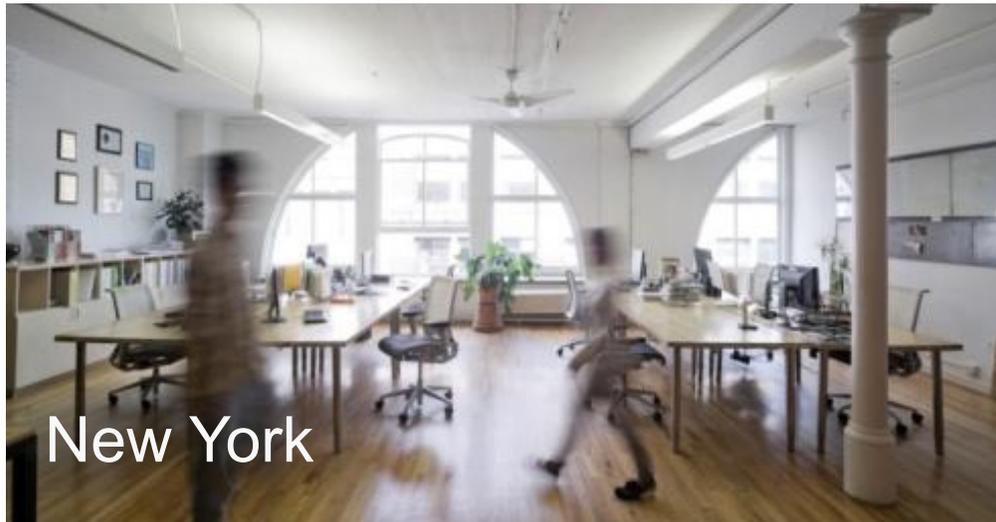


Bauwerksbegrünung aus Sicht des Klimaengineerings

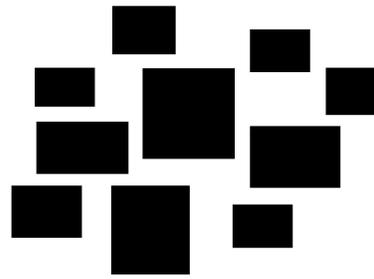


Prof. Volkmar Bleicher, 31.01.2020

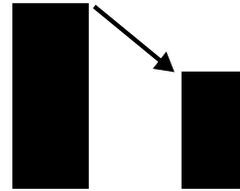
Standorte



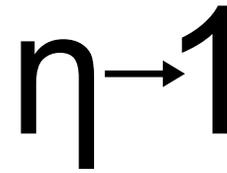
Klimaengineering: Ziele



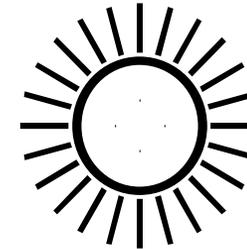
1
Optimierung des
Städtebaus für
Außenbezug, Tageslicht, Solarenergie
+ Außenkomfort



2
Minimierung des
Gebäudeenergiebedarfs



3
Maximierung der
Energieeffizienz

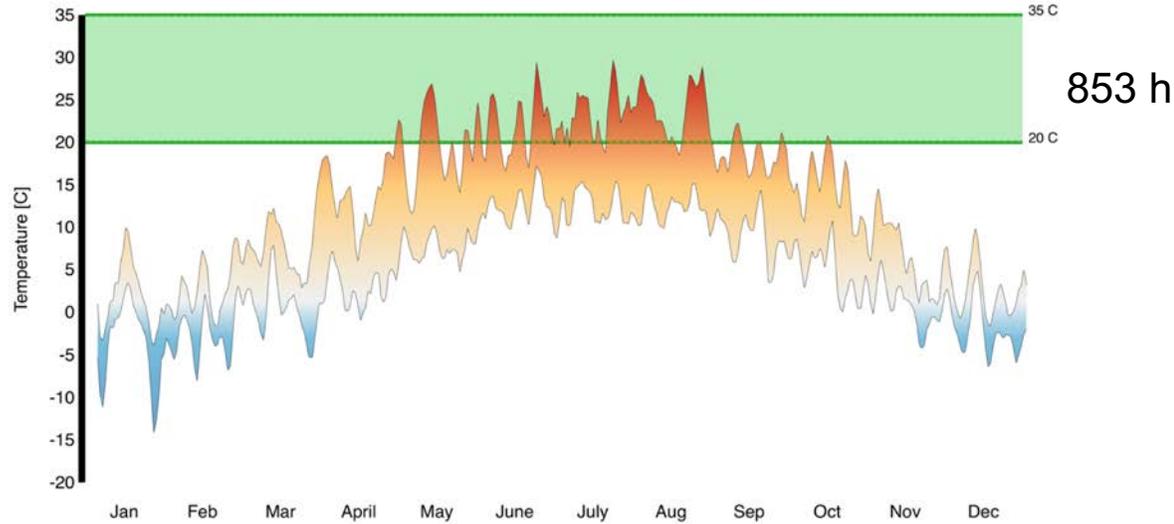


4
Maximierung der
erneuerbaren Energien

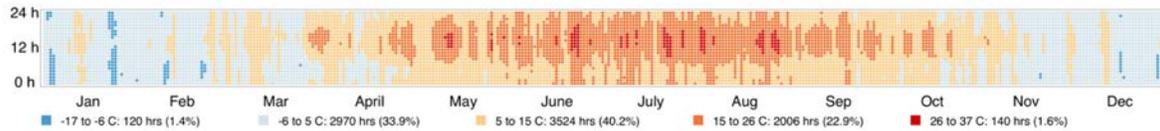


Klima: Entwicklung

2015

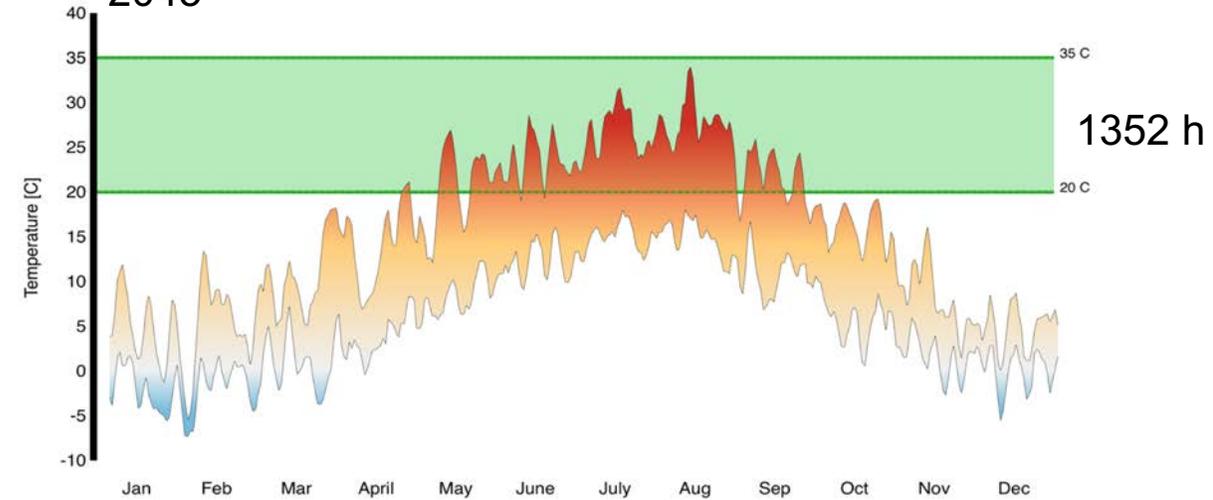


Station name: try2015y_Garching
 Period of min-max average: 3 days
 Yearly temperature [C] profile
 853 Hours in bounds (out of 8760) between 20 and 35 C
 Turn: 0 degrees

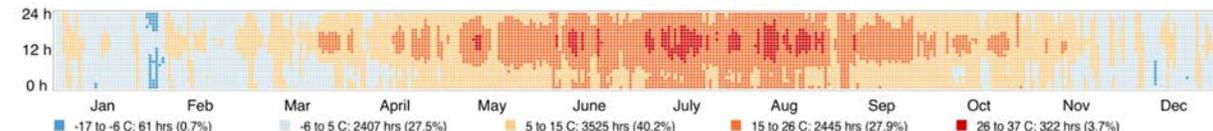


Station Name: try2015y_Garching
 Temperature between -17.2 and 37 C
 Relative humidity between 21 and 100 %
 Jan 1 to Dec 31
 From 0h to 24h
 8760 hrs (100%) within selection criteria
 Turn: 0 degrees

2045



Station name: try2045s_Garching
 Period of min-max average: 3 days
 Yearly temperature [C] profile
 1352 Hours in bounds (out of 8760) between 20 and 35 C
 Turn: 0 degrees



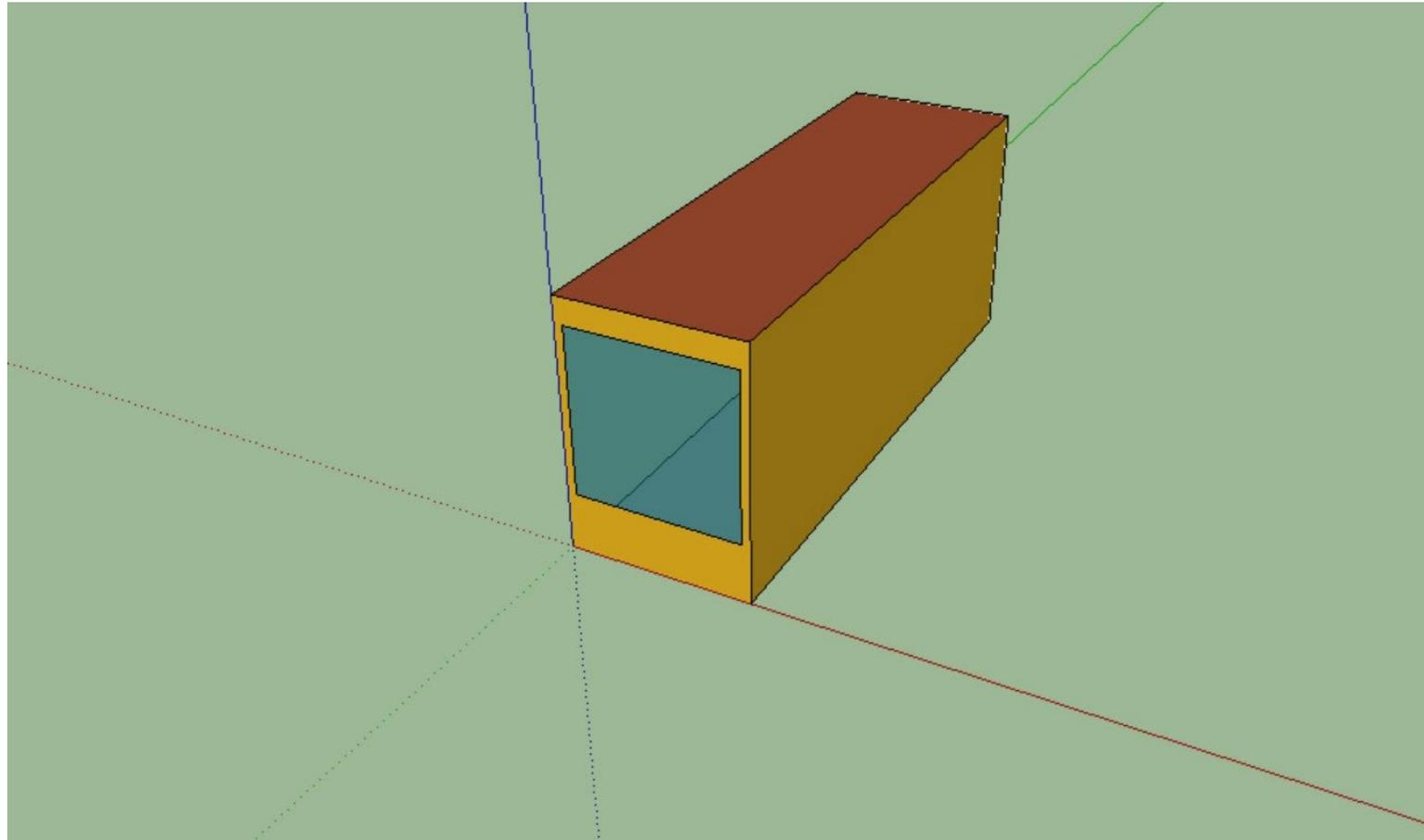
Station Name: try2045s_Garching
 Temperature between -17 and 37 C
 Relative humidity between 16 and 100 %
 Jan 1 to Dec 31
 From 0h to 24h
 8760 hrs (100%) within selection criteria
 Turn: 0 degrees

→ Entwicklung: signifikante höhere Temperaturen tags wie nachts!

Klima: Entwicklung

Auswirkung auf natürliche Lüftungskonzepte?

Beispiel: Holzmodul, Vollholzwände, natürliche Lüftung



Raummaß:
7m x 2,1m x 2,9m

Fenstermaß:
1,92m x 1,92m

Normal Wetterdatensatz 2015

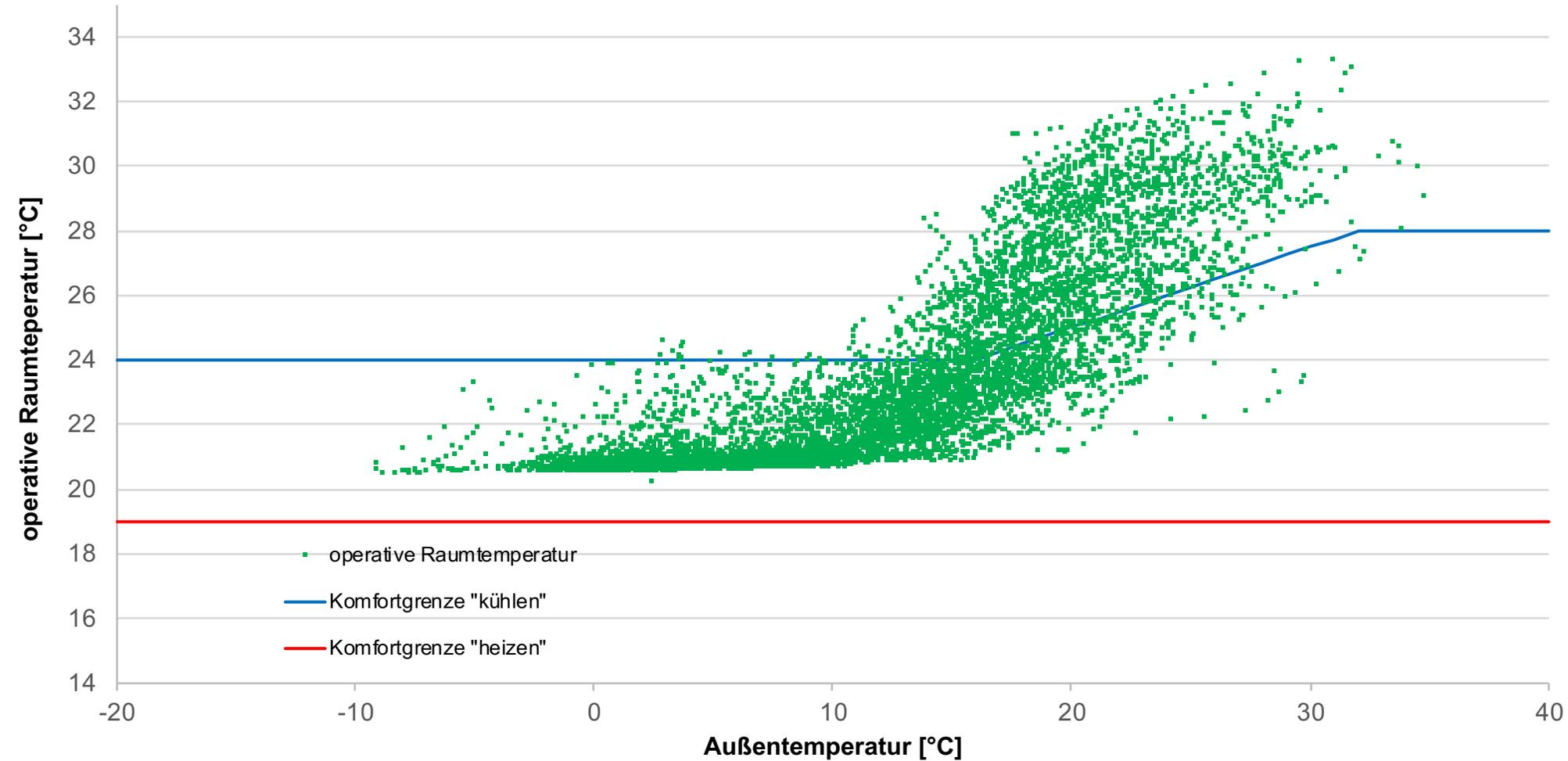
Beispiel: Holzmodul, Vollholzwände, natürliche Lüftung

Übertemperaturstunden >26°C:

Top: 513 h

Grenze: 500 h

Büro - operative Raumtemperatur über Außentemperatur



Sommer Wetterdatensatz 2045

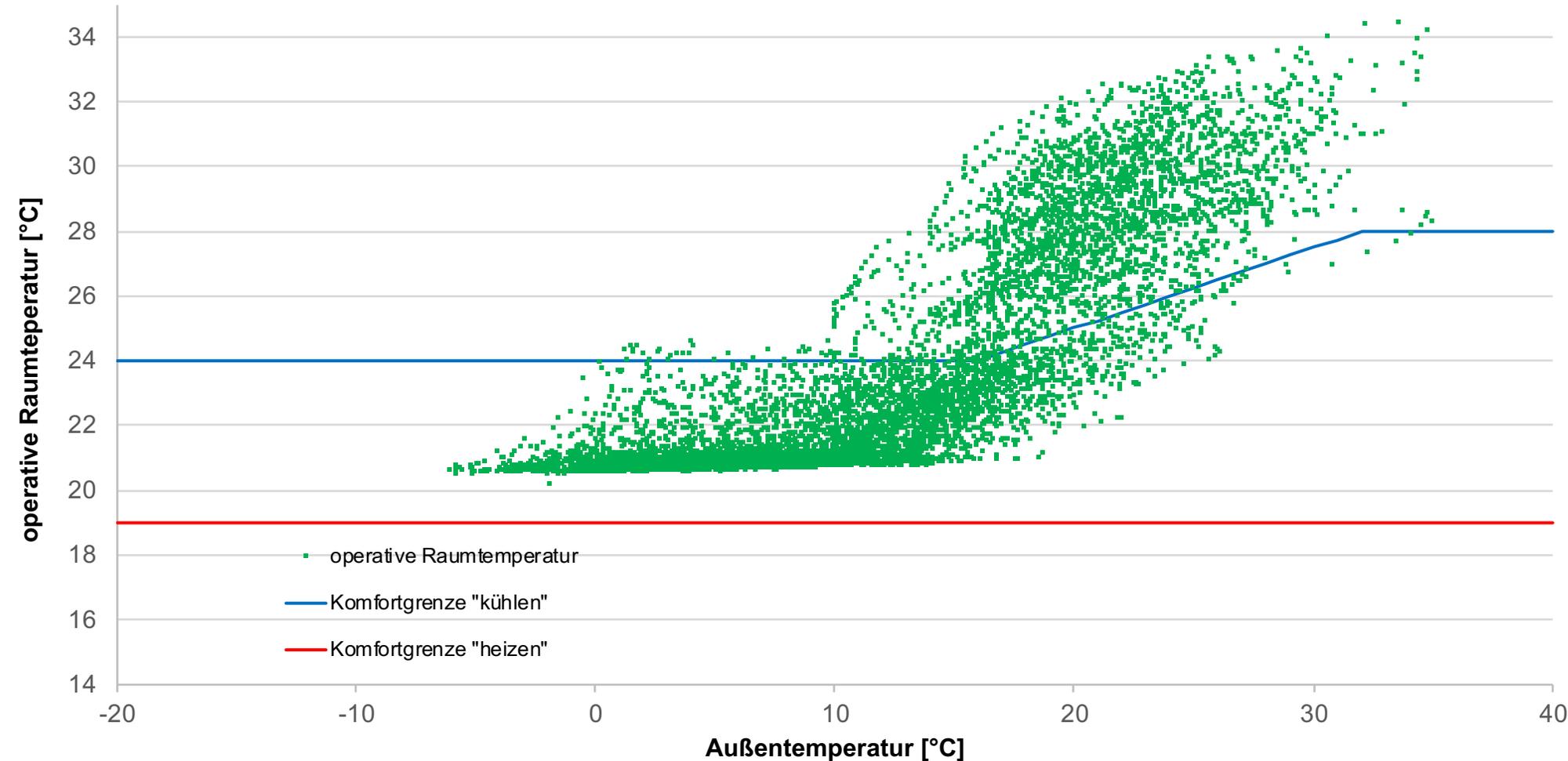
Beispiel: Holzmodul, Vollholzwände, natürliche Lüftung

Übertemperaturstunden >26°C:

Top: 701 h

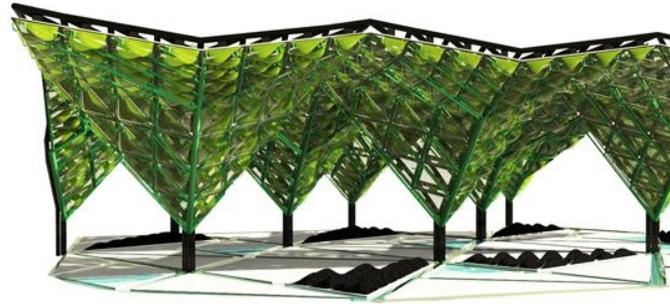
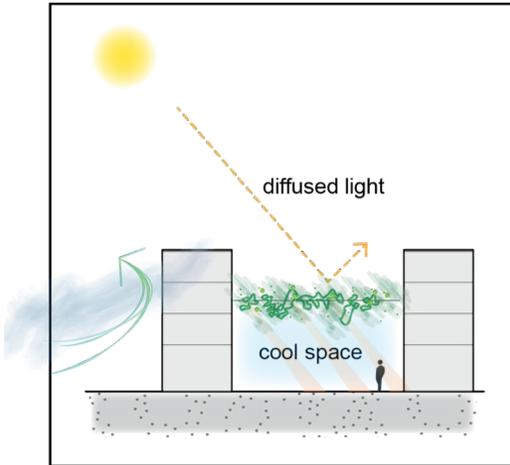
Grenze: 500 h

Büro - operative Raumtemperatur über Außentemperatur



→ Entwicklung: Außenzulufttemperatur muss reduziert werden!

Passive Strategies, sun (urban scale) *shading by vegetation*

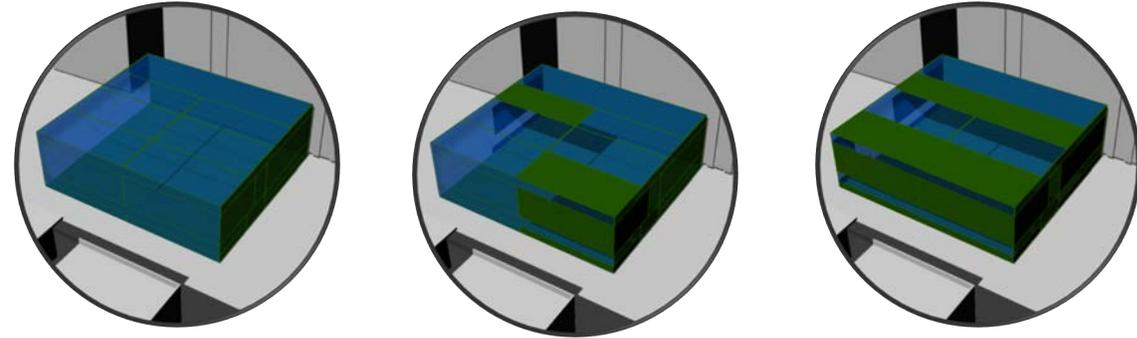


Passive Strategies, sun (urban scale) *shading*

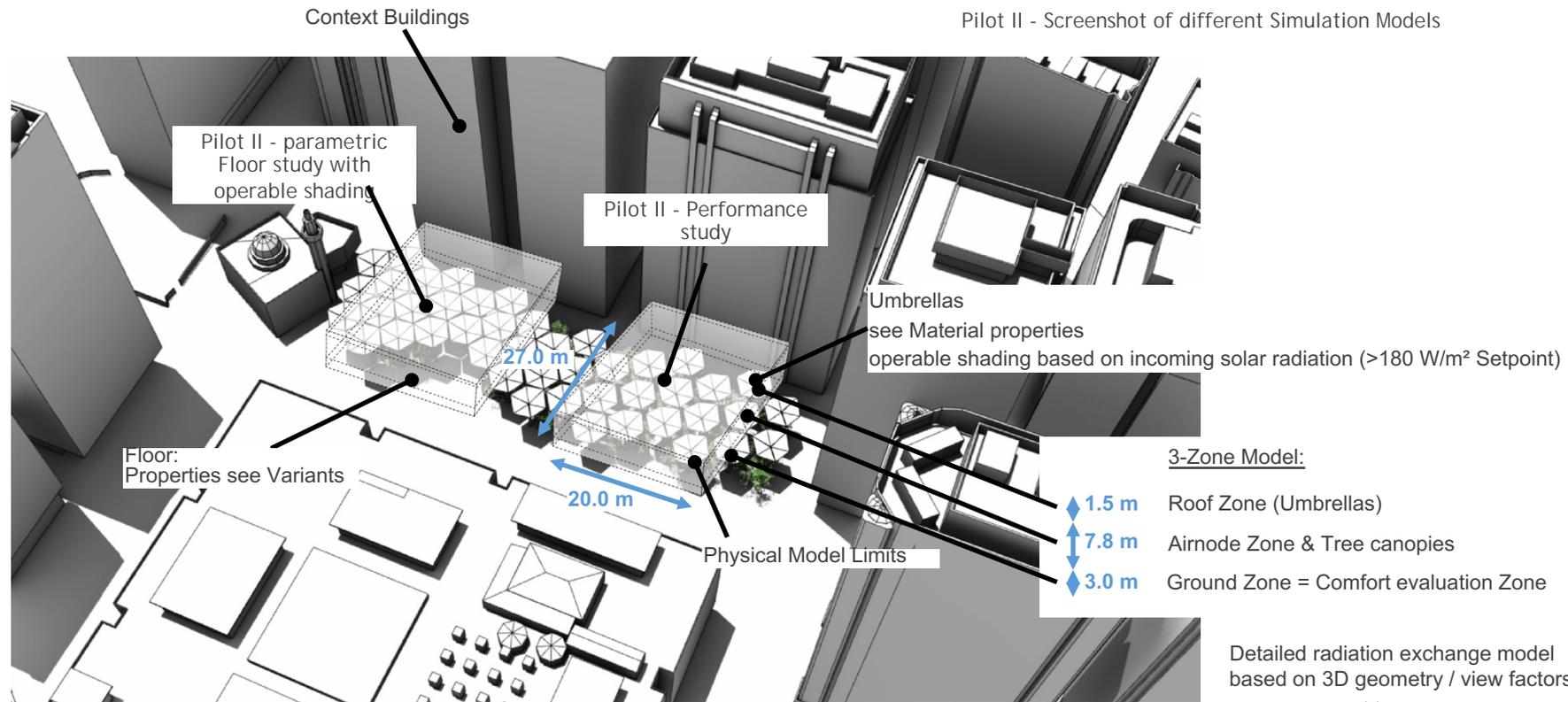


→ Frage: reicht eine Verschattung aus, oder sind noch andere Maßnahmen notwendig?

Beispiel: Außenbereich im heißen Klima

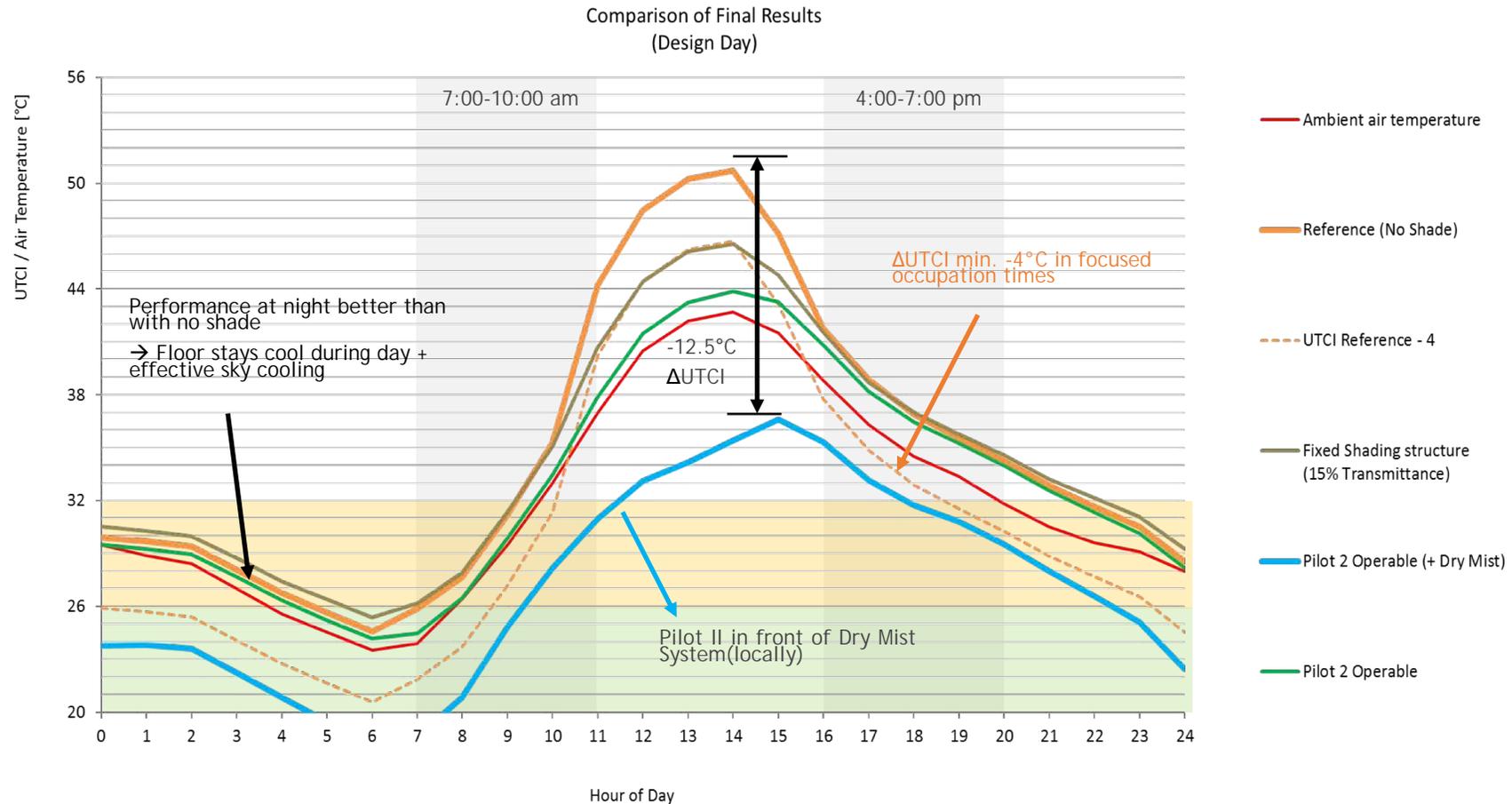


Pilot II - Screenshot of different Simulation Models



Beispiel: Außenbereich im heißen Klima

Design Day



- Pilot II achieves a UTCI reduction of 4°C in areas with Dry Mist for selected times.
- A maximum UTCI reduction of ~ 12.5°C is achieved at peak conditions (1:00-3:00 pm)
- Operable shading has the best performance during day AND night

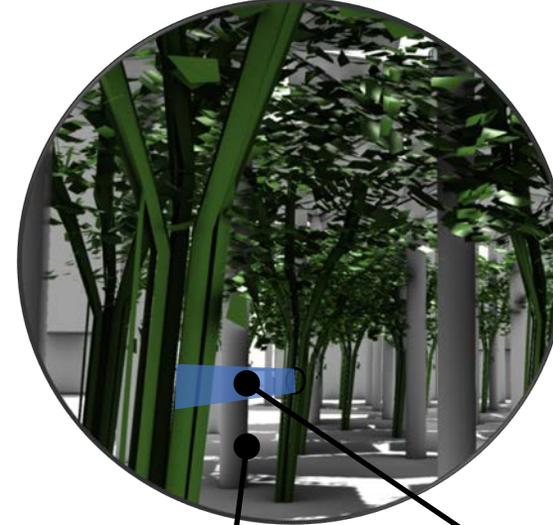
Beispiel: Außenbereich im heißen Klima

Statistics

May & October
7:00 - 10:00 am &
4:00 - 7:00 pm



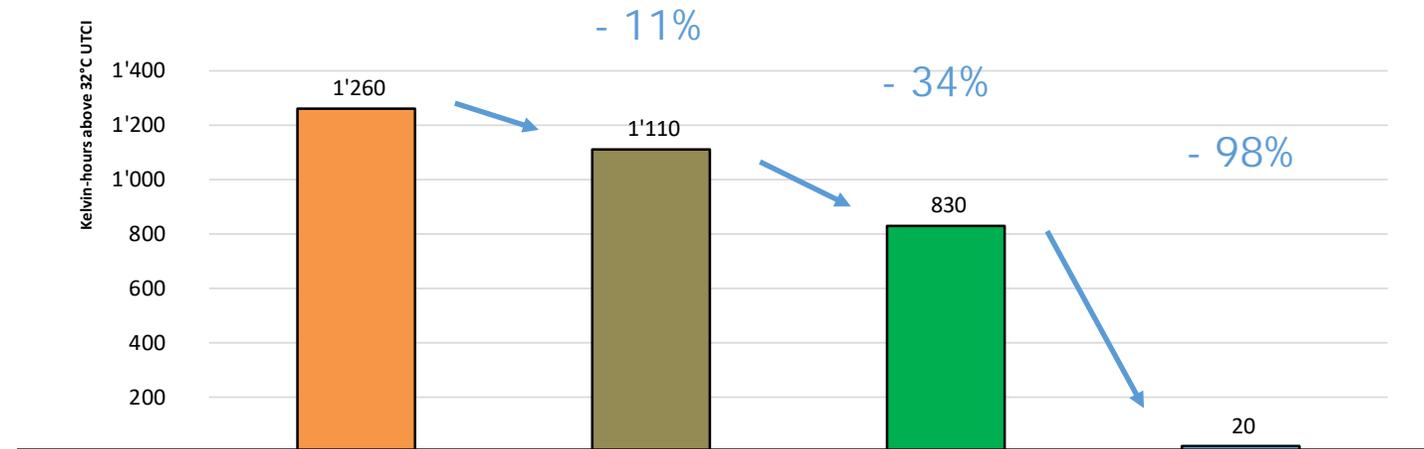
Reference
(No Shade)



Bad shading
(15% Transmittance)

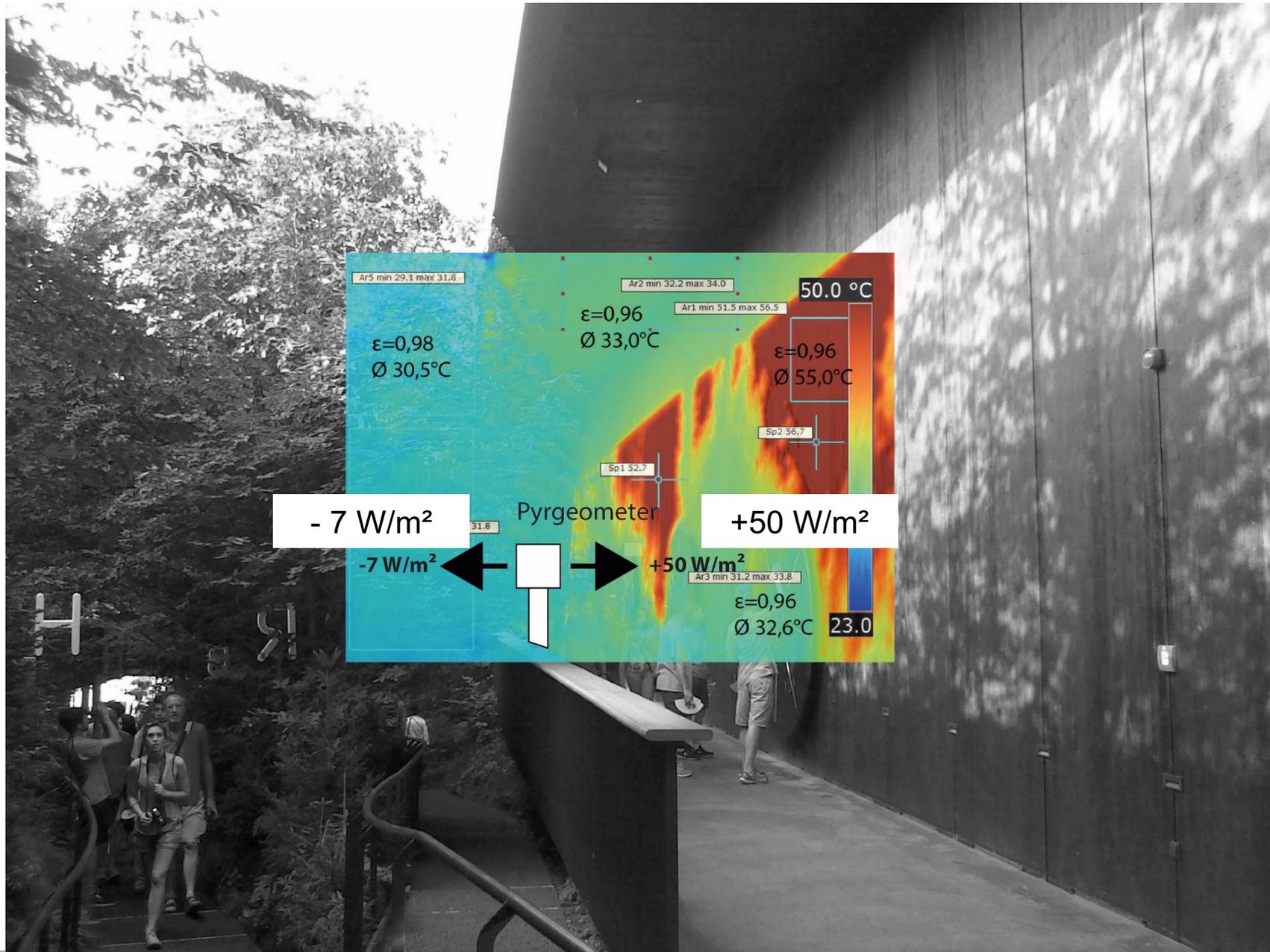
Umbrellas
operable + 25%
Vegetation

Umbrellas
operable + 50%
Vegetation
+ Dry Mist

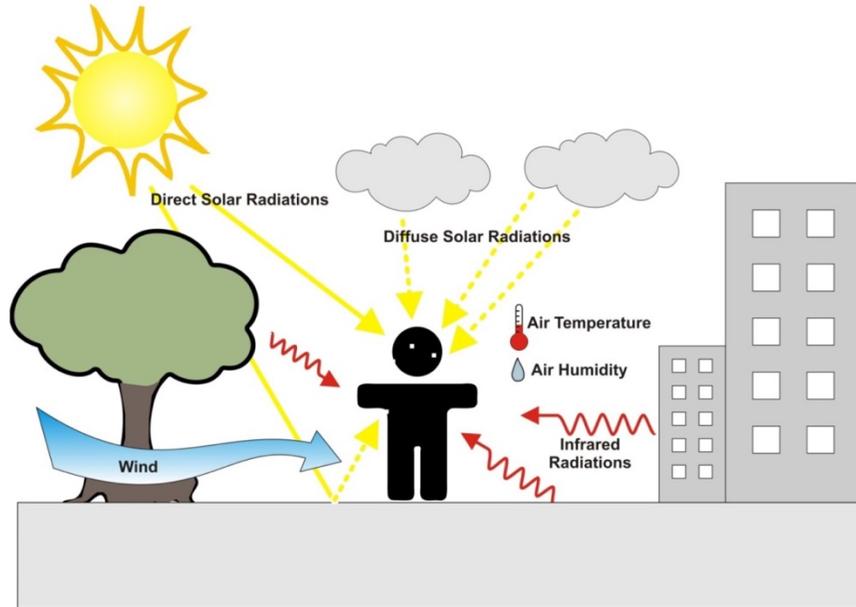


→ Fazit: hoher Anteil Begrünung und Befeuchtung sind sehr effizient!

Auswirkung verschiedener Strahlungstemperaturen

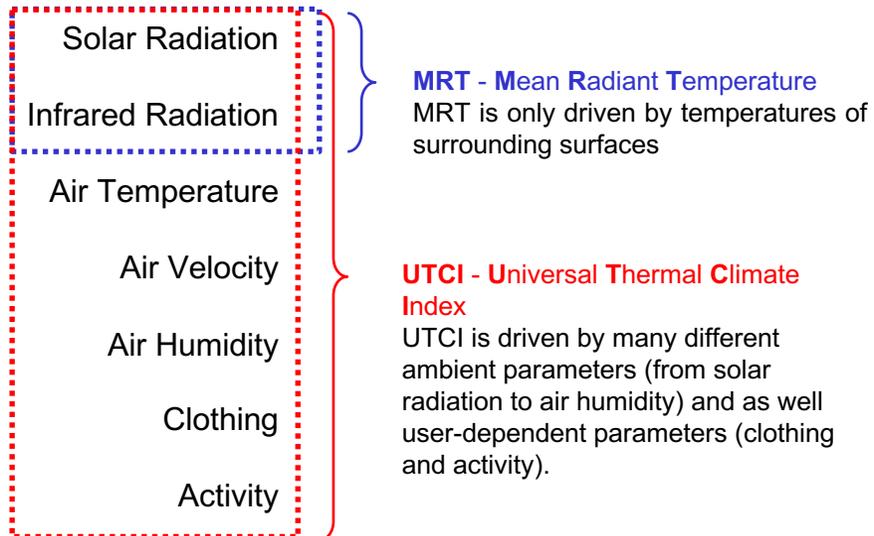


Climate Engineering

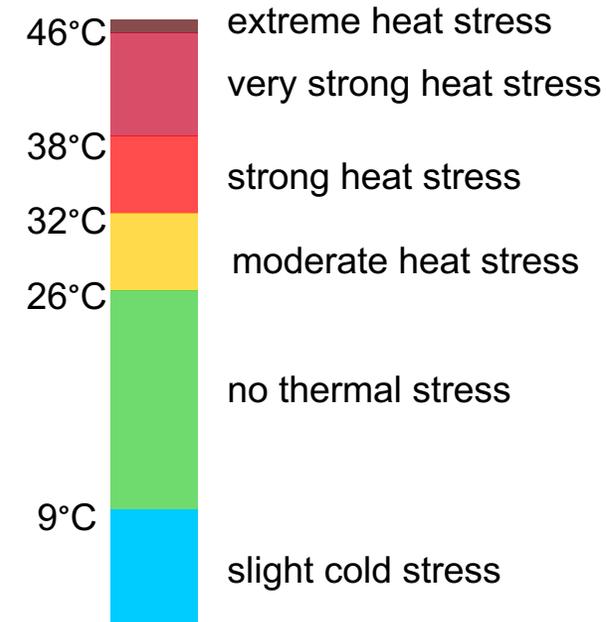


Human thermal comfort (the sensation of heat and cold) cannot only be defined just by air temperature, as it depends on many other ambient and human-related parameters. To assess thermal comfort as accurately as possible, one must account for these parameters. An index, **Universal Thermal Climate Index (UTCI)**, was internationally developed over several years, then released in 2009. UTCI uses a 340-node model of the human body in order to assess heat transfer phenomena which impact thermal comfort.

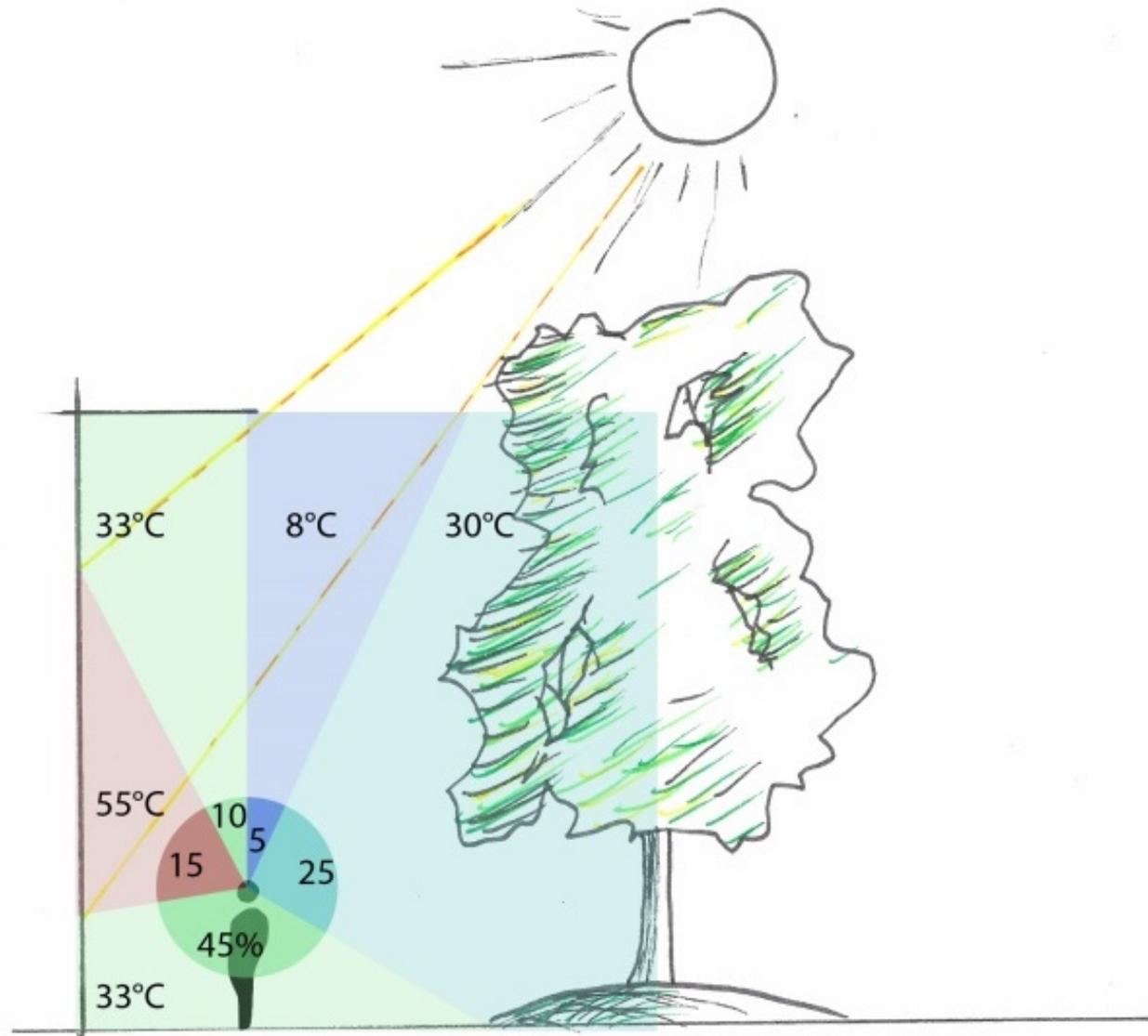
Parameters which influence comfort



Thermo-physiological response of the human body



RADIANT TEMPERATURE. Optimization Pavilion.



Reference conditions:

$$T_{air} = 30.0^{\circ}\text{C}$$

$$RH = 60.0\%$$

$$v = 0.3 \text{ m/s}$$

$$\text{MRT} = 34.5^{\circ}\text{C}$$

(reference)

$$\text{UTCI} = 32.5^{\circ}\text{C}$$

(reference)

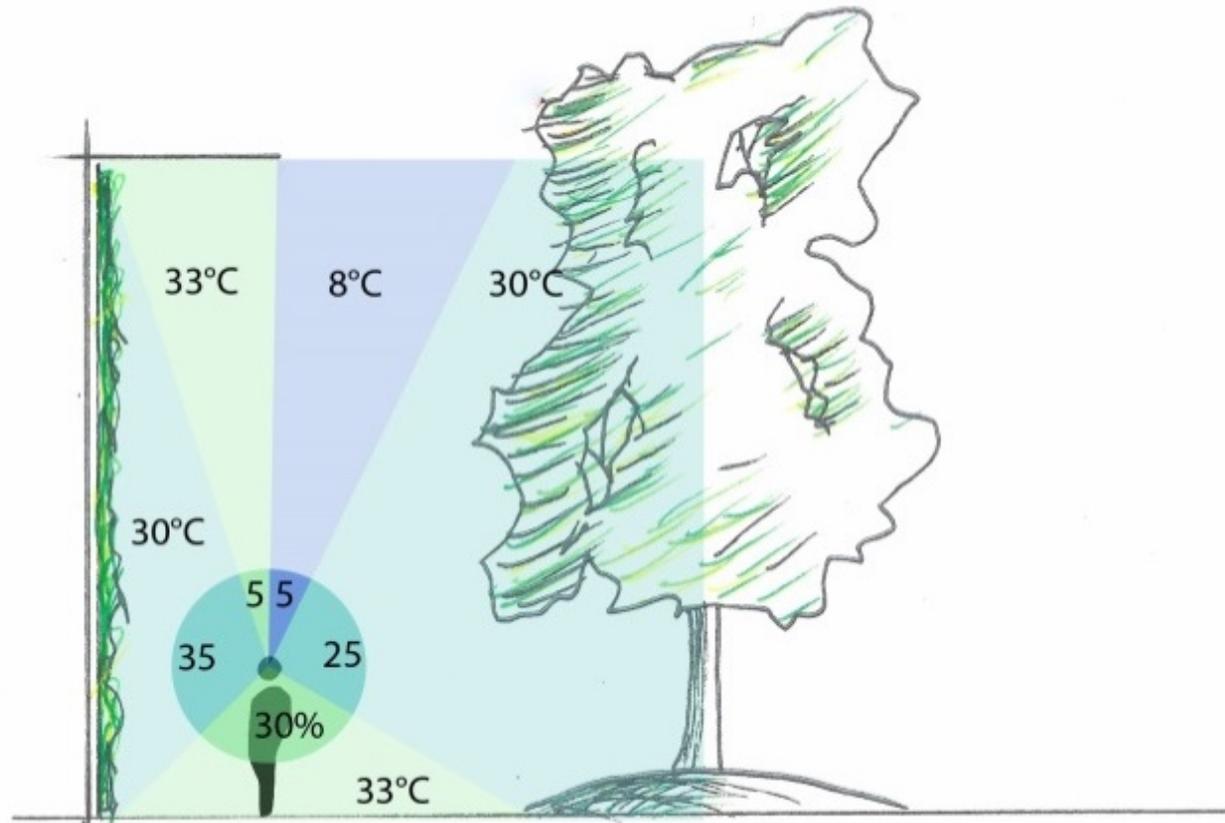
RADIANT TEMPERATURE. Optimization Pavilion.

Reference conditions:

$$T_{air} = 30.0^{\circ}\text{C}$$

$$RH = 60.0\%$$

$$v = 0.3 \text{ m/s}$$



$$\text{MRT} = 30.0^{\circ}\text{C}$$

$$(- 4.5^{\circ}\text{C})$$

$$\text{UTCI} = 31.3^{\circ}\text{C}$$

$$(- 1.2^{\circ}\text{C})$$

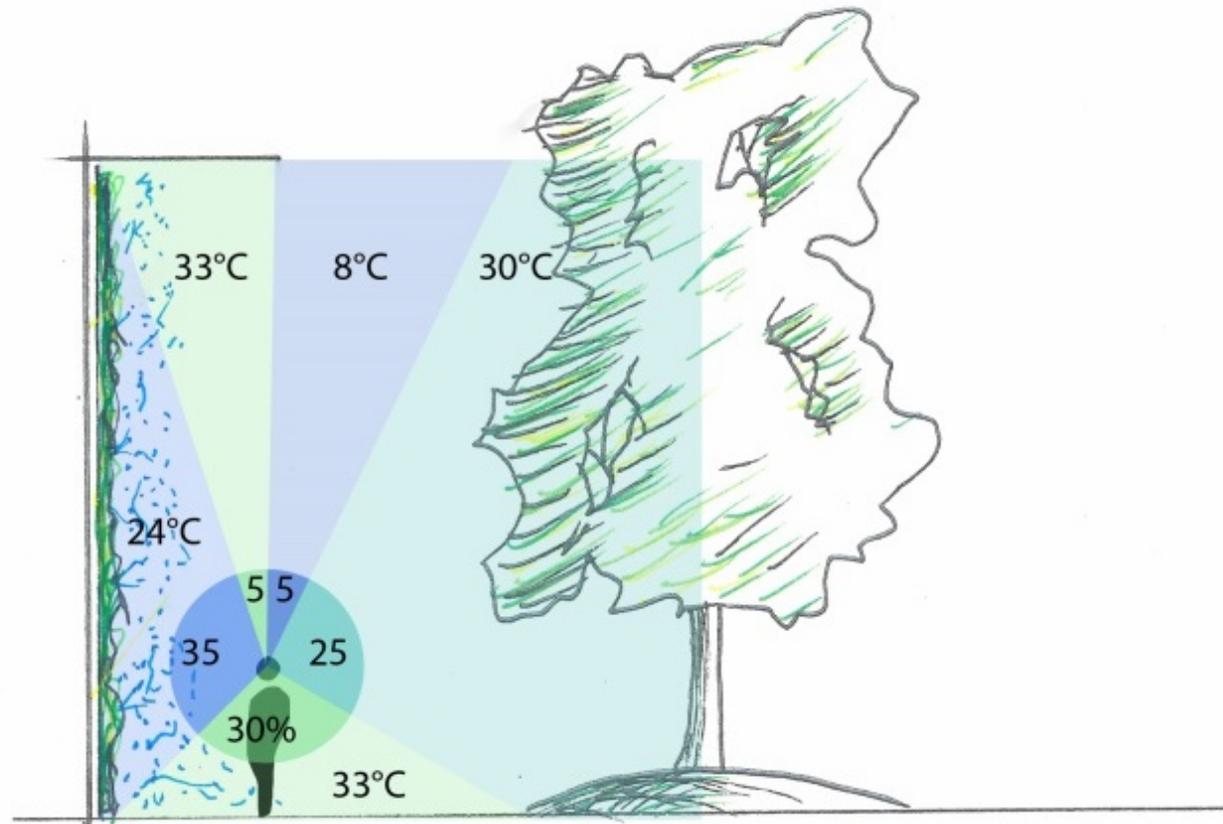
RADIANT TEMPERATURE. Optimization Pavilion.

Reference conditions:

$$T_{air} = 30.0^{\circ}\text{C}$$

$$RH = 60.0\%$$

$$v = 0.3 \text{ m/s}$$



$$\text{MRT} = 27.9^{\circ}\text{C}$$

$$(- 6.6^{\circ}\text{C})$$

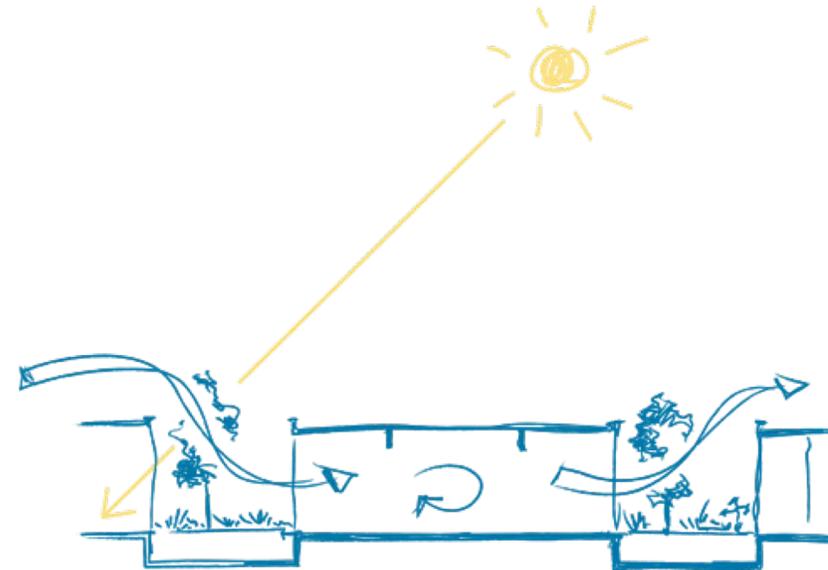
$$\text{UTCI} = 30.8^{\circ}\text{C}$$

$$(- 1.7^{\circ}\text{C})$$

→ Fazit: Reduktion der Temperatur aller Strahlungsteilnehmer ist wichtig !



Erlebniswelt & Schauproduktion Grüne Erde, Pettenbach, Österreich



Nature Invited:
Patios -
13 pieces of
forest and sky

Bauherr Grüne Erde Fertigstellung 2018 BGF 9.000
m² Architekt terrain: integral designs Generalplaner
ARKADE ZT GmbH Haustechnik Ökoenergie Greif
Fotos Grüne Erde (1)

Variantenübersicht, Betrachtung Sommerfall

Maßnahmen am Gebäude →

Maßnahmen mittels technischer Systeme ↓

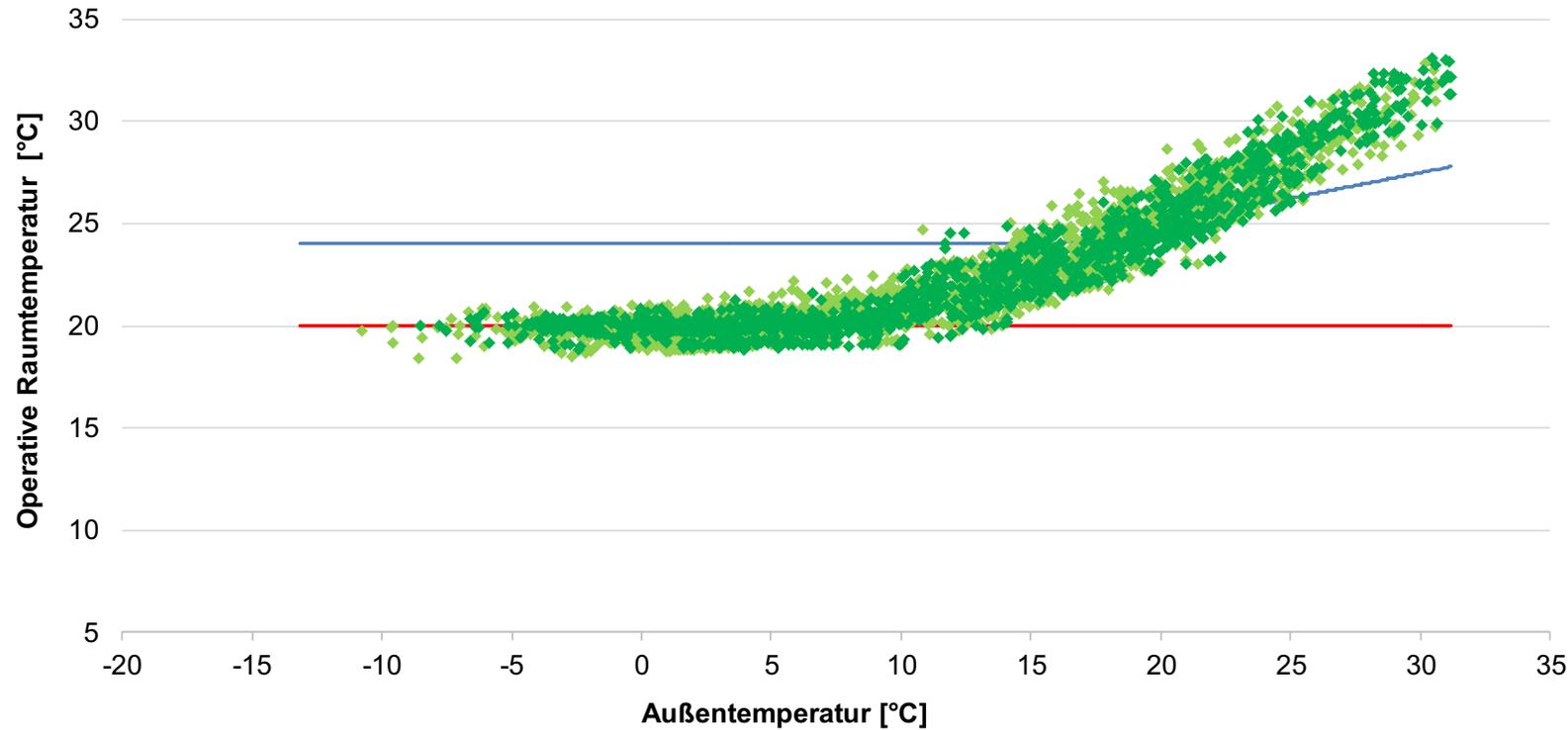
		Thermische Masse	+ Begrünung
Grundvariante	Variante S1		
+ Nachtlüftung	Variante S2	Variante S3	Variante S4
		Variante S5	

Variante S1

- Natürliche Lüftung

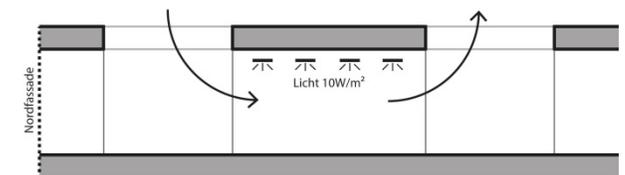


Nutzerkomfort



- ◆ Operative Raumtemperatur
- ◆ vor 09:00 Uhr
- ◆ nach 15:00 Uhr
- Solltemperatur Heizung unterschritten: 784h
- Solltemperatur Kühlung überschritten: 742h

Schematische Skizze

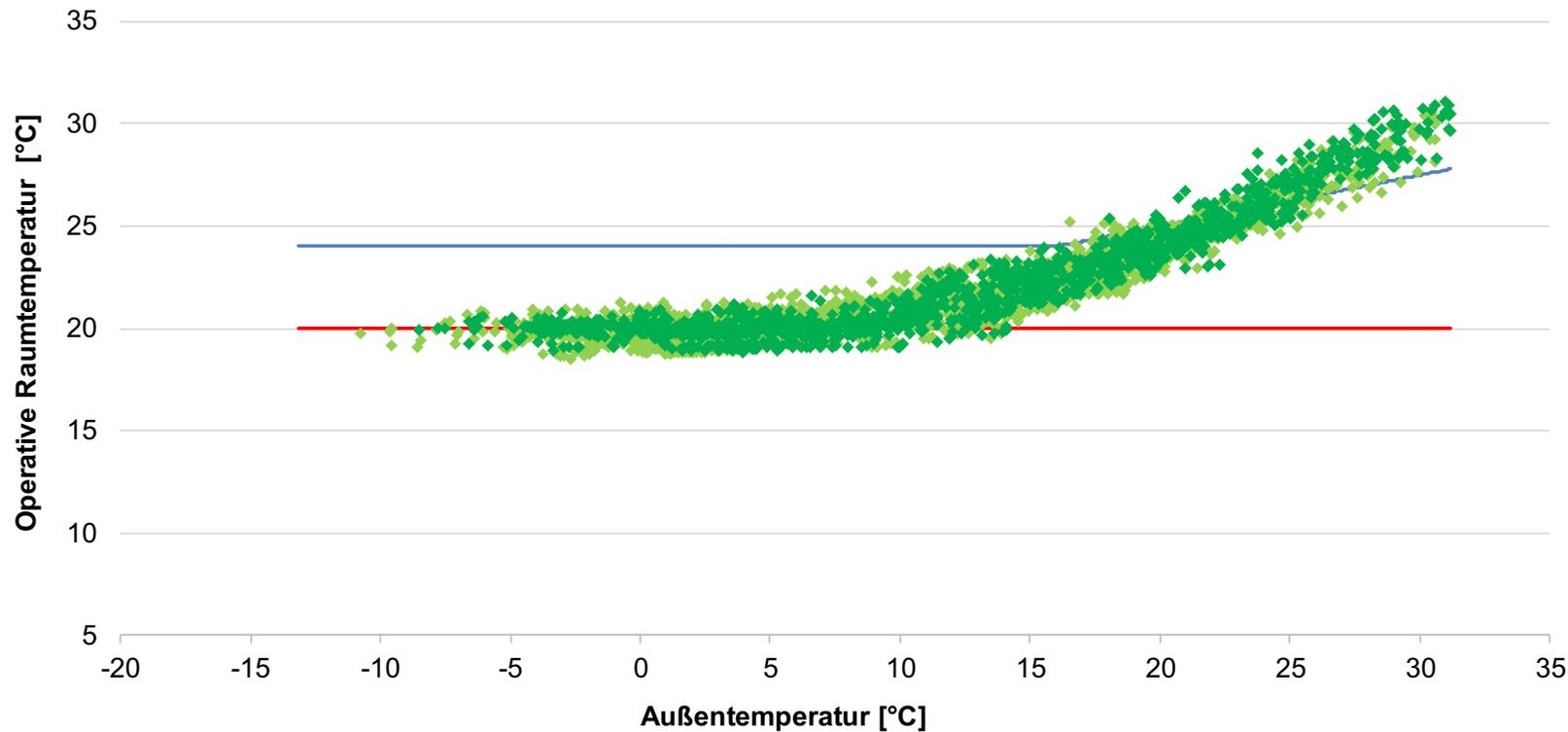


Variante S2

- Natürliche Lüftung
- **Nachtlüftung**

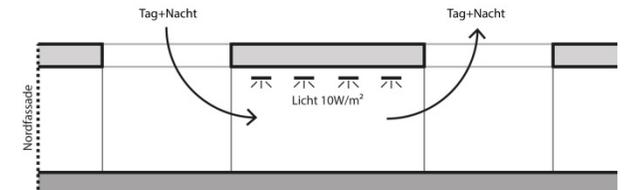


Nutzerkomfort



- ◆ Operative Raumtemperatur
- ◆ vor 09:00 Uhr
- ◆ nach 15:00 Uhr
- Solltemperatur Heizung unterschritten: 795h
- Solltemperatur Kühlung überschritten: 326h

Schematische Skizze

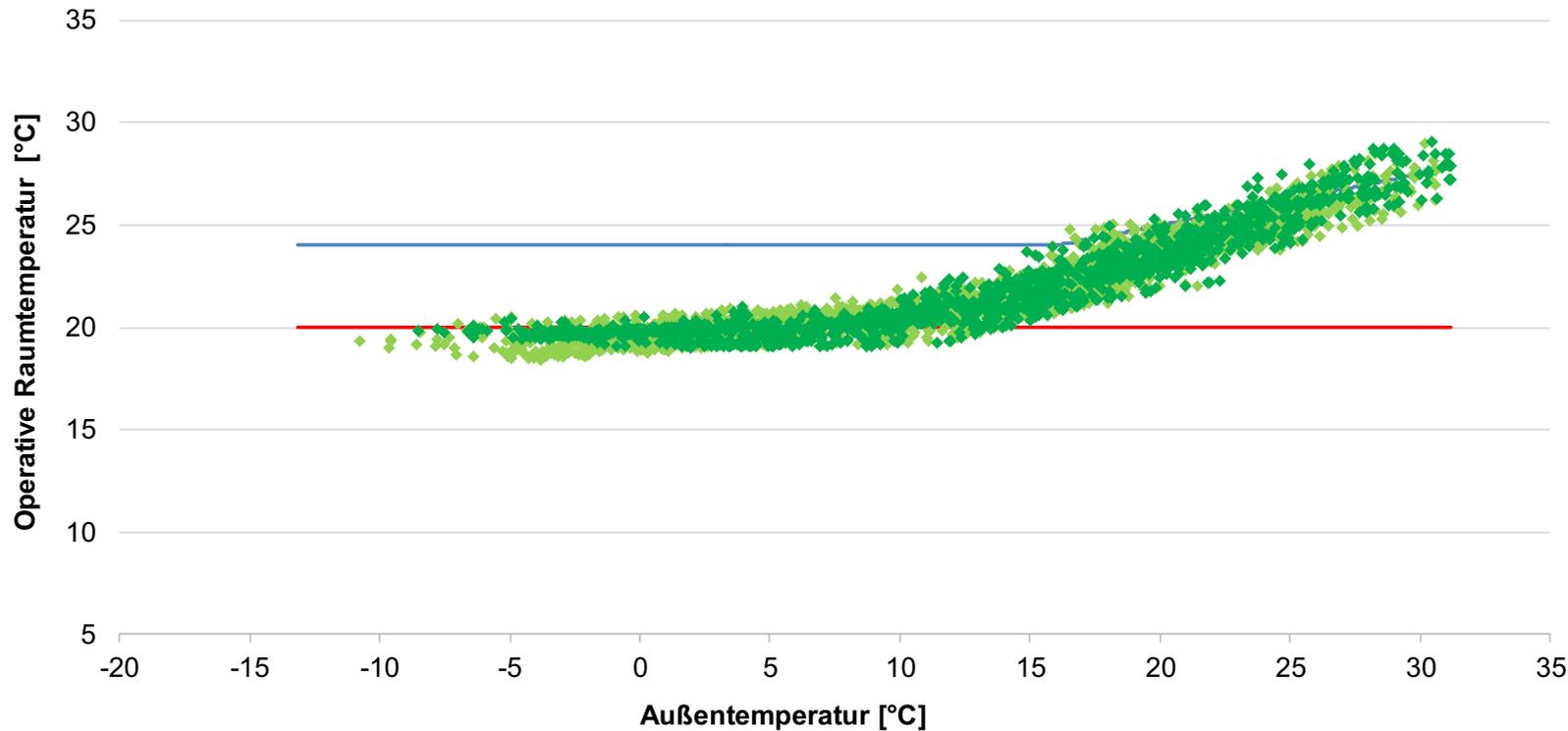


Variante S3

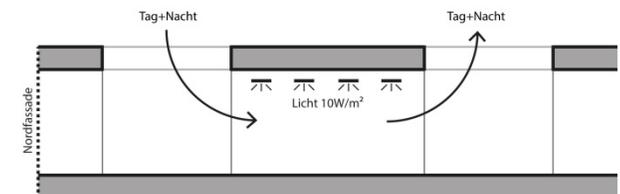
- Natürliche Lüftung
- Nachtlüftung
- **Thermische Masse**



Nutzerkomfort



Schematische Skizze



- ◆ Operative Raumtemperatur
- ◆ vor 09:00 Uhr
- ◆ nach 15:00 Uhr
- Solltemperatur Heizung unterschritten: 1090h
- Solltemperatur Kühlung überschritten: 117h

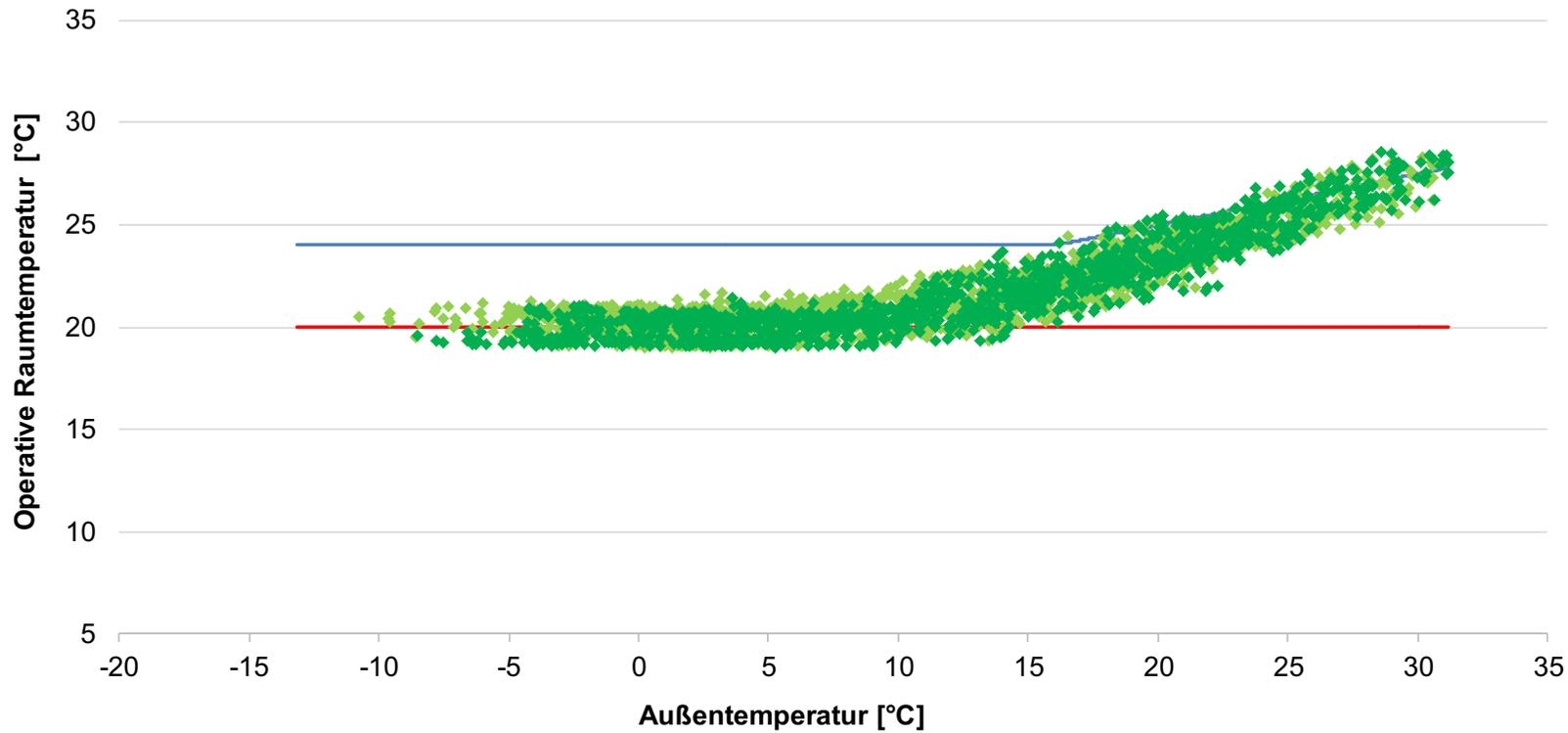
WZOF218_3_SY01

Variante S4

- Natürliche Lüftung
- Nachtlüftung
- **Begrünung**

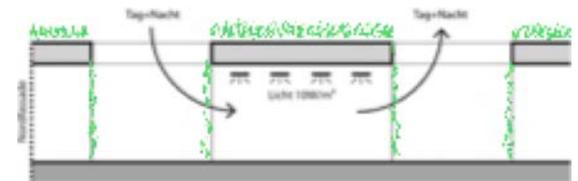


Nutzerkomfort



- ◆ Operative Raumtemperatur
- ◆ vor 09:00 Uhr
- ◆ nach 15:00 Uhr
- Solltemperatur Heizung unterschritten: 577h
- Solltemperatur Kühlung überschritten: 82h

Schematische Skizze

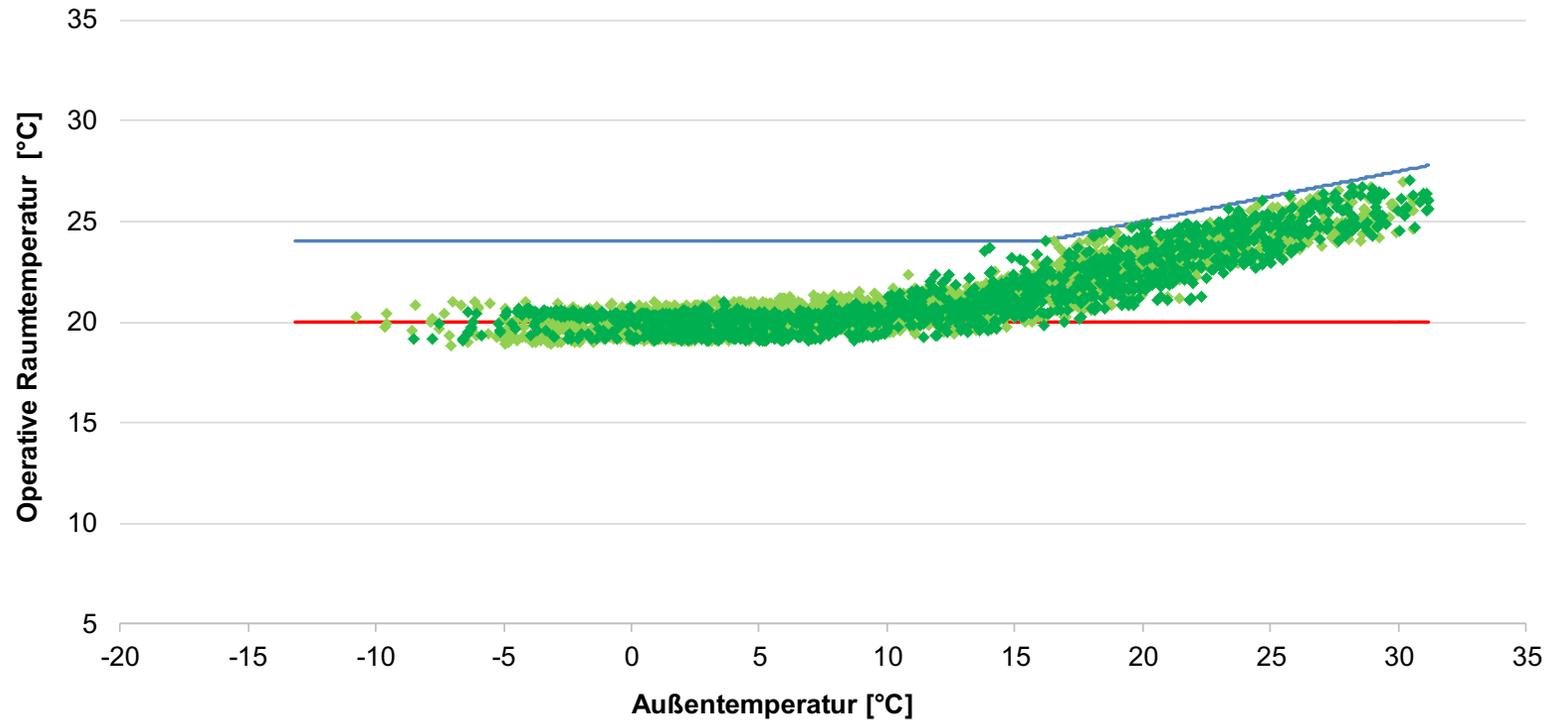


Variante S5

- Natürliche Lüftung
- Nachtlüftung
- Begrünung
- **thermische Masse**

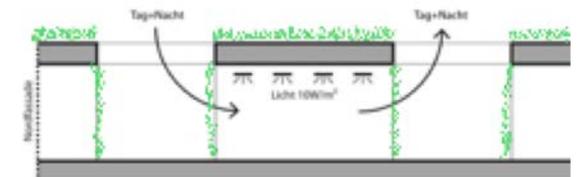


Nutzerkomfort

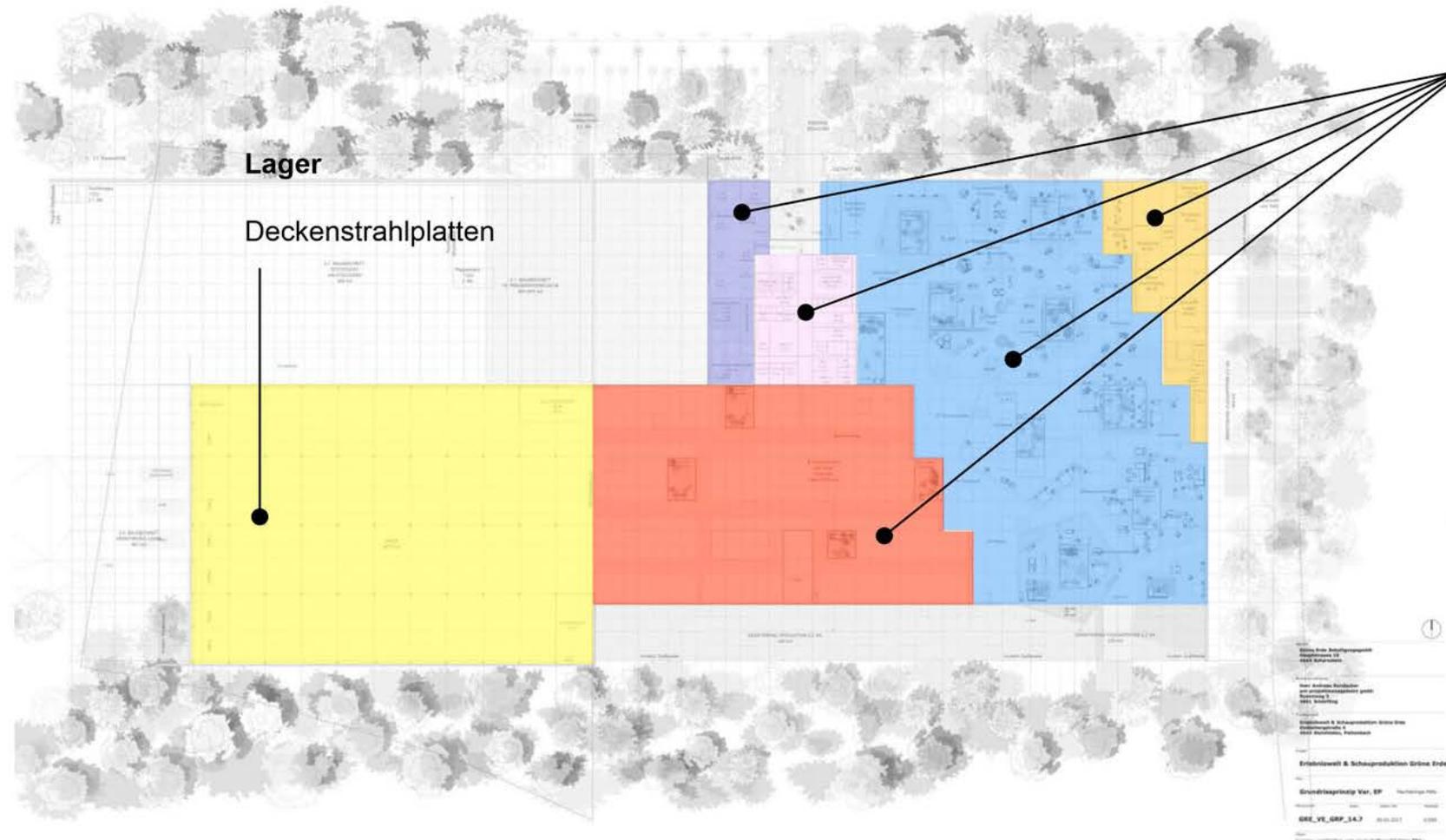


- ◆ Operative Raumtemperatur
- ◆ vor 09:00 Uhr
- ◆ nach 15:00 Uhr
- Solltemperatur Heizung unterschritten: 763h
- Solltemperatur Kühlung überschritten: 0h

Schematische Skizze



Strahlungsheizung/-kühlung:



Gesamter Neubau:

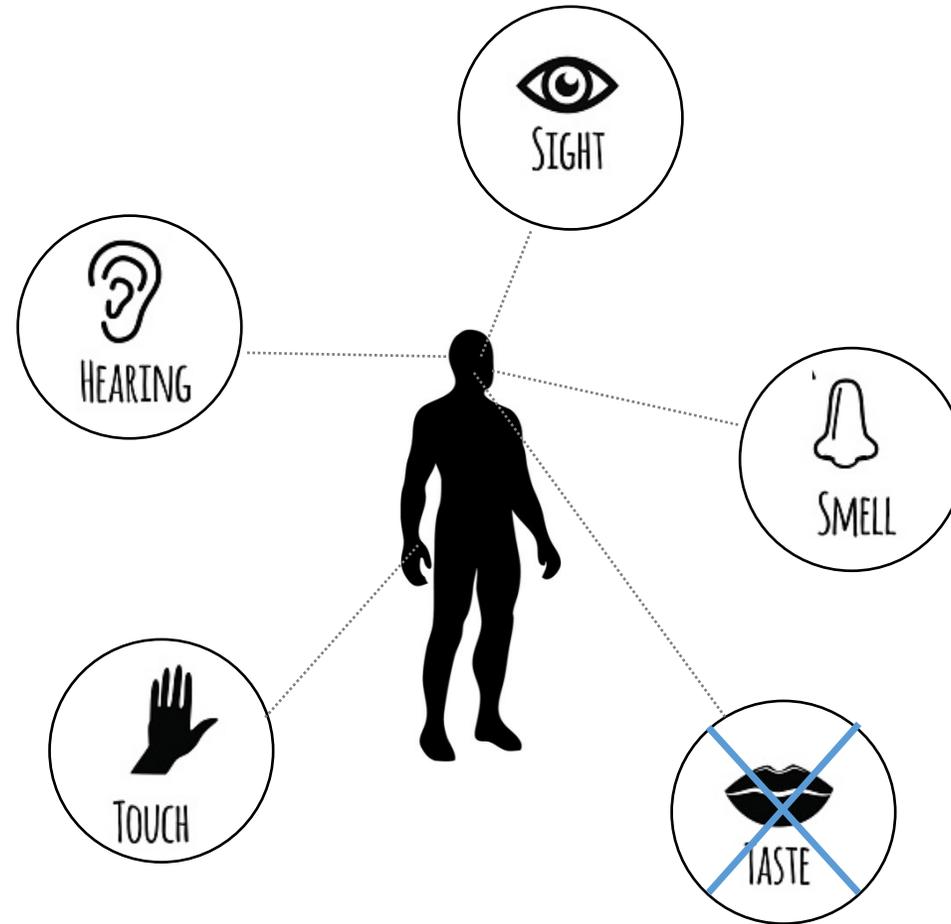
Fußbodenheizung
und -kühlung

Reversio

auf der EDIT Toronto 2017,
Toronto, ON, Kanada

Canada's Design Museum Design Exchange
Fertigstellung 2017 BGF 12 m² Konzept and Design
Transsolar Klimaengineering Akustik und
Vegetation Brens North America Grüne Wand,
Konzept und Design Envirozone Design Inc.
Herstellung Astound group





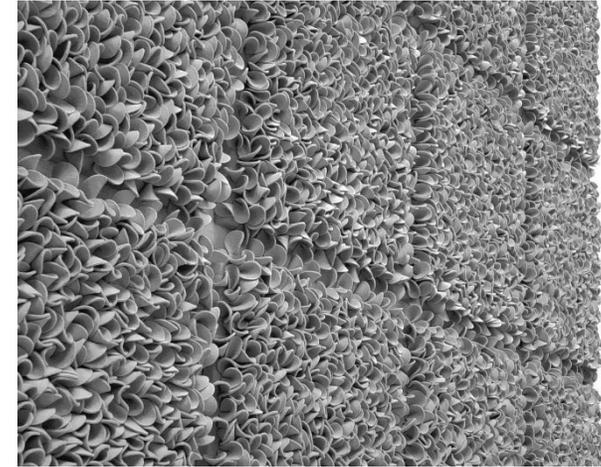
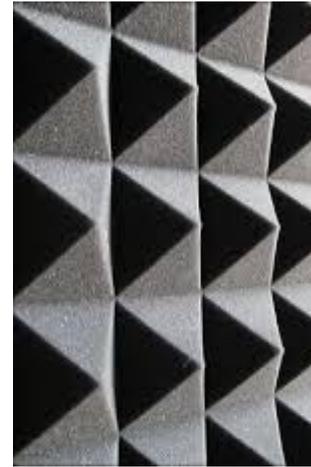
Outdoor Landscape Target



View Mirror



Acoustics



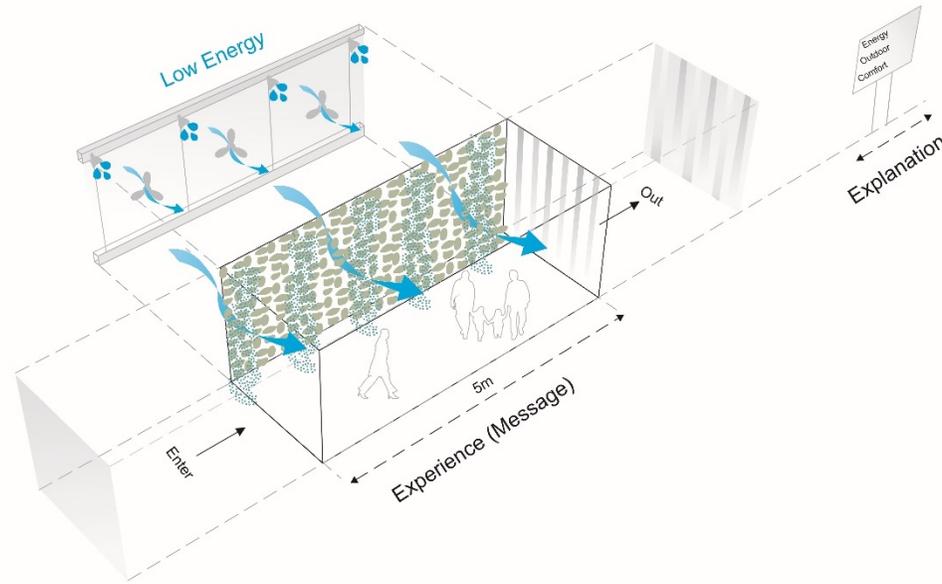
Moss Interiors



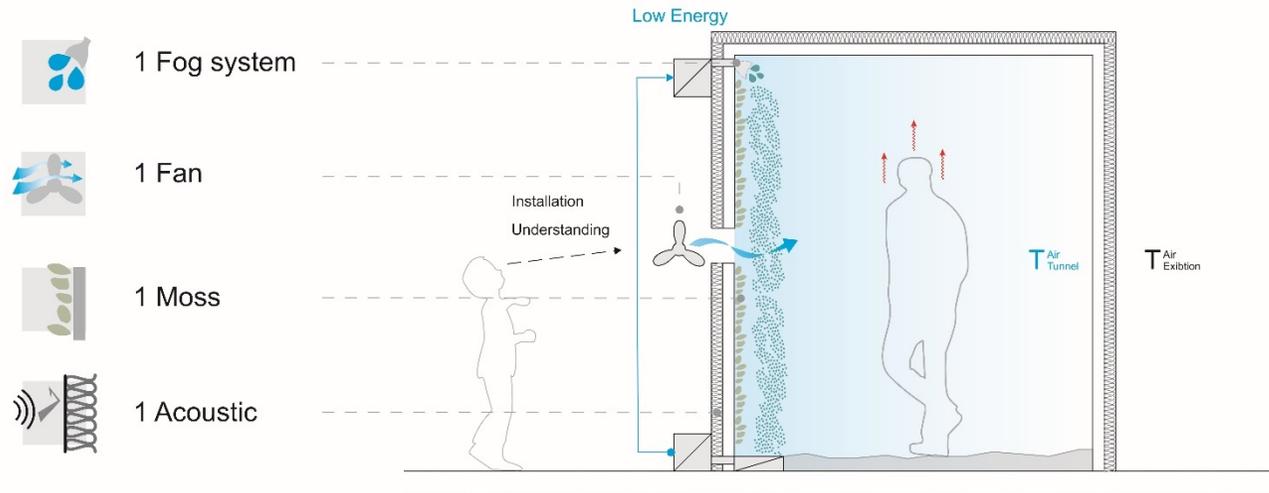
Water



Create Outdoor Comfort

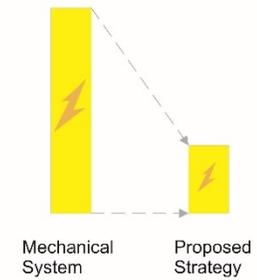


- Dark
- Humid
- Windy
- Cooler



Sustainable Target

Perception = Perception



Create Outdoor Comfort



Dry Mist System



Fan



Jet Nozzles



Acoustic Panel by
Brens

Acoustic insulation



Grass Wall



Green wall by
Envirozone Design

Plants



Pots

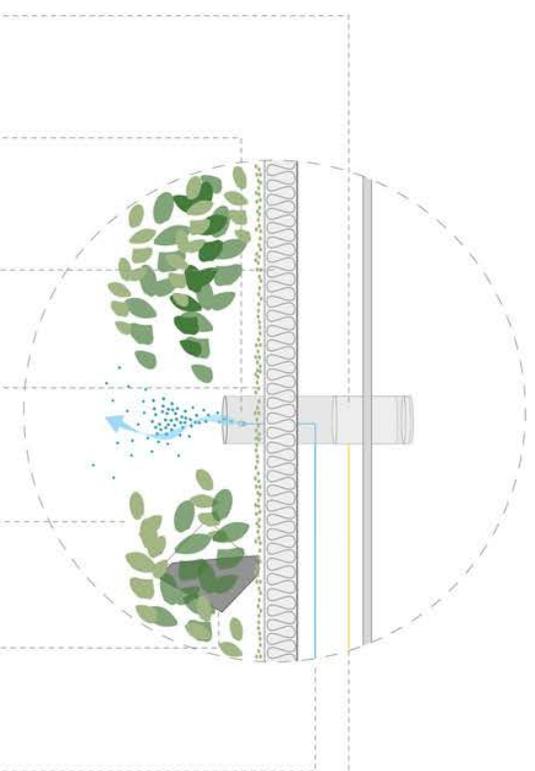
Grid supply



Water



Electricity

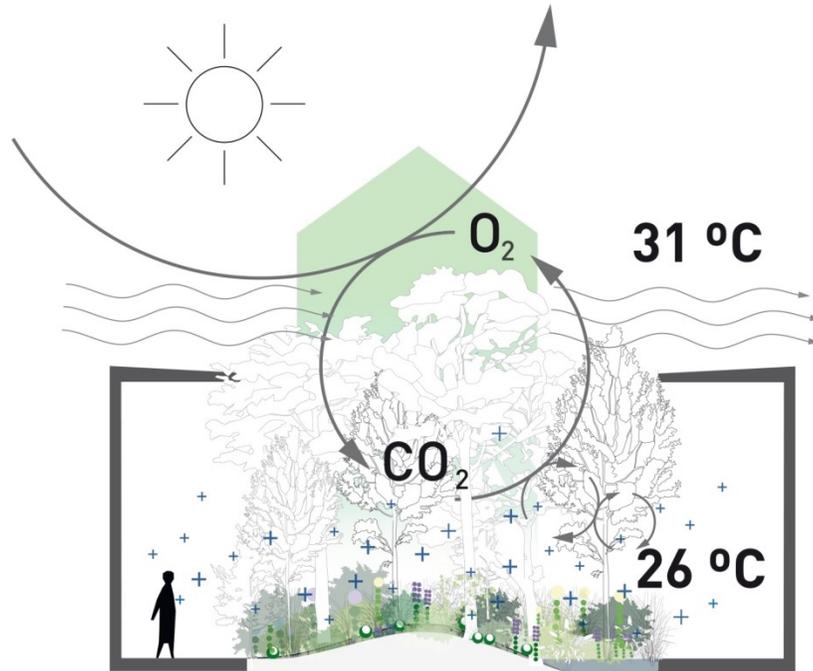


Create Outdoor Comfort



Idea of the Austrian Pavilion: Fresh air as a food and important commodity

Austrian Pavilion - EXPO 2015



Bauherr EXPO-Büro der Wirtschaftskammer
Österreich Architekt Institute for Architecture and Landscape - LandLab, team.breathe.austria
Choreographie/ Umsetzung Nebeltechnik Raintime

Pavilion as a Performance, not an Exhibition

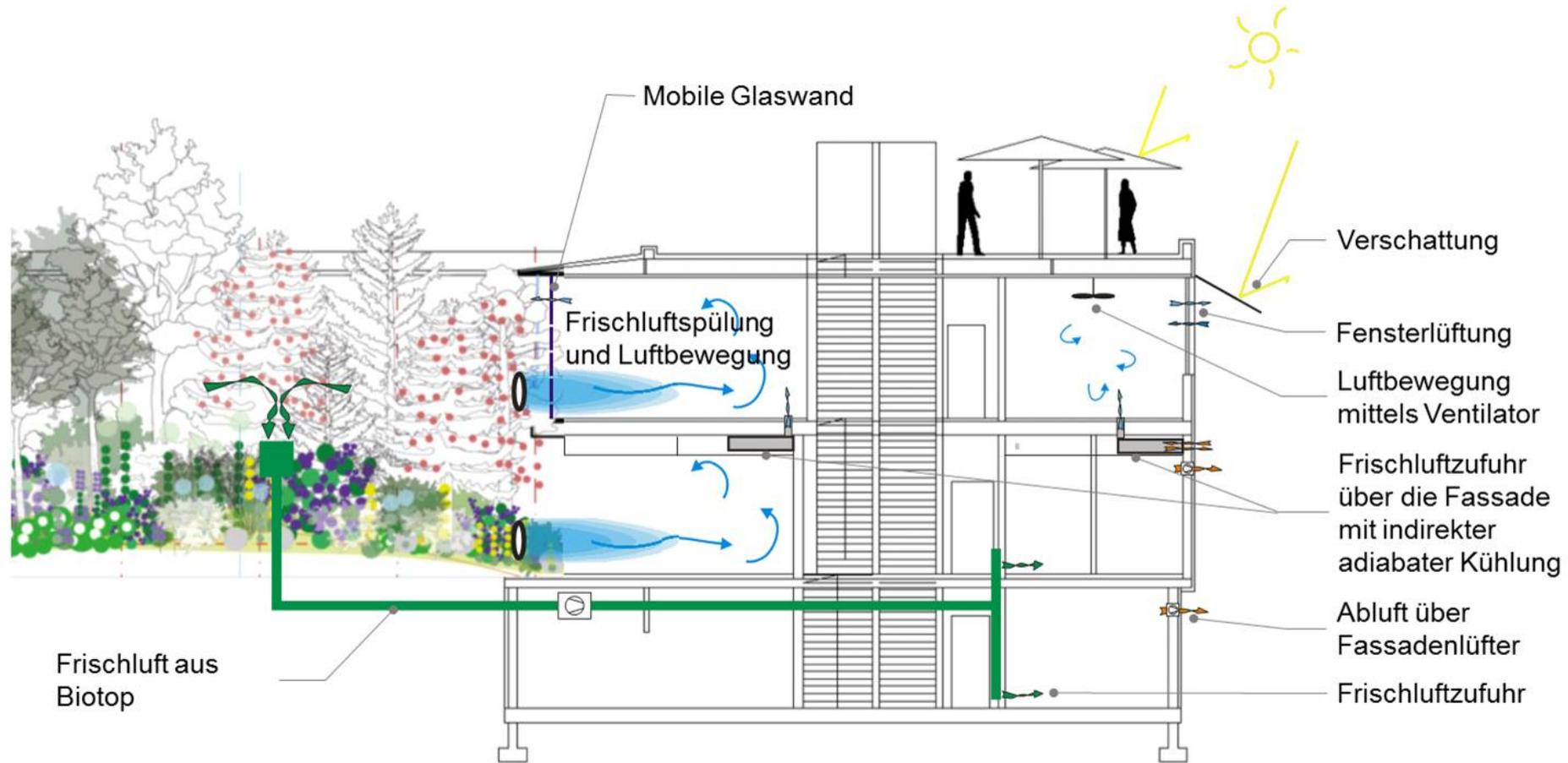
Austrian Pavilion - EXPO 2015



Our goals:

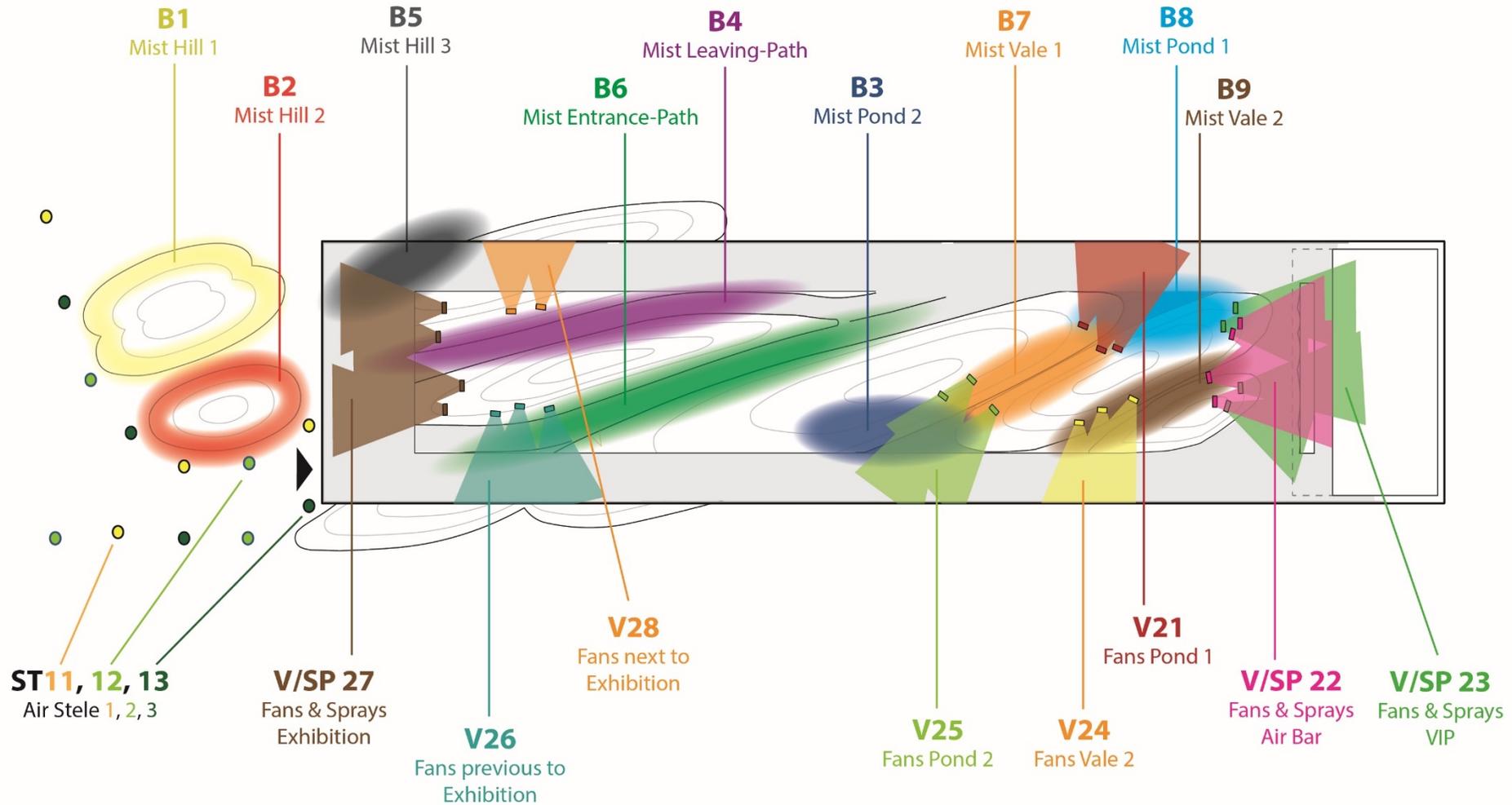
- Create a good outdoor comfort similar to a rich Austrian forest in the Mediterranean climate of Milan
- Make air touchable, an experience

Fresh and cool air from the biotop for the entire pavillon No mechanical cooling for VIPs



Our Installations!

Misting Fans for Comfort
Fog for attraction







Before



After







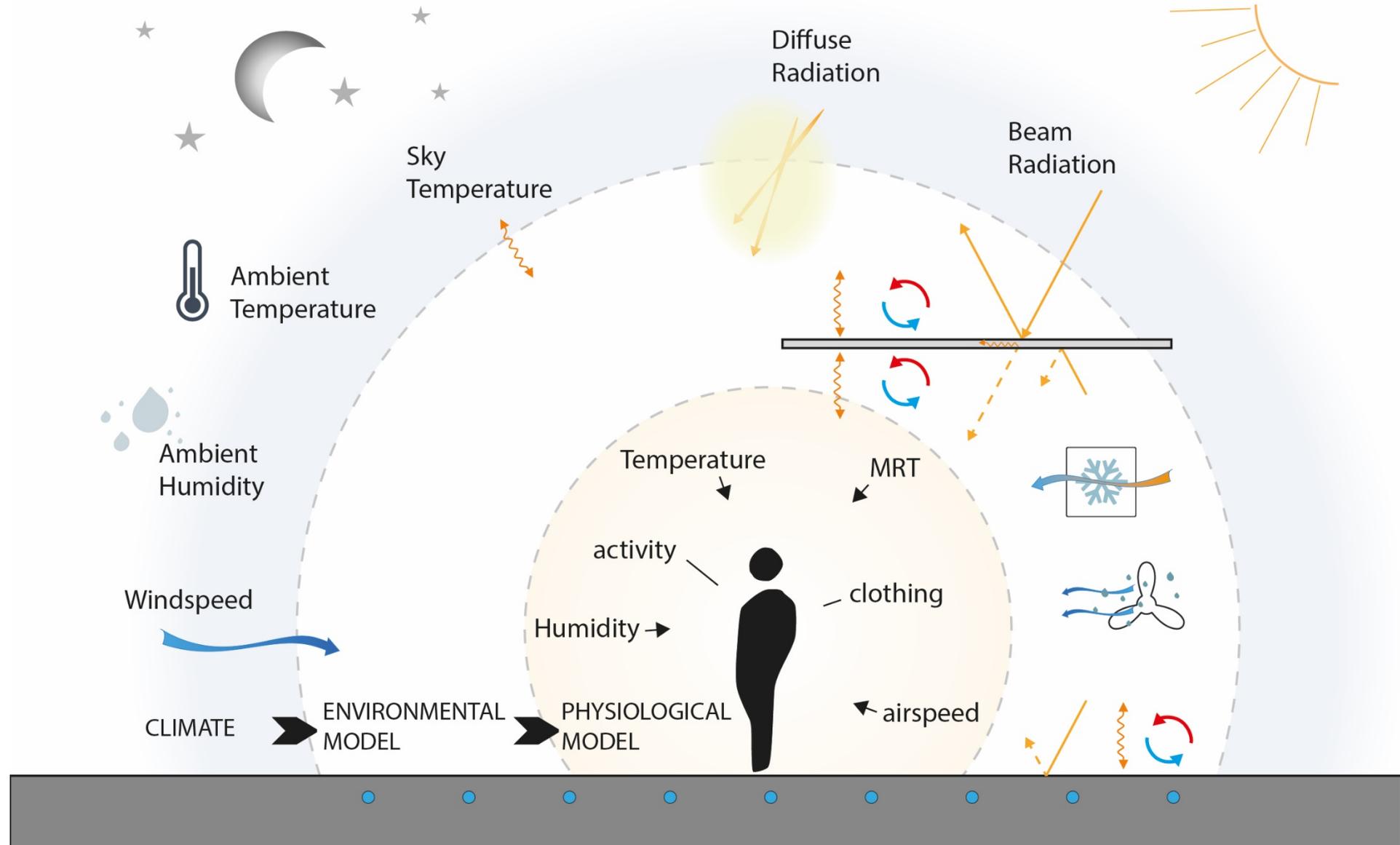
Why do we do all this?



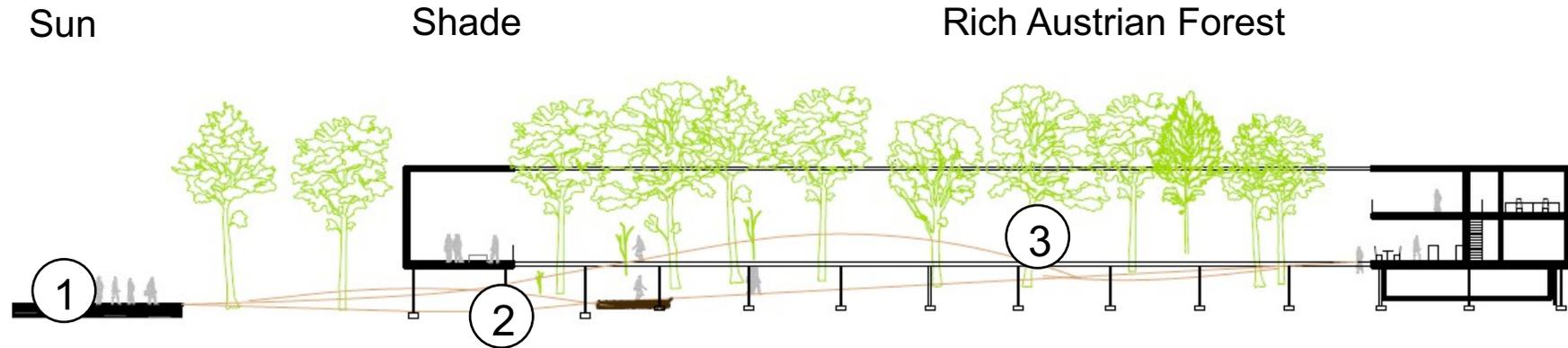
To create high comfort with low impact...



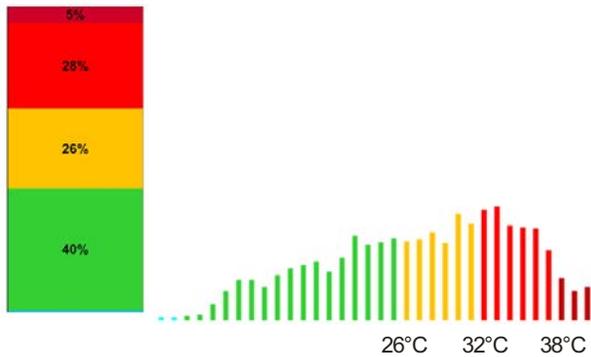
... and to improve and develop our tools



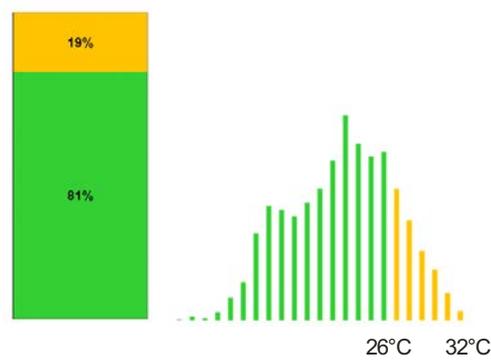
UTCI-Predictions by Simulation based on Competition estimations



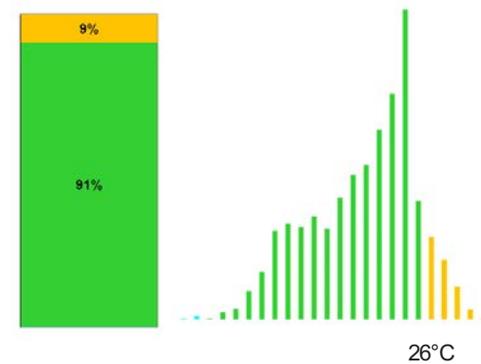
1



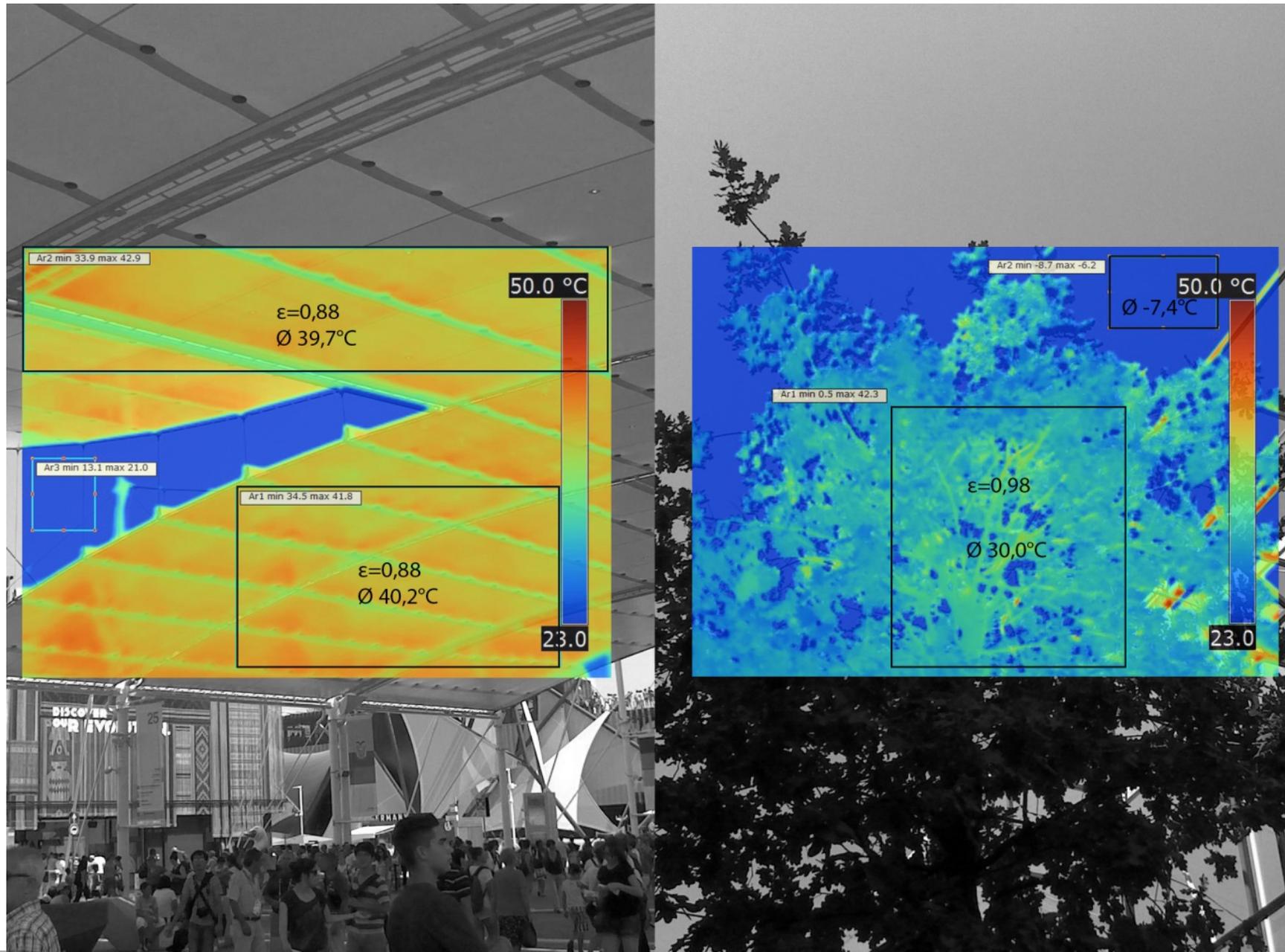
2



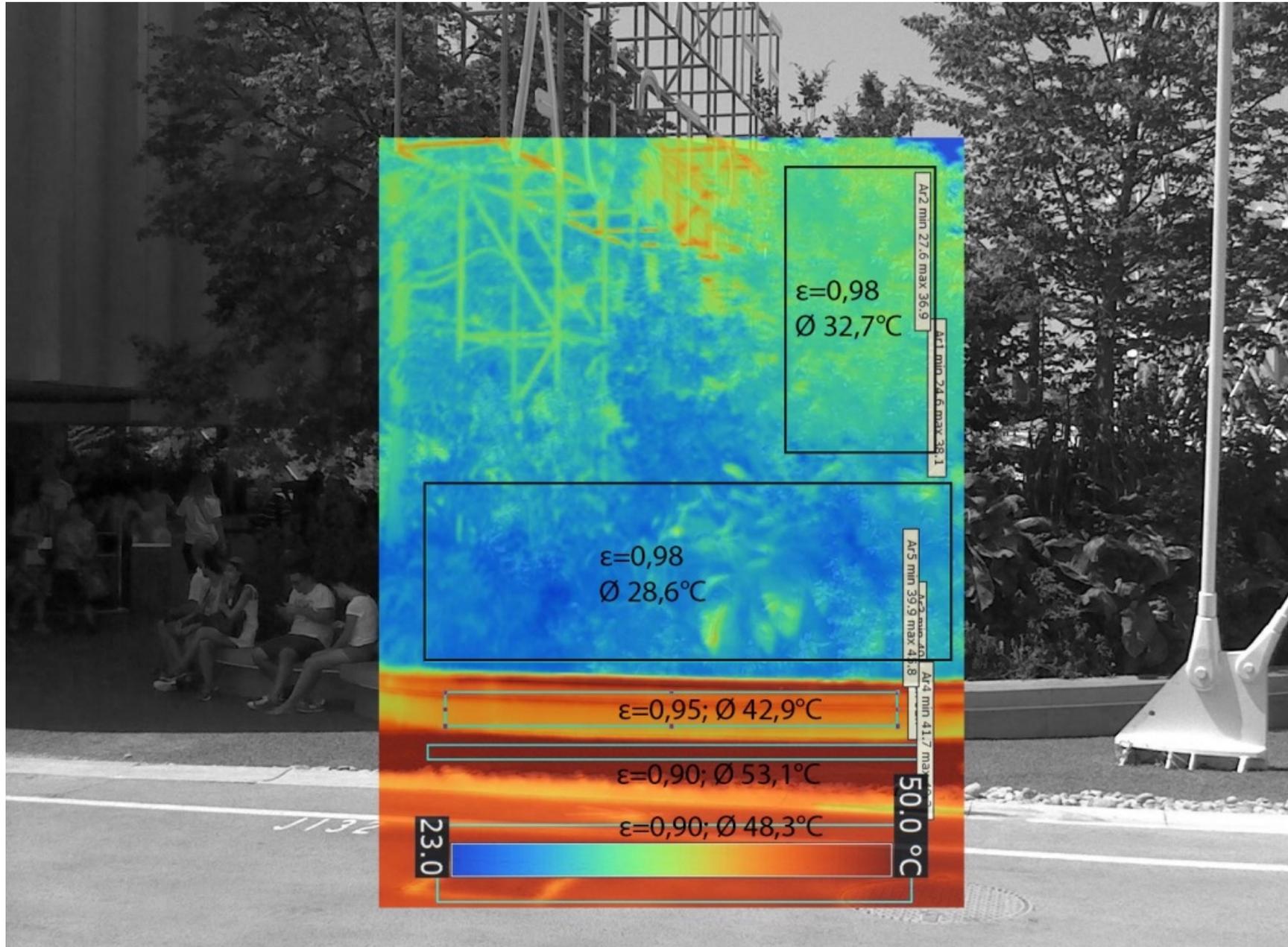
3



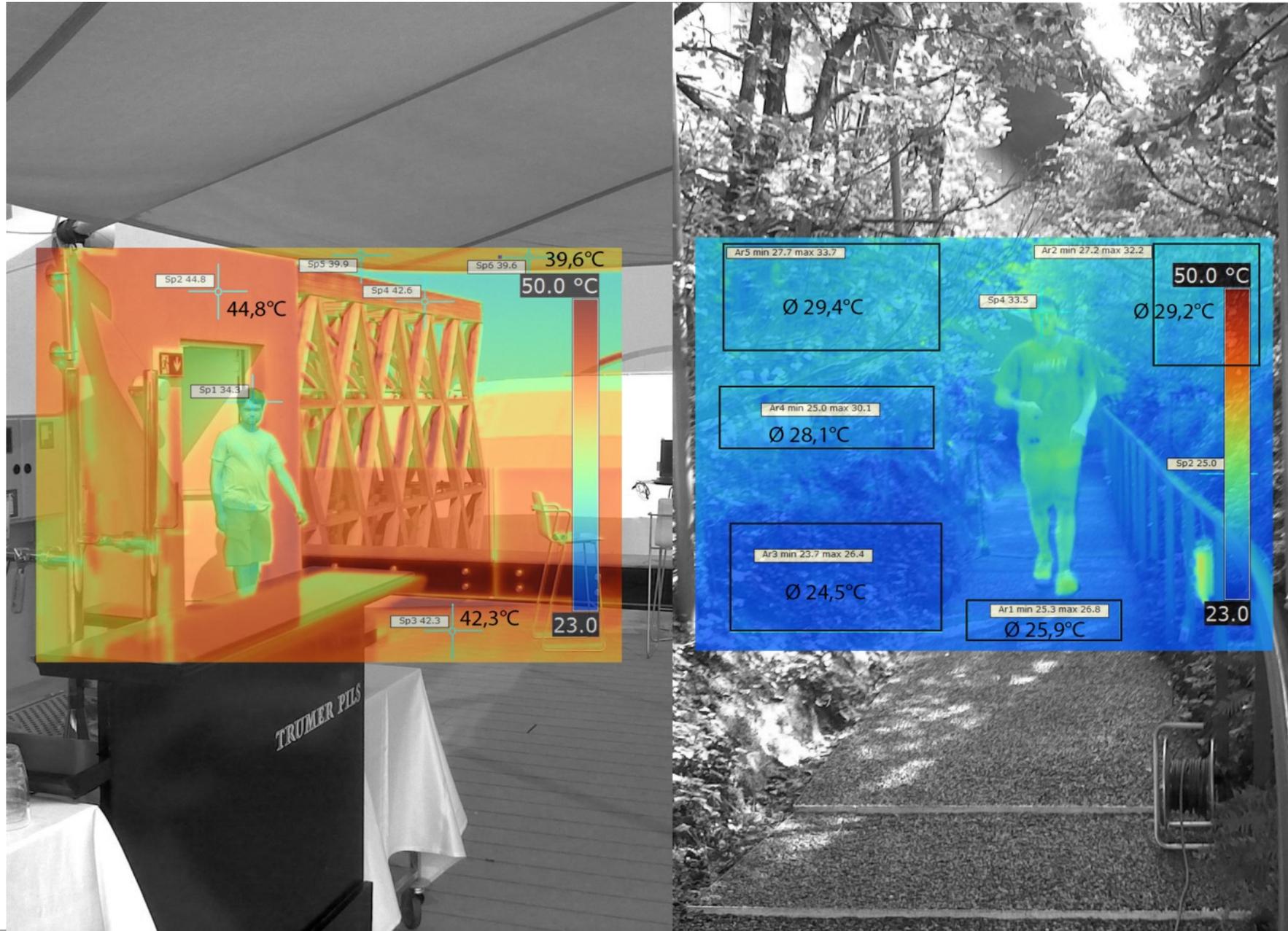
RADIANT TEMPERATURE: Vergleich der Strahlungstemperaturen



RADIANT TEMPERATURE: Vergleich der Strahlungstemperaturen

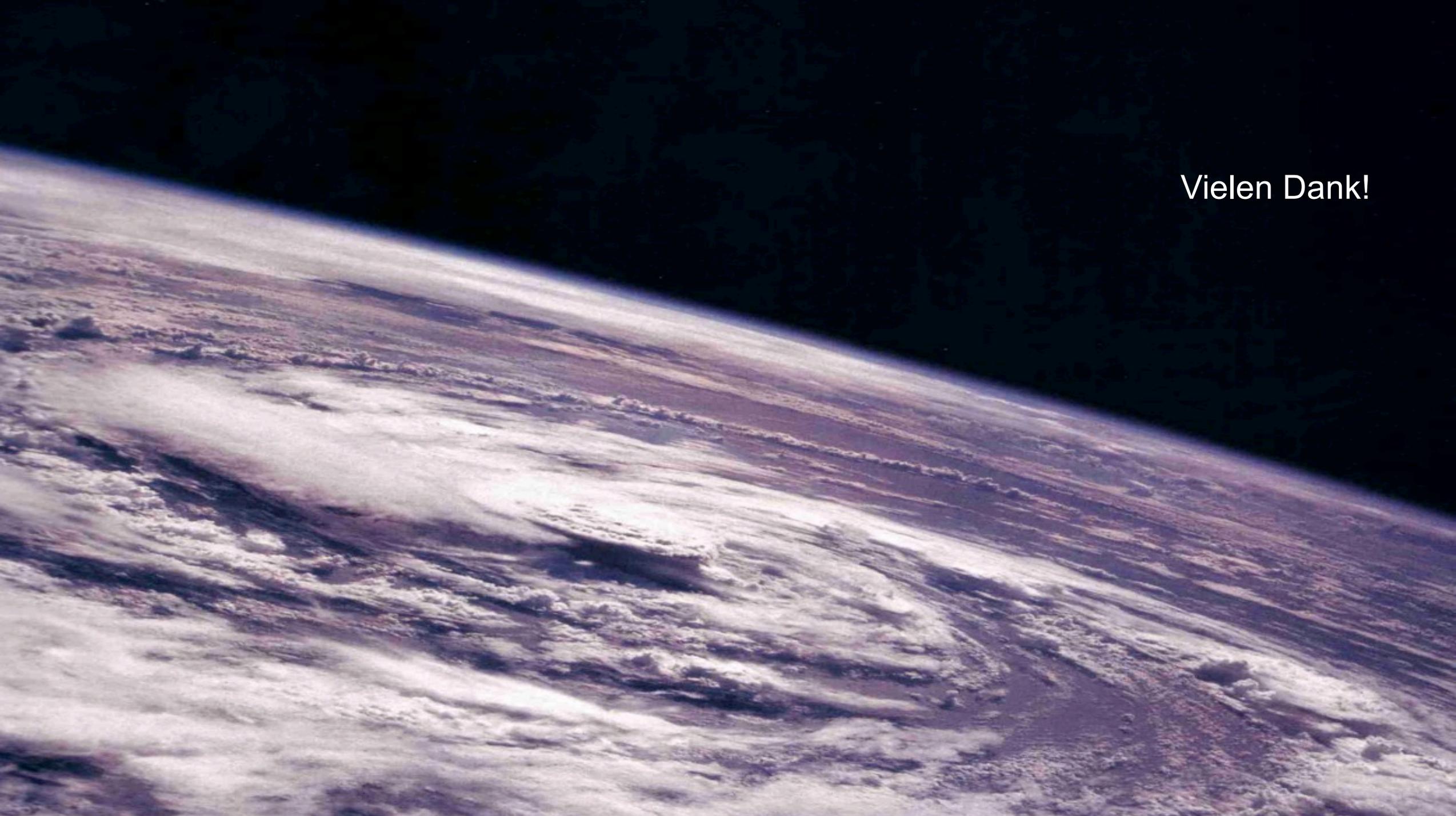


RADIANT TEMPERATURE: Vergleich der Strahlungstemperaturen



Zusammenfassung:

- Entwicklung der Außentemperaturen: signifikante höhere Temperaturen tags wie nachts!
 - Außenzulufttemperatur bzw. Außentemperatur müssen reduziert werden!
 - hoher Anteil Begrünung und Befeuchtung sind sehr effizient!
 - Reduktion der Temperatur aller Strahlungsteilnehmer ist wichtig, auch für ländliche Bereiche!
- Fassadenbegrünung wird in Zukunft ein wichtiger Bestandteil für nachhaltige Konzepte sein.



Vielen Dank!