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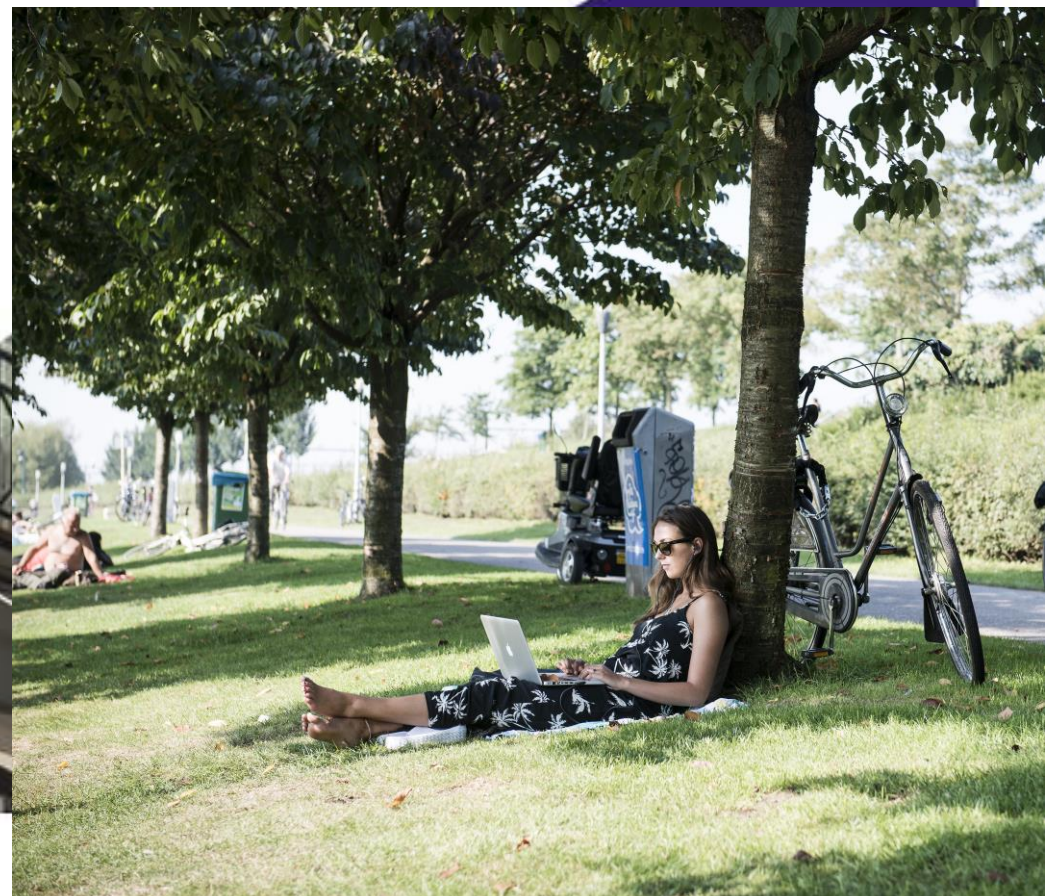
NBS TO FIGHT URBAN HEAT STRESS

September 25th, 2024
Future Green Cities Congres Utrecht
Effectiveness of Nature-Based Solutions for urban climate adaptation



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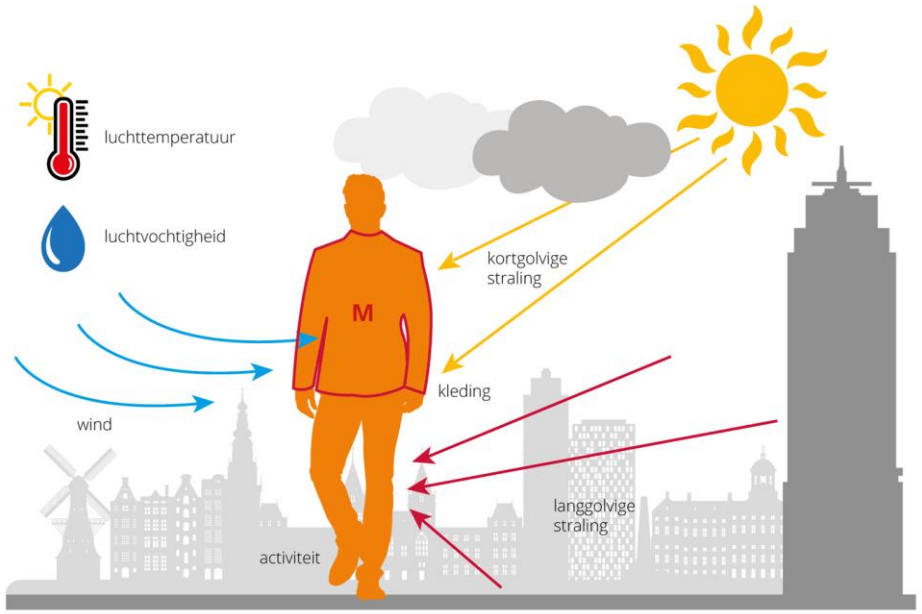
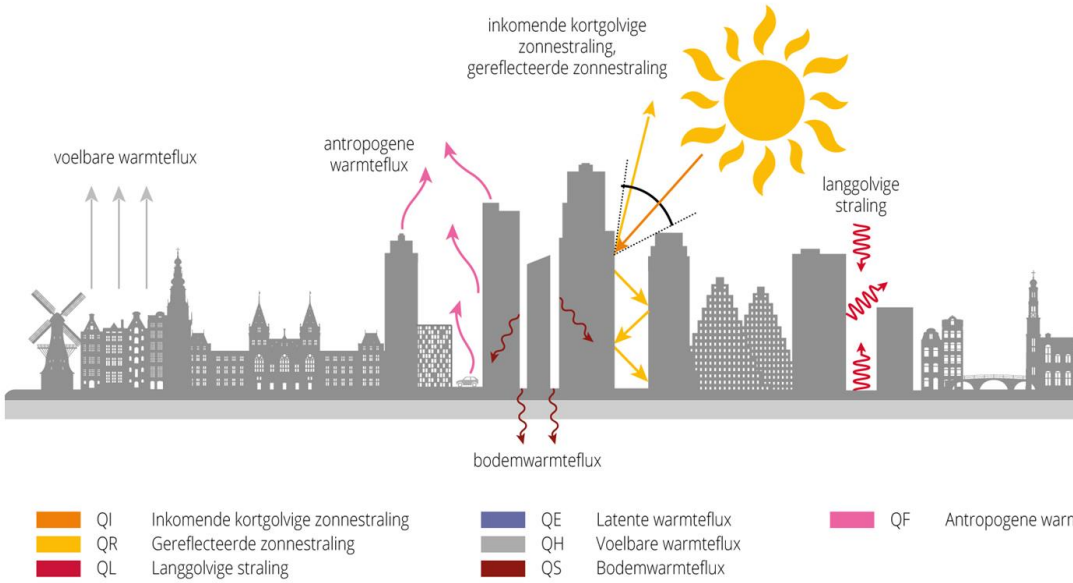
URBAN HEAT

- Liveability ➔ mainly shadow
  - Shadow PET -15 to -20 degrees
  - 300 m to a cool spot
  - 30/40% of shadow no pedestrian routes
- Health ➔ evaporation ➔ green
  - +10% more green ➔ lower air temp 0,5 ºC
  - Reduce UHI
  - > 30% of green (Depending in urban typology)





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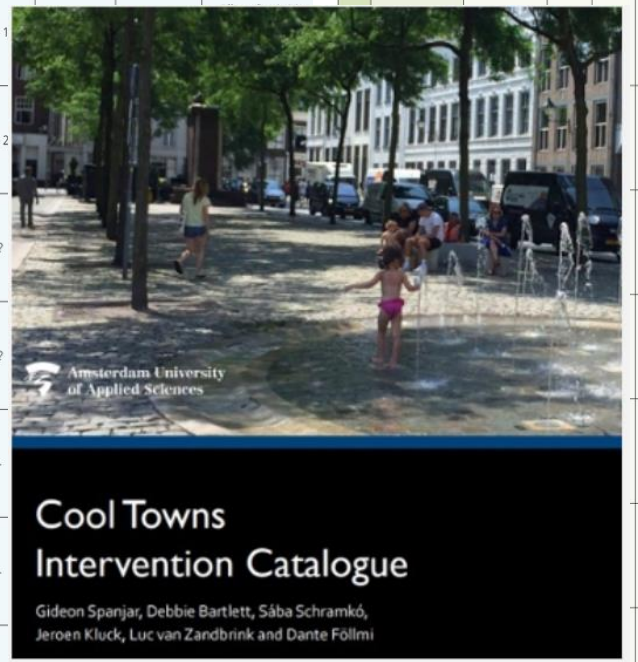
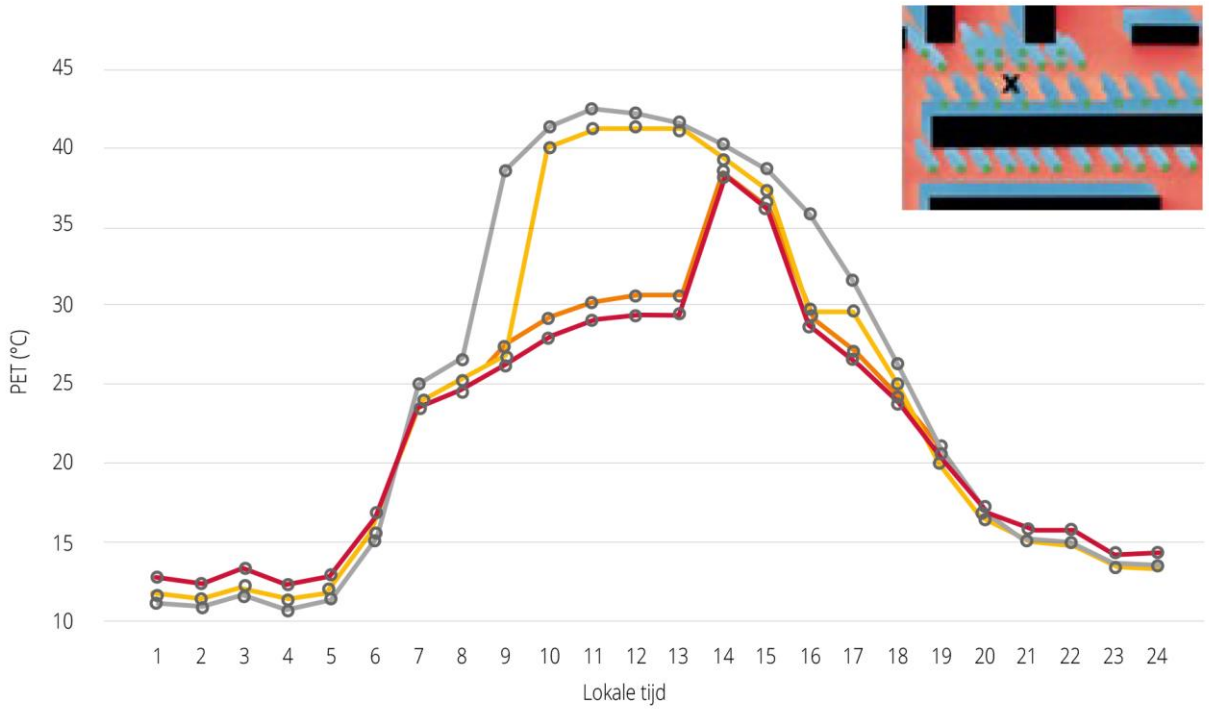
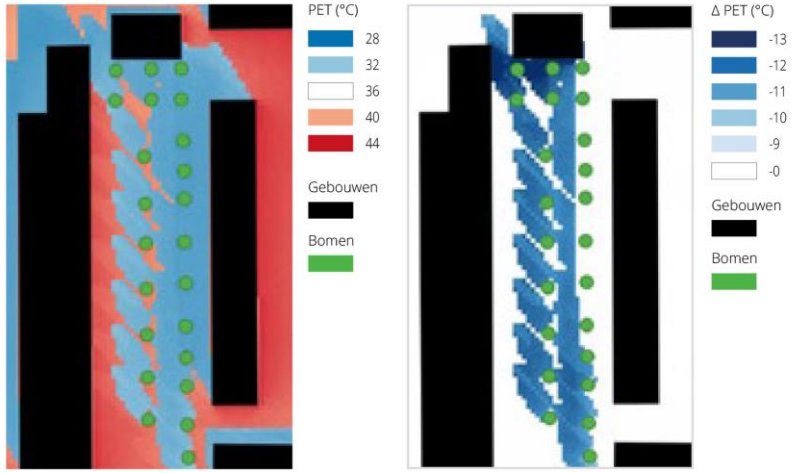
EFFECT OF COOLING INTERVENTIONS (GREY, BLUE, GREEN)



MODELLING LOCAL EFFECT ON COMFORT TEMPERATURE (PET)

- Gray – no tree
- Yellow – small tree
- Orange: open canopy, large tree
- Red: dense canopy, large tree





Figuur 3.9 De gevoelstemperatuur (links) en het verkoelende effect van bomen (rechts) in een van noord naar georiënteerde straat.

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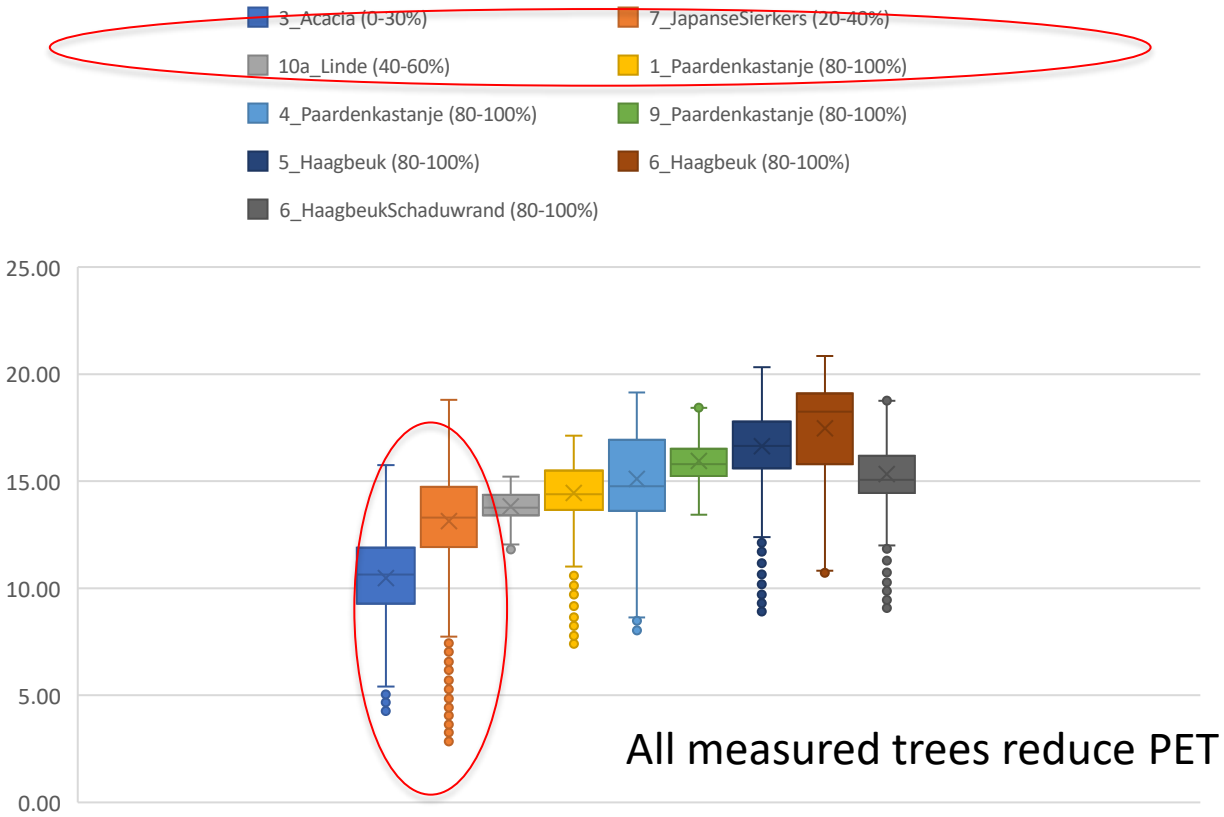
MEASUREMENTS EFFECT CROWN DENSITY ON PET

PET reduction versus crown density – 3 days measurements



All measured trees reduce PET by 10 degrees

Acacia

Kastanje

100 pages with interventions measured

- Trees
- Shelter canopies
- Green walls
- Water features
- Cool surfaces

Cool Towns Intervention Catalogue

Gideon Spanjar, Debbie Bartlett, Sába Schramkó,
Jeroen Kluck, Luc van Zandbrink and Dante Föllmi

Proven solutions to mitigate heat stress at street-level

Single lime tree on a town square, Merelbeke, Belgium

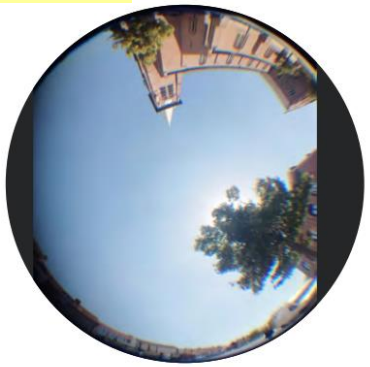
Single tree

Date	23 June 2020
Time	13:00
dPET	14,7 °C PET reduction

Intervention characteristics

Species	*Tilia cordata*
Height	8 m
Crown Ø	2 m
Orientation	na
Ground	Cobble stone
Condition	Healthy
Shape	Oval

	PET (°C)	T_{air} (°C)	T_g (°C)	MRT (°C)	Wind (m/s)	RH (%)
Intervention	**28,8**	24,6	29,1	41,8	1,6	44,6
Reference	**43,5**	24,7	39,8	72,6	1,4	45,3
Difference	**-14,7**	-0,1	-10,7	-30,8	0,2	-0,7
Int. grade	Moderate Heat Stress					
Ref. grade	Extreme heat stress: Level 1					



Group of beech trees in a community courtyard, Eeklo, Belgium

Group of trees

Date	14 June 2021
Time	14:42
dPET	19,9 °C PET reduction

Intervention characteristics

Species	*Fagus spp*
Height	10 m
Crown Ø	10 m
Orientation	na
Ground	Grass / Asphalt (ref.)
Condition	Healthy
Shape	Domed

	PET (°C)	T_{air} (°C)	T_g (°C)	MRT (°C)	Wind (m/s)	RH (%)
Intervention	**27,3**	26,9	27,8	29,5	0,8	35,9
Reference	**47,2**	29,6	45,4	63,9	0,5	34,0
Difference	**-19,9**	-2,7	-17,6	-34,4	0,3	1,9
Int. grade	Slight heat stress					
Ref. grade	Extreme heat stress: Level 2					

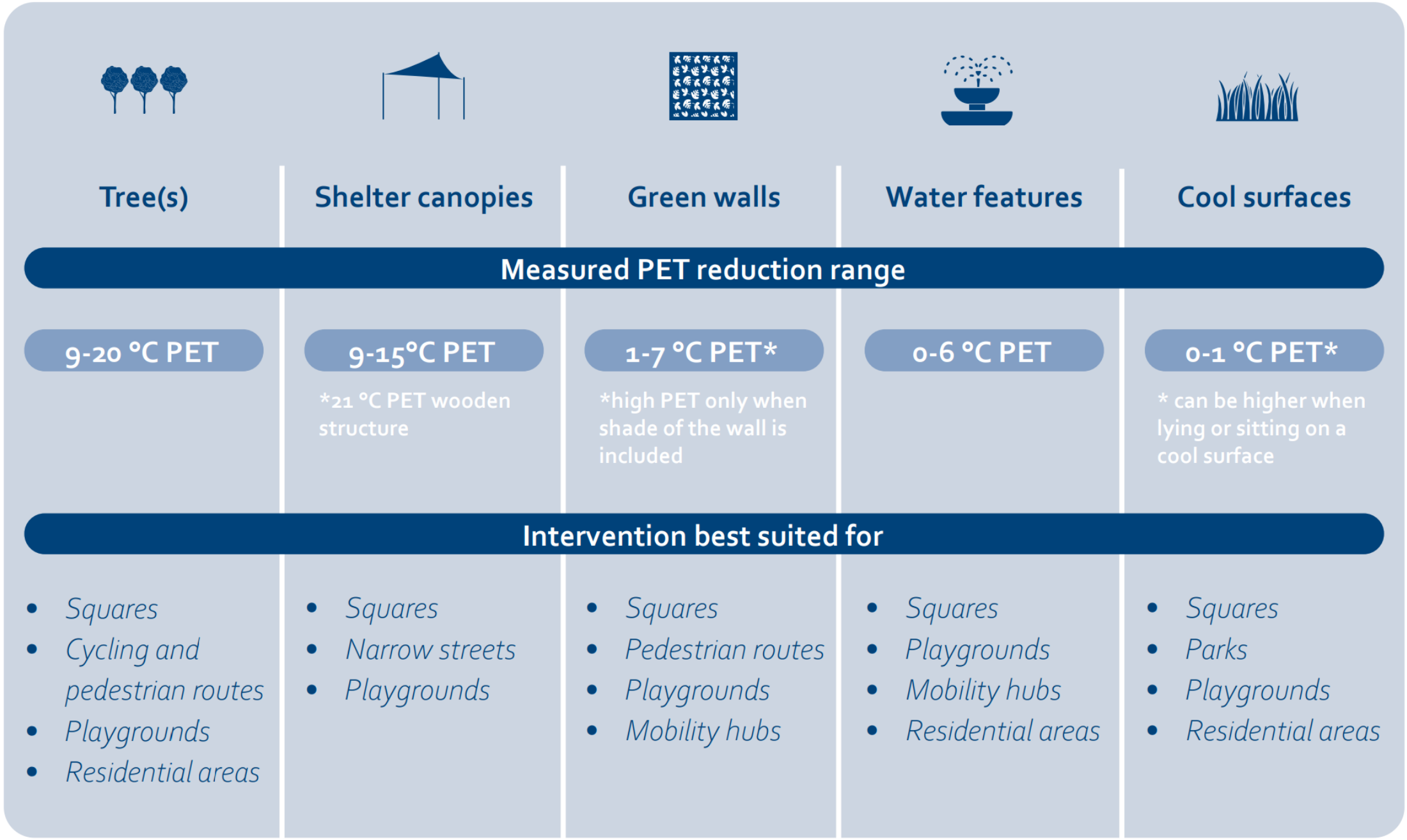


Figure 36: *Heat stress mitigation achieved by the five intervention types, based on CoolTowns measurements conducted between 2019-2022.*

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WHAT IF NO (UNDERGROUND) SPACE FOR TREES

- Street Pergola
  - Temporary
  - Beautifull
  - Attractive
  - Effective

Pergola

Date	6 September 2021
Time	15:25
dPET	8,6 °C PET reduction

Intervention characteristics

Species	*Fallopia baldschuanica* or *Polygonum baldschuanicum*
Height	3 m
Shade size	300 m²
Ground	Concrete paving slabs / Crushed brick (ref.)
Material	Wood pergola structure
Transparency	75%

	PET (°C)	T_{air} (°C)	T_g (°C)	MRT (°C)	Wind (m/s)	RH (%)
Intervention	**25,7**	23,3	26,4	35,4	1,6	56,9
Reference	**34,3**	25,3	33,1	45,3	0,7	52,2
Difference	**-8,6**	-2,0	-6,7	-9,9	0,9	4,7
Int. grade	Slight heat stress					
Ref. grade	Moderate heat stress					

Measurements conducted by Oostende

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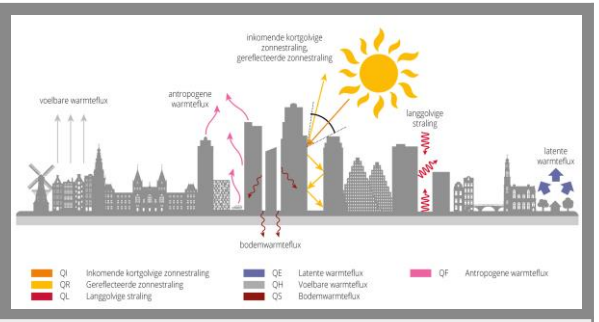
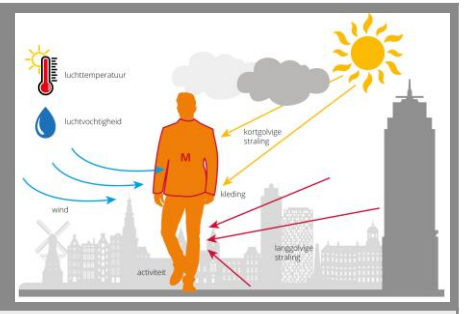
TEMPERATURE REDUCTION

Air temperature	
25% green roof + 30% more trees and parks : (Kleerekoper et al., 2018)	Up to 2 °C daytime And 1 °C 'night time
Water: large lake (Theeuwes et al., 2013)	Up to 1,5 °C
Increase green with 10 % (Steeneveld et al., 2011; Heusinkveld et al., 2014)	Up to 0,5 °C

Comfort temperature (PET)	
Shadow of trees (and buildings) (Klok et al., 2019)	12 to 22 °C
Gras (Klok et al., 2019)	Up to 4 °C
Small water bodies (Jacobs et al., 2020)	Up to 1,5 °C
Shadow (trees) (Heusinkveld et al., 2011; 2014)	~15 °C

CONCLUSION

- Shadow is effective
- Most important: Size canopy and number of trees!
  - Note in NL 30%-40% shadow on pedestrian routes
- Less important: permeability

- ➔ healthy trees ➔ tree pit! or in green.

- Important for choices
  - Biodiversity
  - Draught resistance
  - Aesthetics
  - Pollen

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VOORBEELD STEDELIJK BOUWBLOK

Hogeschool van Amsterdam

THANK YOU FOR YOUR ATTENTION

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Link to report

Cool Towns Intervention Catalogue: Proven solutions to mitigate heat stress at street-level

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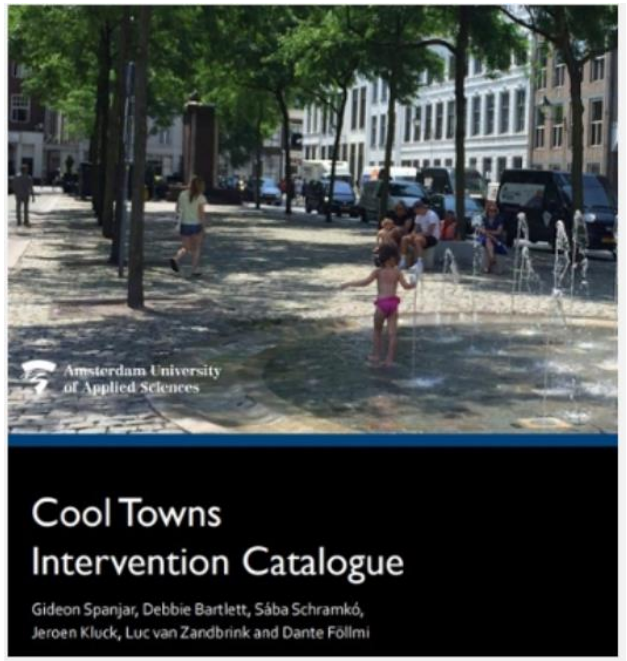

Link to report