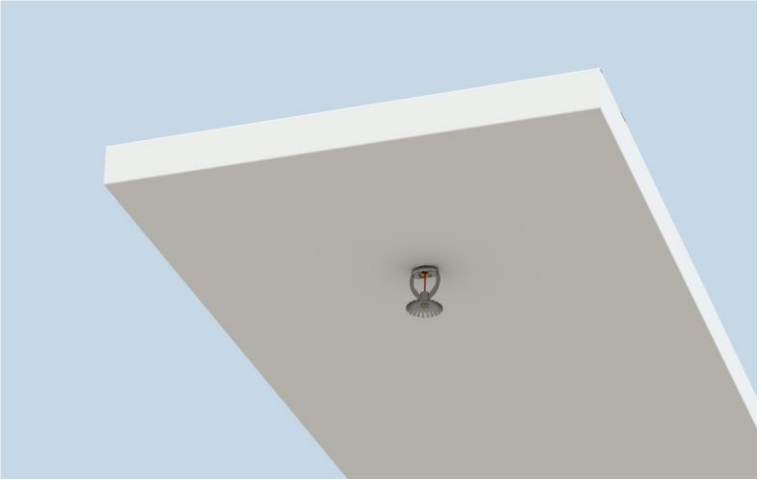
ituGraf®

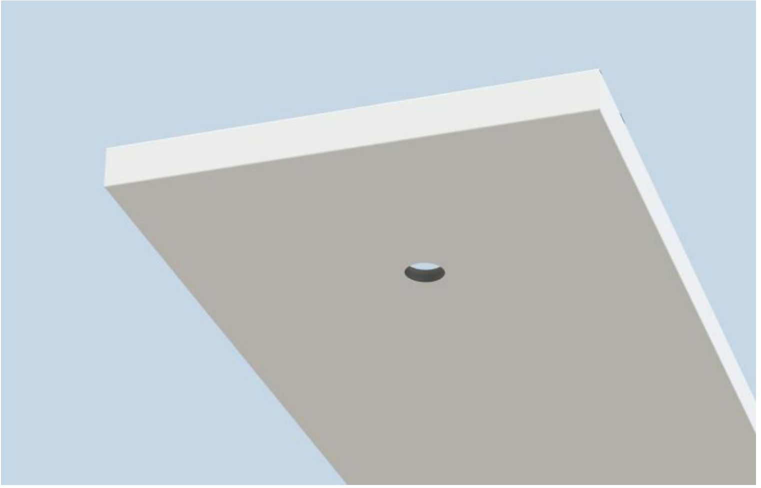
ITUGRAF AS A BUILDING TECHNOLOGY INSTALLATION PLATFORM

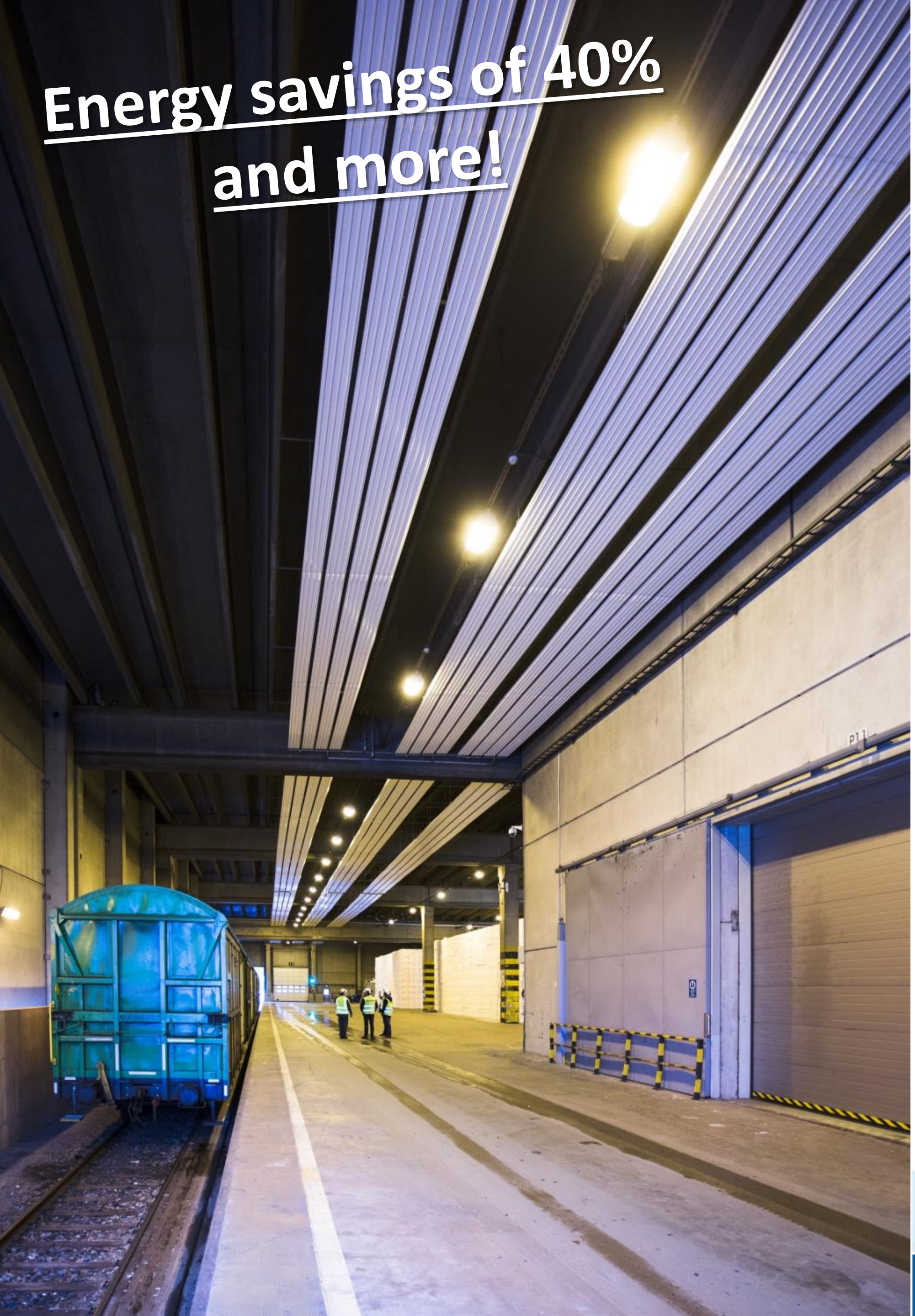
Lighting sensors • Fire and smoke detectors
Electric sockets • Data sockets • Ventilation valves
Access panels • Valves • Actuators





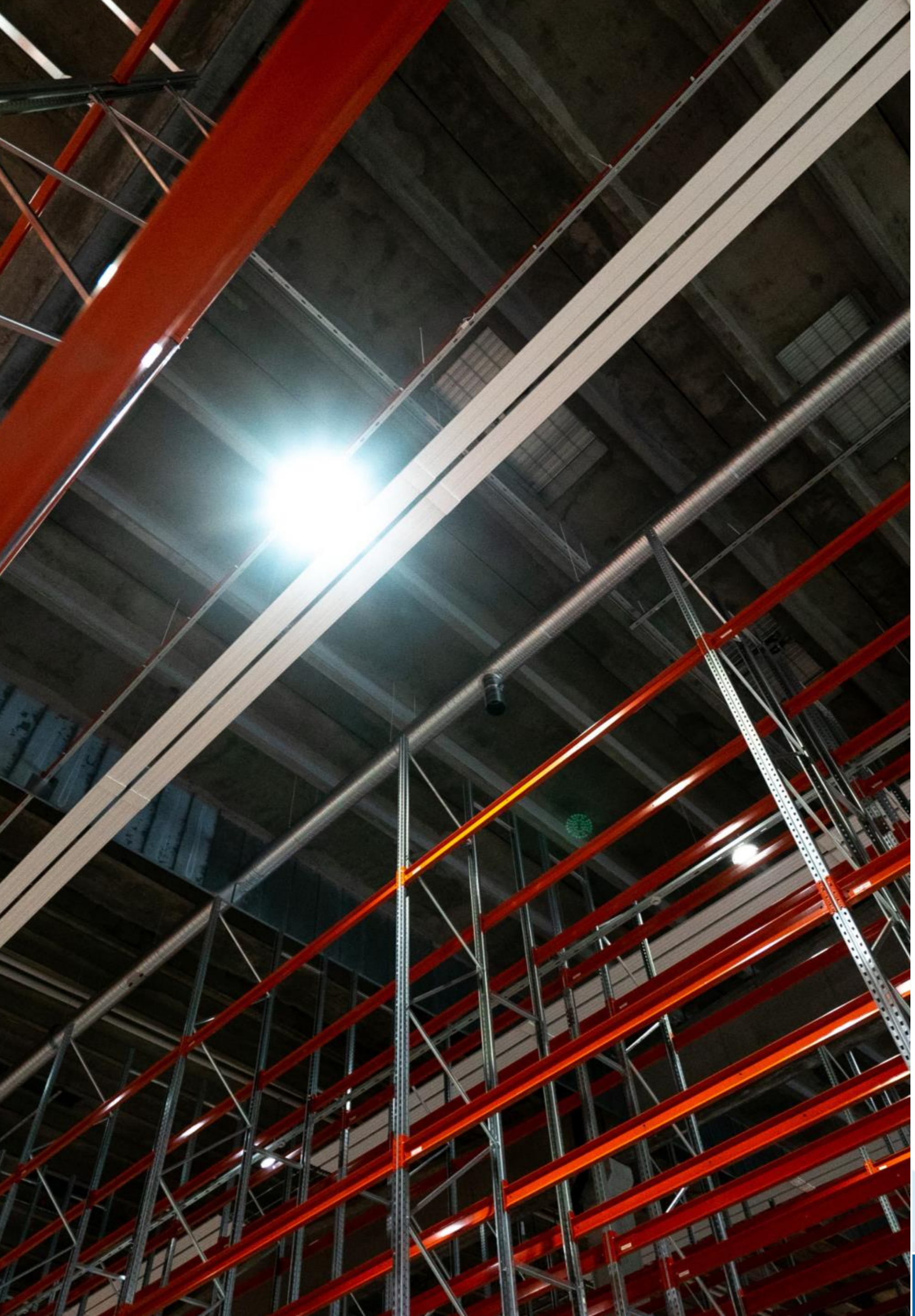






New model - ItuString+

- Guarantees optimal indoor climate conditions and lower energy consumption in sites even with 30 metres in height
- Applications
  - Sport halls
  - Logistic centers
  - Production halls and warehouses
  - Maintenance halls and hangars (for Buses, trains, aircrafts, …)
  - Shopping malls
  - Showrooms
  - Wet rooms
  - Farming (livestock farming – greenhouse)
- CE-marked ItuString+ panels are tested in accordance with the EN14037 standard



Hassle-free installations on all sites

- Modular design, can be combined freely in terms of both length and width, length 3, 4, 5 and 6 m, width 320 mm
- Modular structure enables installations on all sites, and its light weight makes installation easy (< 5 kg/m module)
- Connecting ceiling panels with crimp fittings, it is possible to put panels together over strip lengths of 70 meters

Itula’s Partner in Estonia

S.F.P. Group OÜ

Contact: Janek Teder, tel. +372 511 6800

www.sfp.ee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THANK YOU!

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