

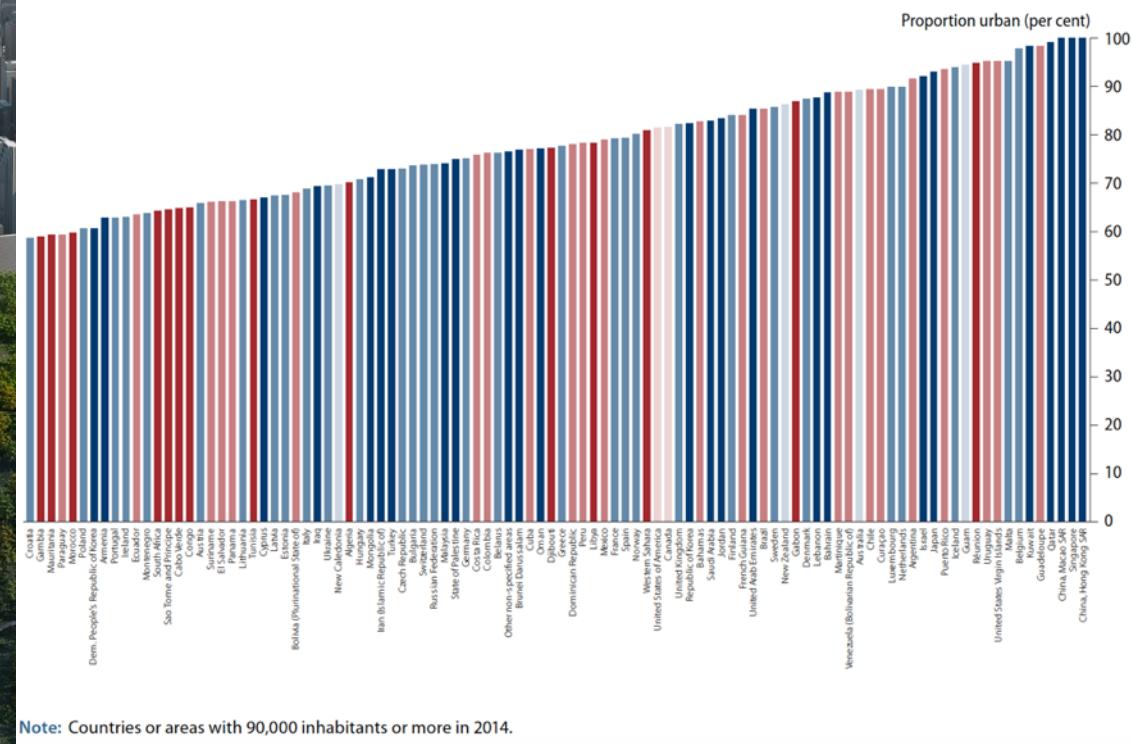
# Management of urban climate adaptation with NBS and **GREENPASS<sup>®</sup>**

# Population growth

until the year 2050

4 out of 5 Europeans

will live in a city

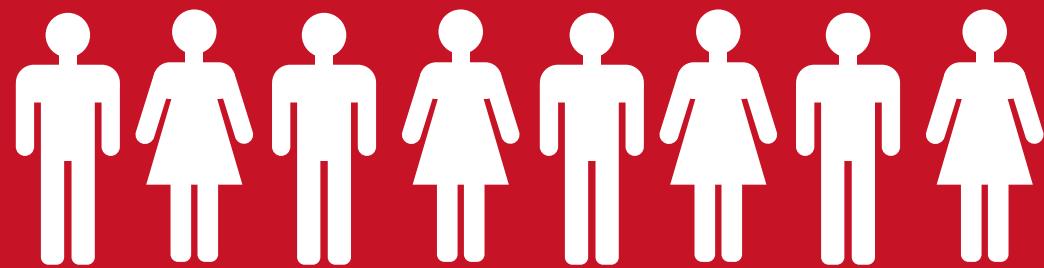


# Urban growth



**what is built TODAY  
will stay for decades!**

# HEAT caused deaths



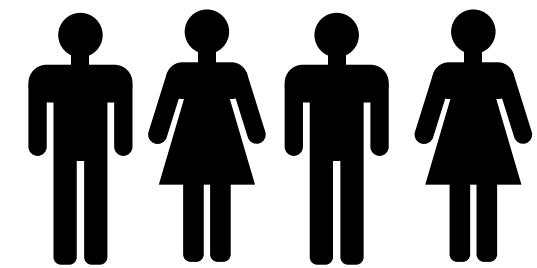
2018

766

Quelle: AGES/Statistik Austria

© GREENPASS®

# TRAFFIC caused deaths



400

# TREND





## Today

poor climate  
resilience of  
cities

## Climate change & urban growth

## Impacts

Heat waves  
Pluvial flooding  
Health risks  
Follow-up costs

## livable cities

## GREENPASS® urban development support

## Need

Strategy and  
control of  
climate  
adaptation  
measures

# Strategies



HOW MUCH  
WHICH ONE  
WHERE





measurable  
comparable

# Solution

effects of **urban structures**, materials & **green** and **blue Infrastructure**

- **measurable**
- **comparable**
- **transparent**



**12 Urban Key Performance Indicators**



**15 Urban Performance Indicators**



Official certificate & report

# Software

1

Software  
for



MUNICIPALITIES



DEVELOPERS



PLANNERS

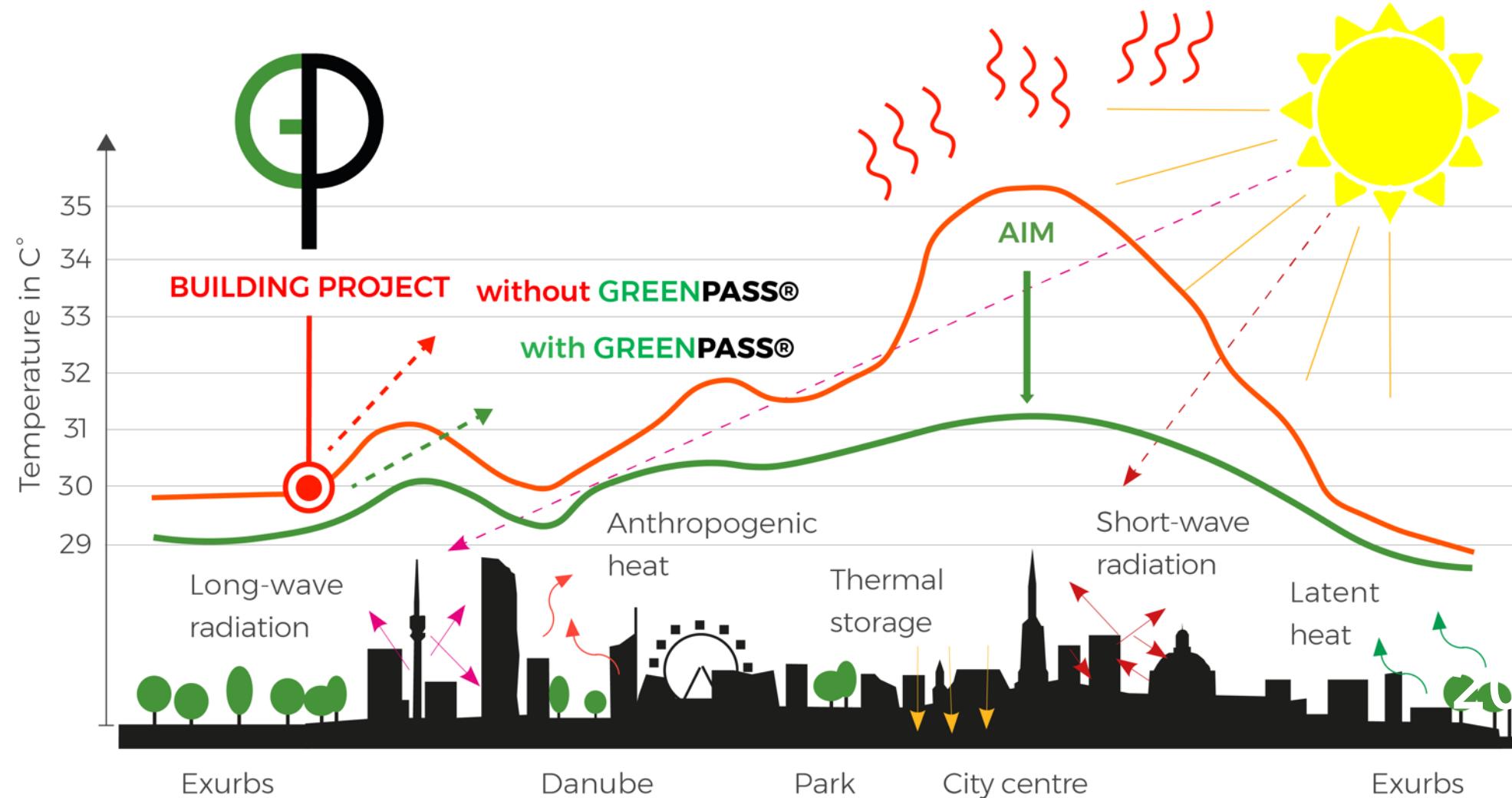


- to find best solution
- taking right decisions

optimization

- Climate resilience
- Cost efficiency
- Green and Blue Infrastructure

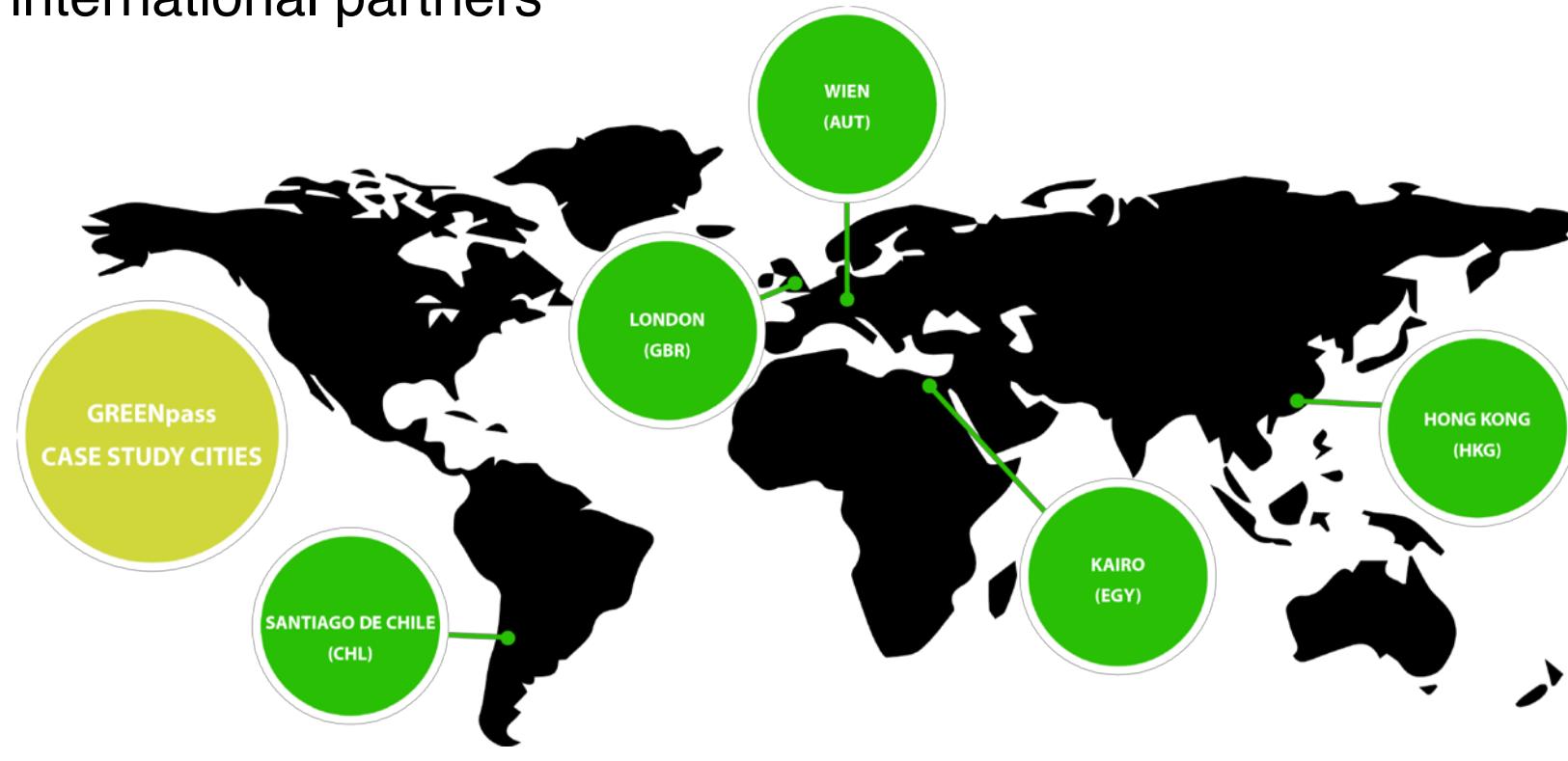
# Aim



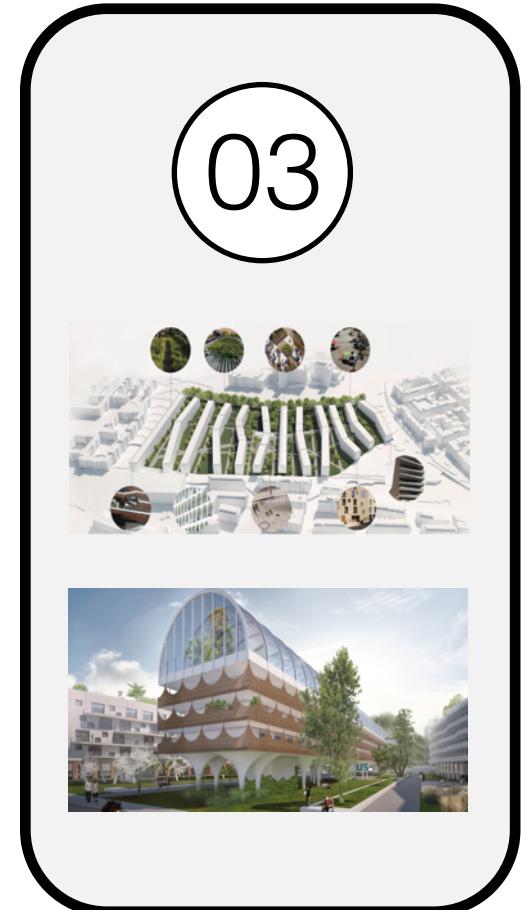
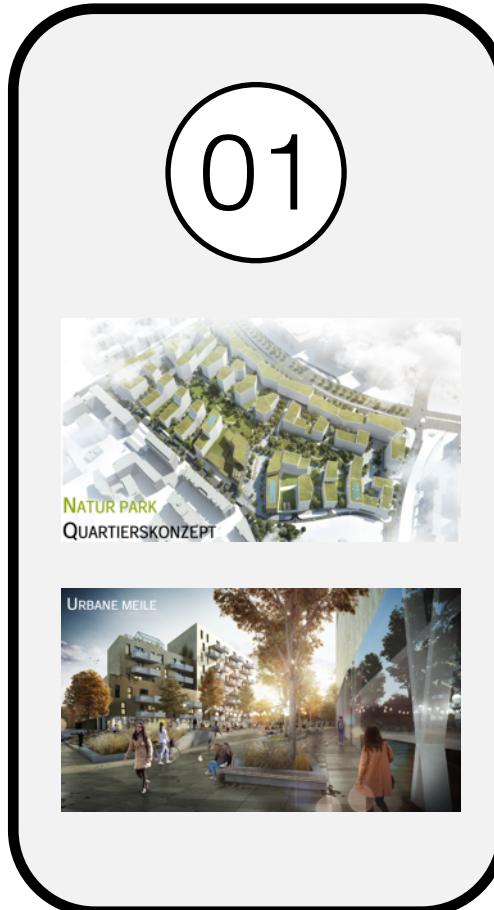
Source: MA 22 | UHI Strategy Vienna  
Additions: GREENPASS GmbH

# GREENPASS® Development

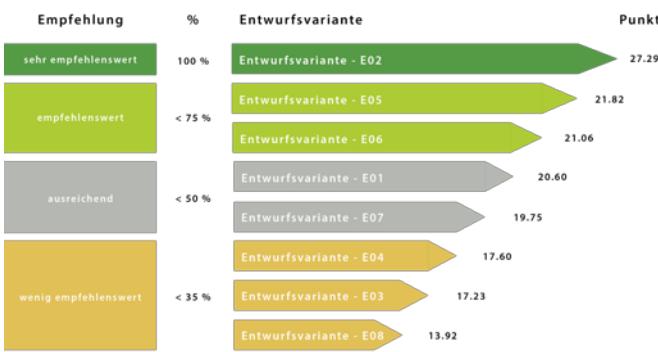
- 9 years of R&D
- 4 mill. € Investment
- 3 international R&D projects
- 1 crowdfunding campaign
- several international partners



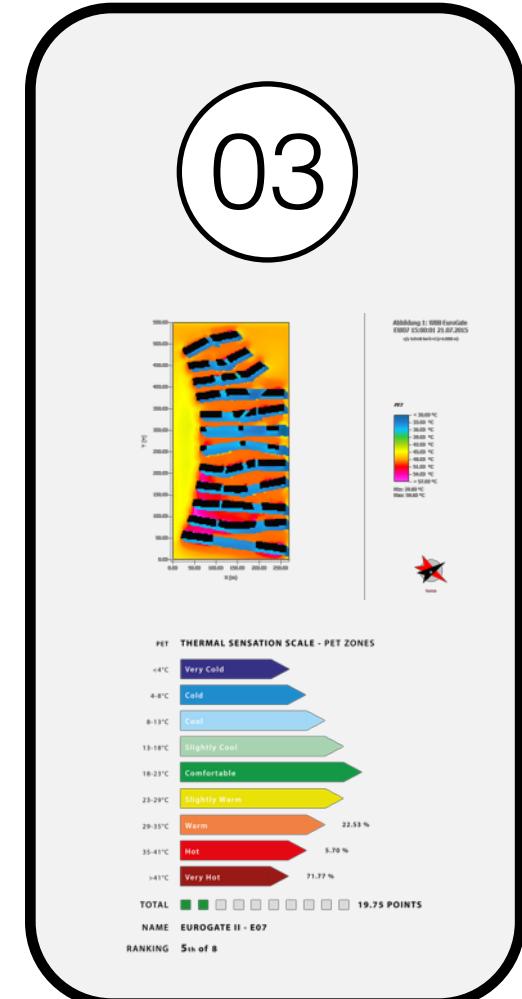
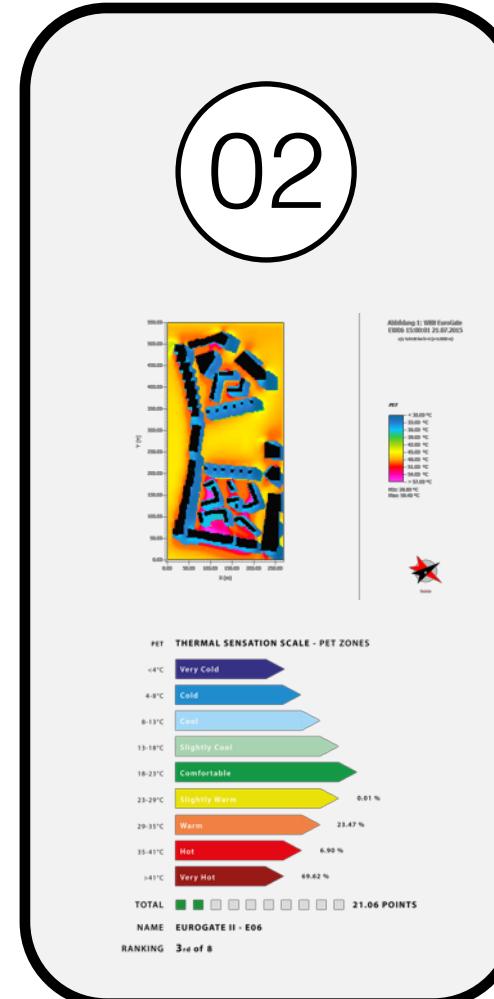
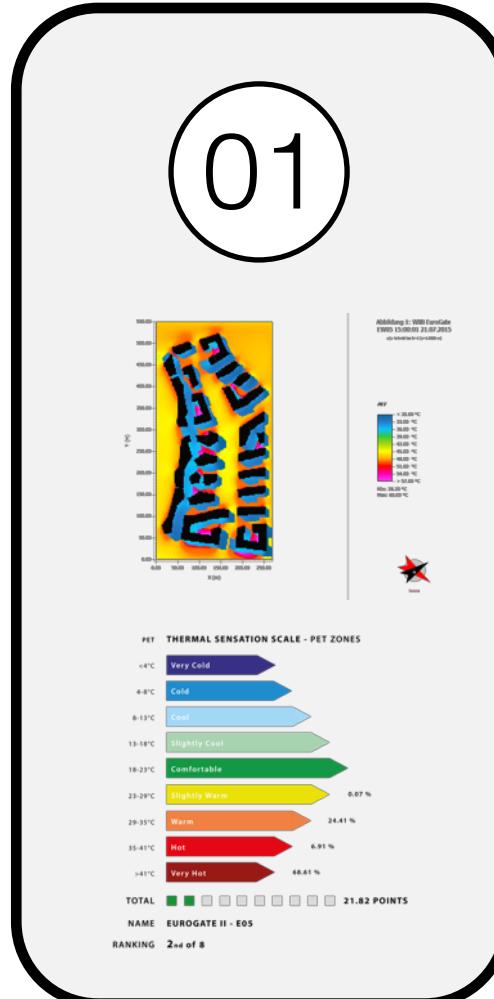
# What is the best planning?

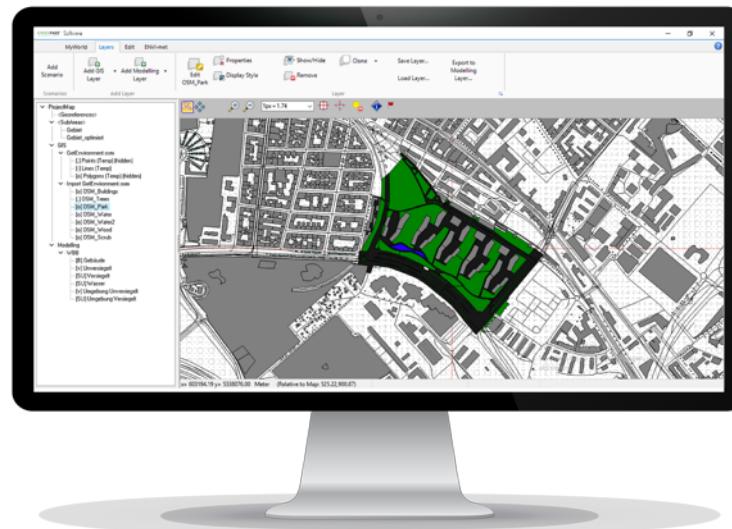


# Fact-based decision making



\* Entwurfsvariante E02 (100%) und E08 (0%) dienen als Berechnungsgrundlage für die relative Rahmenbildung der Empfehlung.





 **GREENPASS®**

**START**  
Idea and initial situation



**STEP 01**  
Preliminary design  
**GREENPASS® assessment**



**STEP 02**  
Concept design  
**GREENPASS® pre-certification**



**STEP 03**  
Detailed design  
**GREENPASS® certification**

**FINISH**  
Planning optimized and ready  
for construction permit.



- 5 Performance Scores
- 7 Key Performance Indicators
- 15 Performance Indicators



**Climate**



**Biodiversity**



**Water**



**Energy**



**Air**



**Cost**

**01**



### ASSESSMENT

Design check based on  
database analysis

#### 5 Key Performance Indicators

- Thermal Load Score
- Thermal Comfort Score
- Thermal Storage Score
- Run-off Score
- Carbon sequestration Score
- Thermal performance
- Wind resistance
- Shading area
- Evapotranspiration
- Albedo
- Radiation
- Leaf Area
- Investment cost GI
- Maintenance cost GI
- Water demand
- Cooling degree hours
- and many more

**02**



### PRE CERTIFICATION

Project evaluation based on  
short ENVI-met® simulation

#### 12 Key Performance Indicators

- Thermal Load Score
- Thermal Comfort Score
- Thermal Storage Score
- Run-off Score
- Carbon sequestration Score
- Thermal performance
- Wind resistance
- Shading area
- Evapotranspiration
- Albedo
- Radiation
- Leaf Area
- Investment cost GI
- Maintenance cost GI
- Water demand
- Cooling degree hours
- and many more

**03**

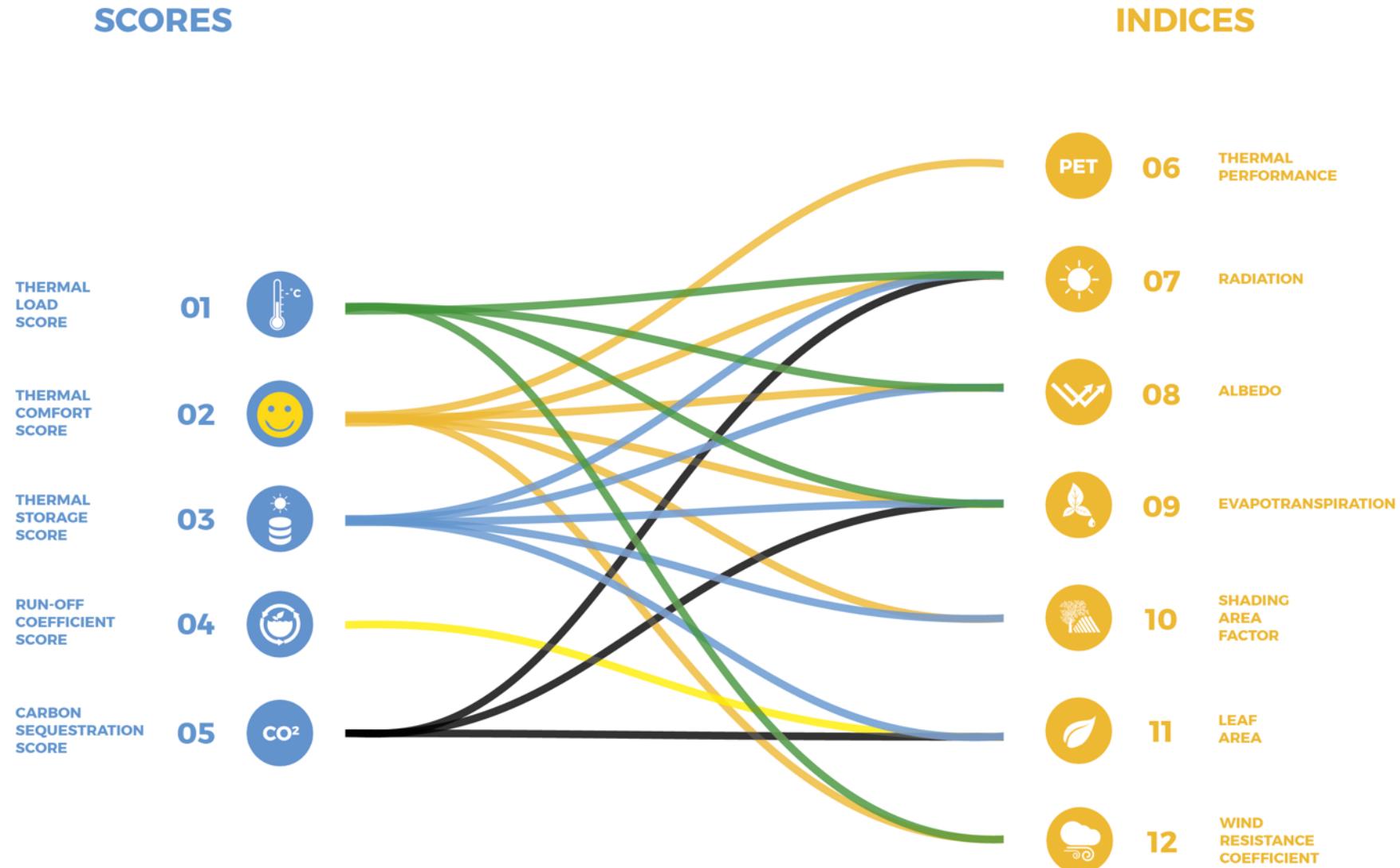


### CERTIFICATION

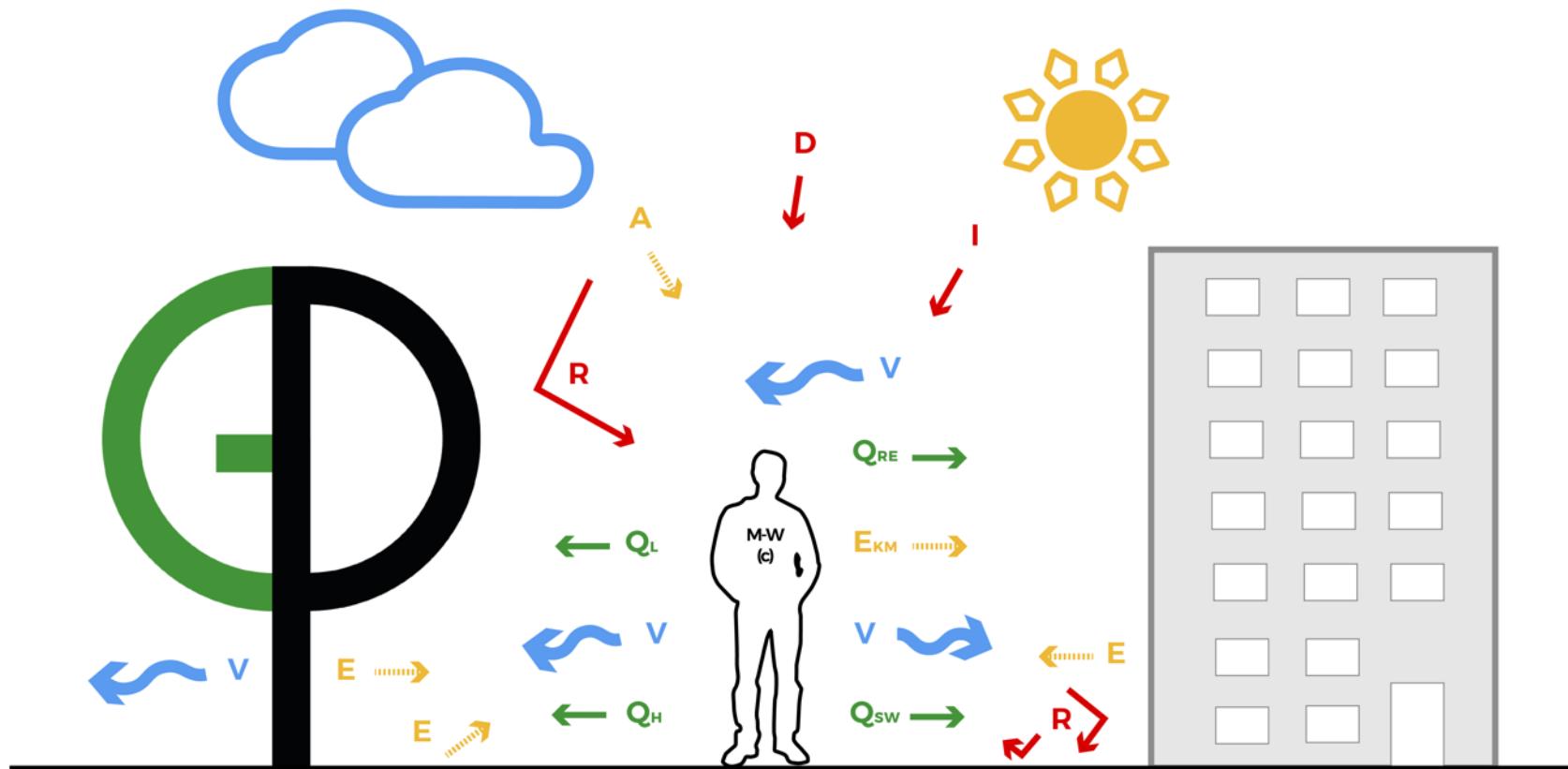
Project optimization and  
certification

#### 30 Key Performance Indicators

- Thermal Load Score
- Thermal Comfort Score
- Thermal Storage Score
- Run-off Score
- Carbon sequestration Score
- Thermal performance
- Wind resistance
- Shading area
- Evapotranspiration
- Albedo
- Radiation
- Leaf Area
- Investment cost GI
- Maintenance cost GI
- Water demand
- Cooling degree hours
- and many more



# THERMAL COMPLEX

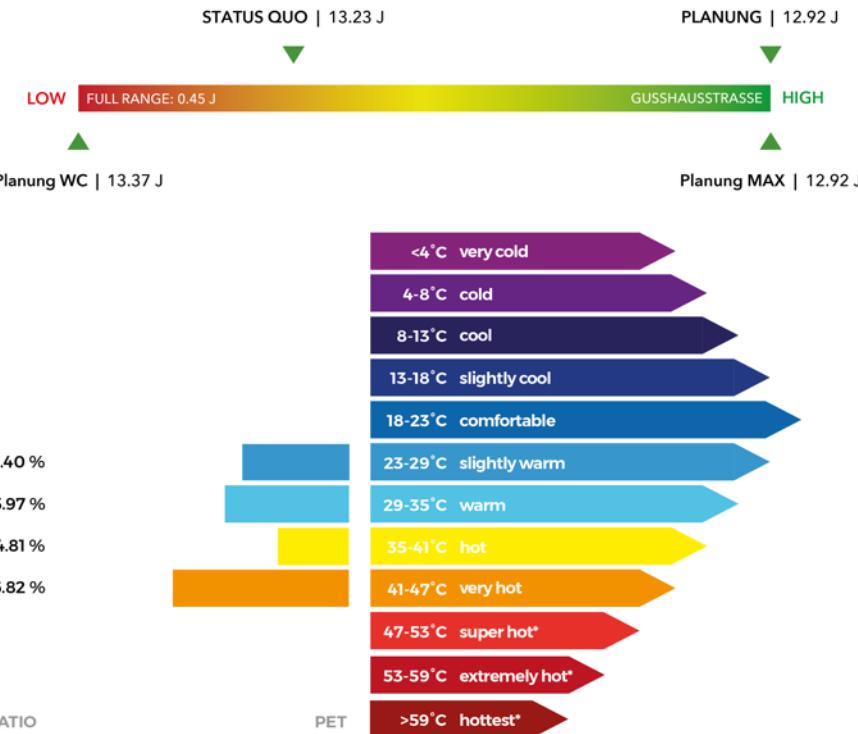


**M** metabolic rate (energy turnover)  
 **$Q_H$**  turbulent flow of sensible heat  
 **$Q_{SW}$**  turbulent flow of latent heat  
 **$Q_L$**  flow latent heat through water vapour diffusion  
 **$Q_{RE}$**  heat flow through breathing (sensible and latent)  
 **$V$**  wind speed  
 **$M-W$**  heat production through energy metabolism

**I** direct solar radiation  
 **$D$**  diffuse solar radiation  
 **$R$**  reflected solar radiation  
 **$A$**  counterradiation  
 **$E$**  long-wave emission of surrounding surfaces/materials  
 **$E_{KM}$**  infrared radiation of human's surface  
 **$(c)$**  heat insulation of clothing



### Thermal Storage Score



### 02 ☺ TCS

### TOTAL

**47.04 PUNKTE**

### THERMISCHER KOMFORT WERT

NAME: Freiraumwunder

SZENARIO: Status quo, Planung, Worst Case, Moderate, Maximum, Planung opt.

AUSWERTUNG: Sommertag, 21.07., 15:00, Kinder, Erwachsene, Ältere

ID: Europe-2019-003

TOOLBOX: GREENPASS® Pre-Certification

\*Thermische Komfort Klasse wurde zur visuellen Darstellung und Differenzierung der heißen Temperaturen gebildet und erweitert die Messskala.  
Sie fließt jedoch nicht in der Bewertung des TCS ein.

## WERTE

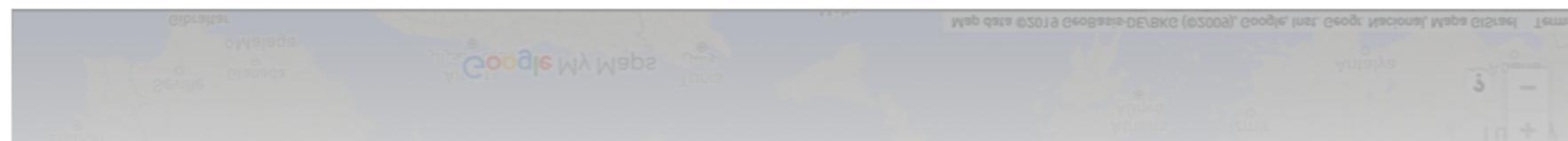
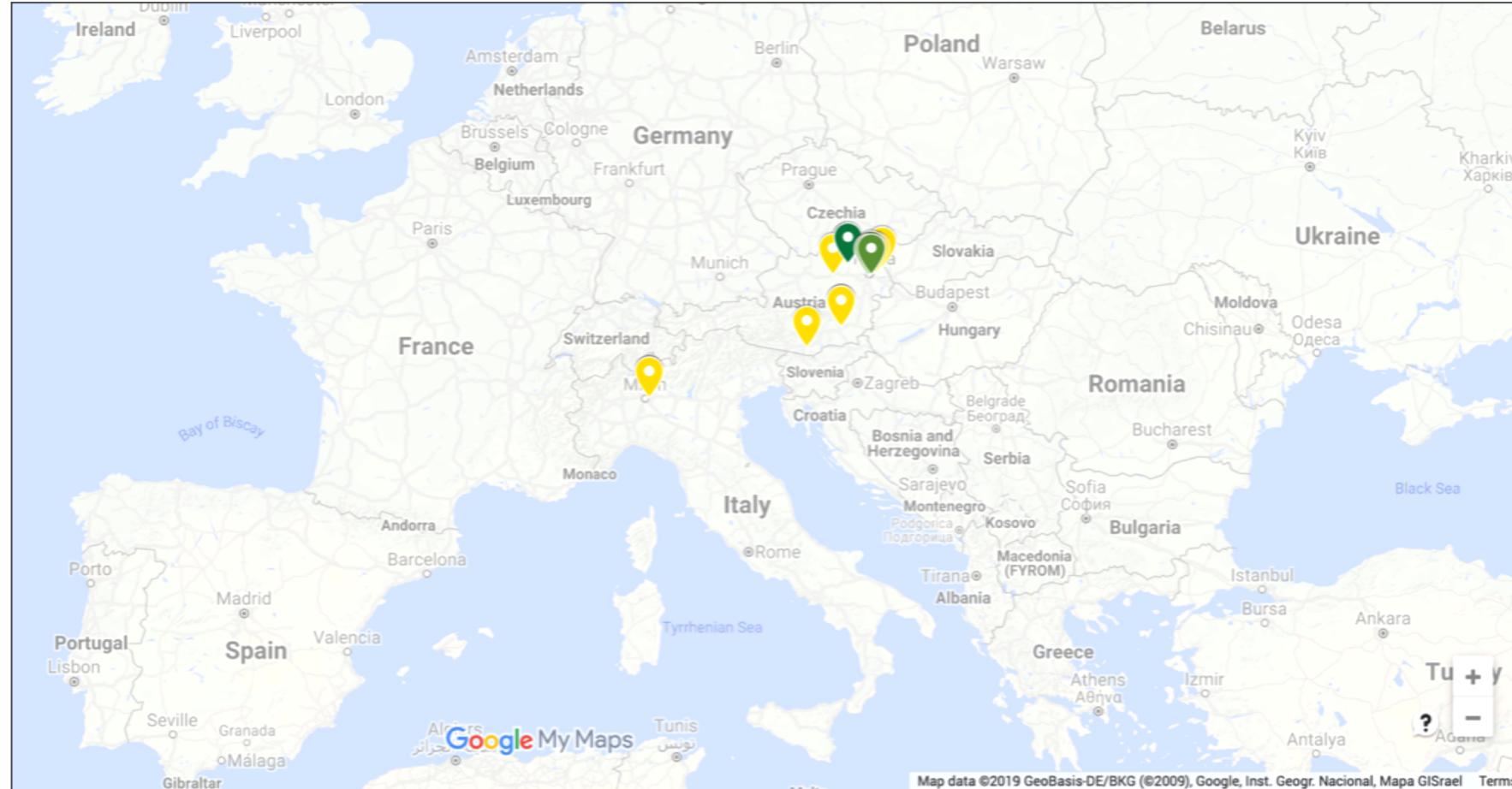
01	🌡️	THERMISCHER ABLUFTSTROM (TLS)	-4°C	[-3, -2, -1, 1, 2, 3]	4°C	+0.328°C
02	😊	THERMISCHER KOMFORT (TCS)	0	[0, 25, 50, 75, 100]	100	49.66
03	💡	THERMISCHE SPEICHERFÄHIGKEIT (TSS)	37.67	[J]	37.67 J	
04	🚽	ABFLUSSBEIWERT (ROS)	0	[0, 75, 100]	1	0.68
05	CO <sub>2</sub>	CO <sub>2</sub> SPEICHERUNG (CSS)	205.95	[kg/day]	205.95 kg/day	

## INDIKATOREN

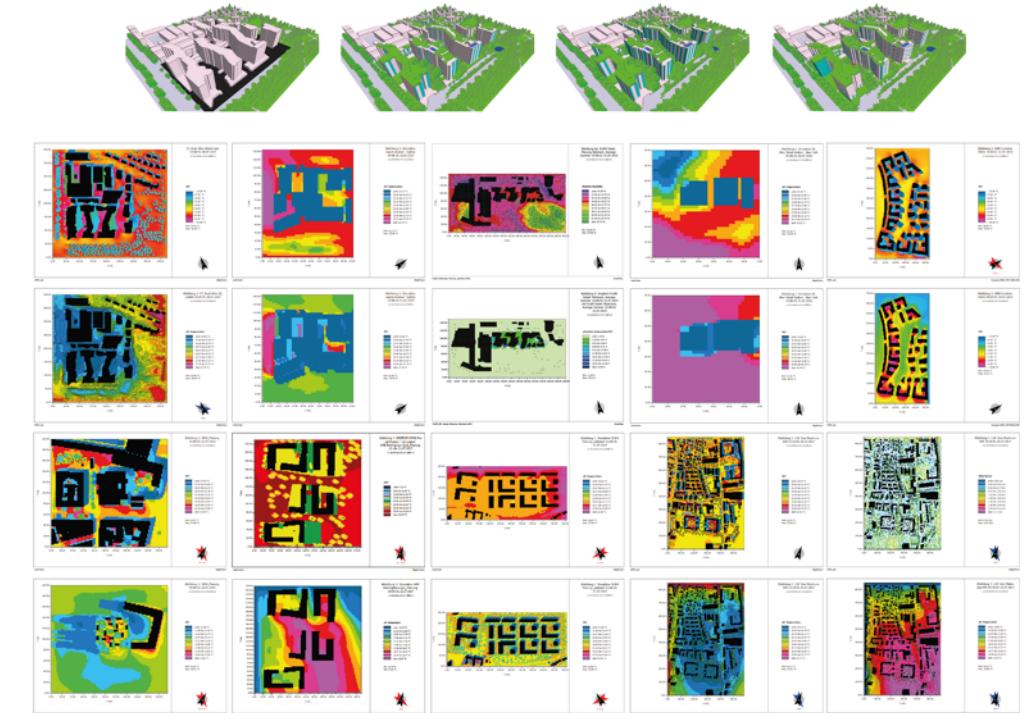
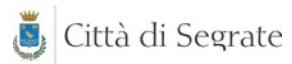
06	PET	THERMISCHE PERFORMANZ	25°C	[27, 29, 31, 33, 35, 37, 39, 41, 43]	45°C	36.135°C
07	☀️	STRÄHLUNG	116.769.322	[kW]	116.769.322 kW	
08	⚡	ALBEDO	0	[0, 25, 50, 75, 100]	1	0.204
09	🌿	EVAPOTRANSPIRATION	228.9	[kg/s]	228.9 kg/s	
10	🌳	BESCHATTUNGSFAKTO	0	[0, 25, 50, 75, 100]	1	0.21
11	🌿	BLATTFLÄCHE	70.190	[m <sup>2</sup> ]	70.190 m <sup>2</sup>	

# GREENPASS® use cases

- 25+ Projects inter- and national



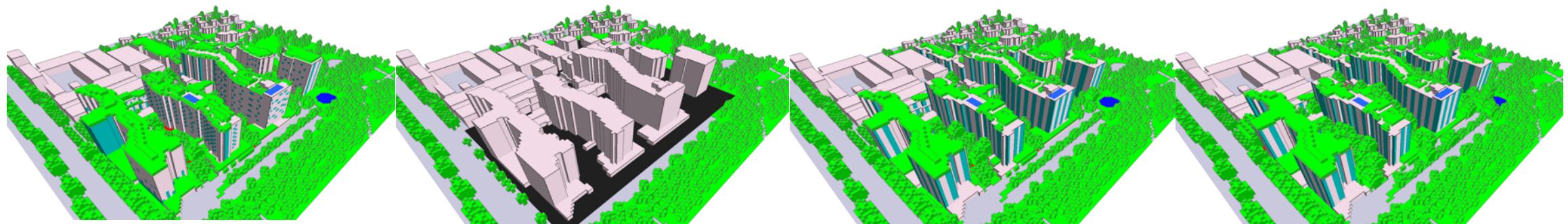
# GREENPASS® references





**BIOTOP CITY**





**Planned project**

**Worst Case**

**Moderate**

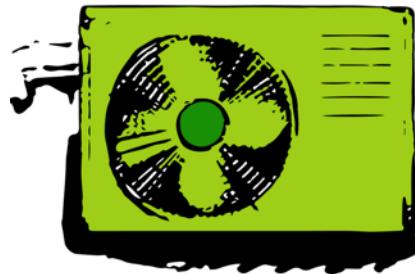
**Maximum**



# TLS

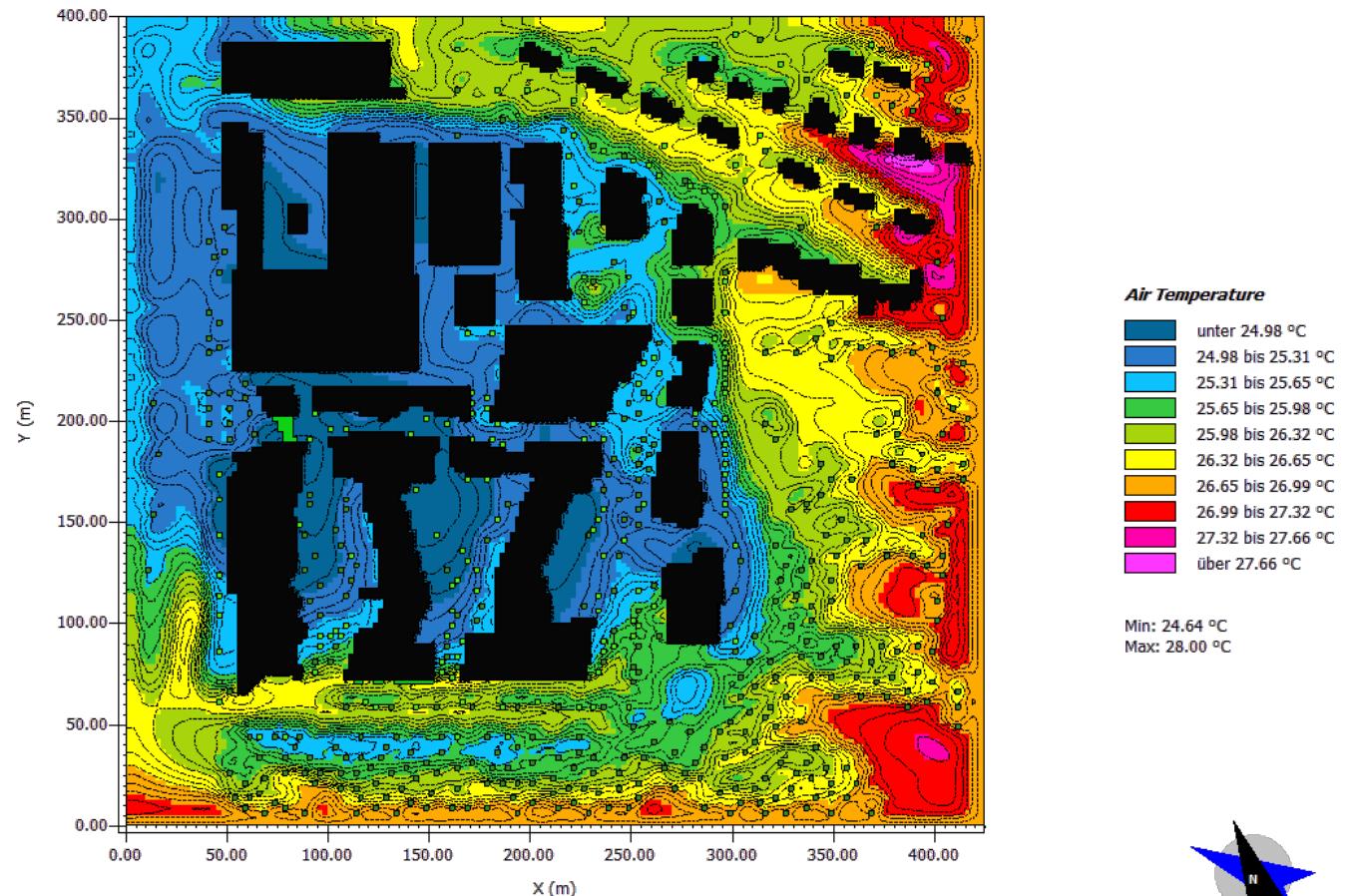
## THERMAL LOAD SCORE

Graphical illustration



up to 3 °C cooler

= NATURAL AIR CONDITIONING





# Average. **RUN OFF COEFFICIENT** numerical analysis

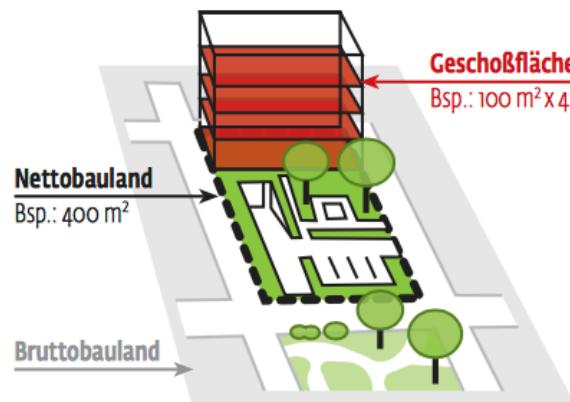
average run-off coefficient: 0.5

DURCHSCHNITTLICHER ABFLUSSBEIWERT	UST	Variante	versiegelte Flächen (Asphalt, ...) - (m <sup>2</sup> )	Grün (m <sup>2</sup> )	Sträucher (m <sup>2</sup> )	semi-intensive Dachbegrünung (m <sup>2</sup> )	extensive Dachbegrünung (m <sup>2</sup> )	durchschnittlicher Abflussbeiwert	Diff WC-MAX/ Diff WC-Planung	Anteil der max. Entsiegelung (%)	Qualitätsstufe	Bewertungspunkte
			0,9	0	0	0,2	0,4					
PLANUNG	PLANUNG - WC		51480	0	0	0	0	0,9				
	PLANUNG - MOD		28868	0	0	14	4340	0,6	0,4	70		
	PLANUNG - MAX		23372	0	0	2184	0	0,4		100		
	PLANUNG - SQ		25.076	0	0	1081,25	4212,5	0,5	0,4	81	4	10



app. 38 €/m<sup>2</sup> Floor space index

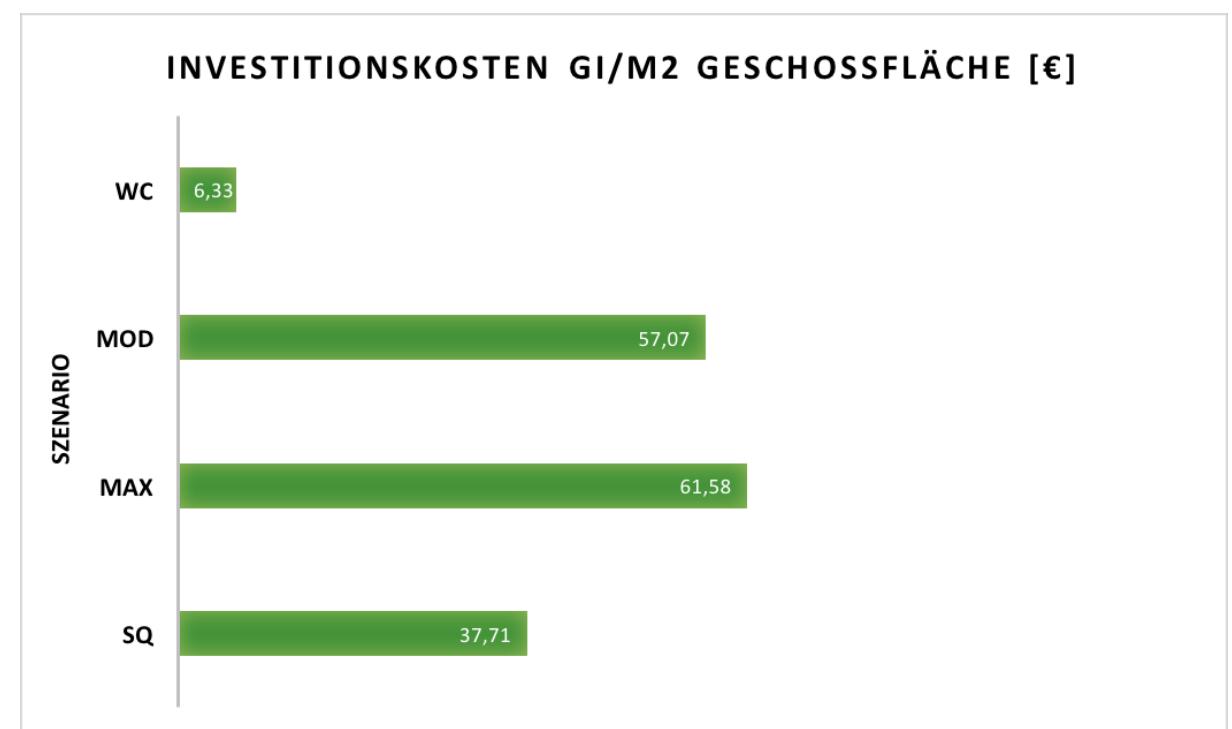
## INVESTMENT GI numerical analysis



Die NettoGESCHOßFLÄCHENZAHL NGFZ gibt das Verhältnis der Geschoßfläche GF zum Nettobauland NBL an.

$$\text{NGFZ} = \text{GF}/\text{NBL}$$

$$\text{hier: NGFZ} = 400/400 = 1$$



only 2.5 % of total construction costs

# INVESTMENT GI

## numerical analysis

**NGFZ = GF/NBL**

GFZ	3
Grundfläche (Nettobauland)	59.019 m <sup>2</sup>
Geschoßfläche	<b>177.056 m<sup>2</sup></b>
Investitionskosten GI	<b>6.676.018 €</b>
Gesamtbaukosten (1500 €/m <sup>2</sup> )	<b>265.584.375 €</b>
Gesamtbaukosten - Anteil GI	<b>2,51 %</b>

INVESTITIONSKOSTEN GI	Gebiet	Variante	Investitionskosten GI Gesamt (x)	Investitionskosten GI/m <sup>2</sup> (x)	Investitionskosten GI/m <sup>2</sup> Geschoßfläche (x)	Diff WC-MAX/ Diff WC-Planung	Anteil der max. Investitionskosten GI (%)	Qualitätsstufe	Bewertungspunkte
PLANUNG	PLANUNG - WC		1.121.625,00	0,00	6,33	-	-	-	-
	<b>PLANUNG - MOD</b>		10.103.830,05	56,57	57,07	8.982.205,05	100	-	-
	PLANUNG - MAX		10.902.676,57	46,06	61,58	-	-	-	-
	<b>PLANUNG</b>		<b>6.676.017,64</b>	<b>49,05</b>	<b>37,71</b>	<b>5.554.392,64</b>	<b>62</b>	<b>3</b>	<b>5</b>

# INVESTMENT GI

## numerical analysis

cost-efficient and economical





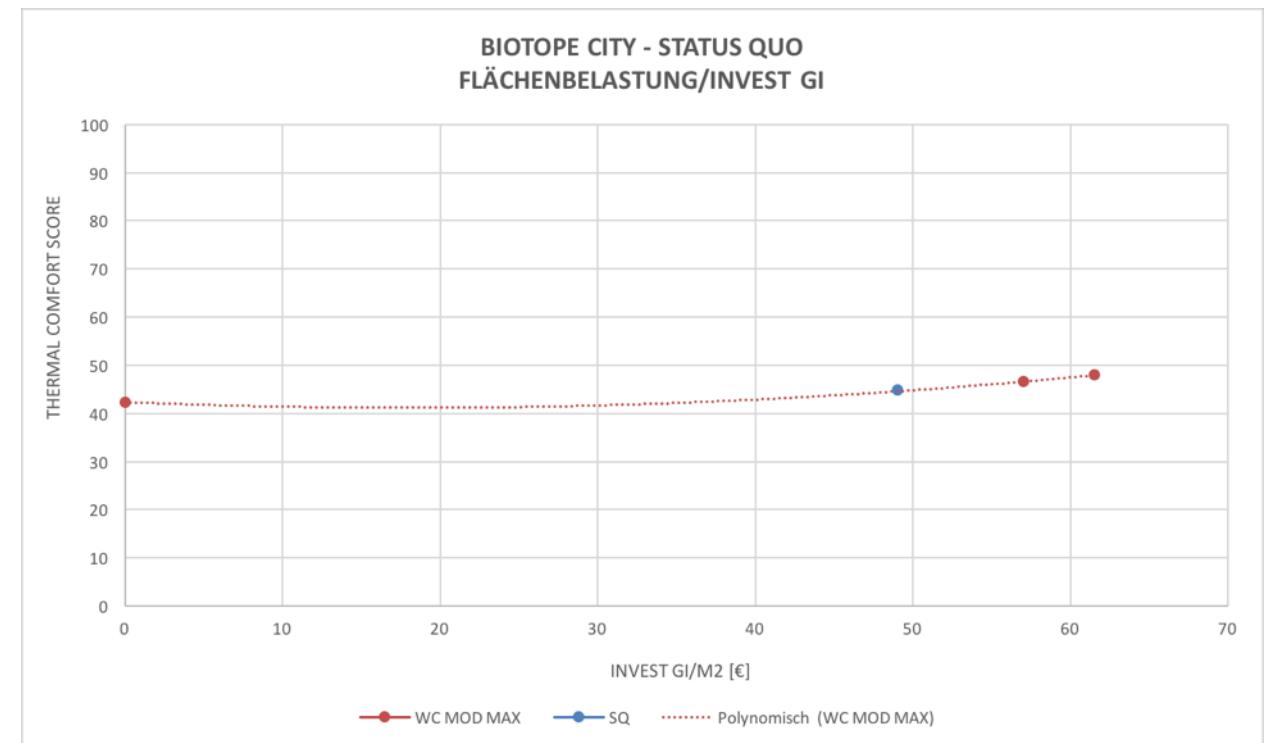
## EFFICIENCY

# TCS/ INVESTMENT GI numerical analysis

	PET	Invest/m <sup>2</sup> GFZ	PET/Invest	PET	Kosten
WC	<b>42,34</b>	0,00	-	-	-
MOD	<b>46,60</b>	57,07	0,82	0,97	0,93
MAX	<b>47,94</b>	61,58	0,78	1,00	1,00
SQ	<b>44,95</b>	37,71	1,19	0,94	0,61

SQ	1,46	0,96	0,66
Wirksamkeit	<b>146 %</b>	<b>96 %</b>	<b>66 %</b>
in Relation	von MOD	von MOD	von MOD





## CERTIFICATION

### Total degree of fulfillment



87 % total degree of fullfillment



**WE SHAPE OUR  
BUILDINGS;  
THEREAFTER  
THEY SHAPE  
US**

**Winston Churchill**





## Management of urban climate adaptation with NBS and **GREENPASS®**



[www.greenpass.at](http://www.greenpass.at)

