

Sustainability and Beyond: Prospects in the Built Environment

December 7th and 8th, 2024, at MSA University

Professor Debbie Bartlett CMLI FCIEEM SFHEA



Just to introduce myself

CMLI Chartered Member of the Landscape Institute

FCIEEM Fellow Chartered Institute of Ecology and Environmental Management

Landscape Ecology

Landscape ecology is the study of how ecosystems interact and how those interactions affect ecological processes within a landscape.

Landscape ecology is a scientific perspective that's relevant to many ecological, geophysical, and social sciences.

Includes urban – cityscapes – and people

Sustainability

the ability to be maintained at a certain rate or level.
"the sustainability of economic growth"

avoidance of the depletion of natural resources in order to maintain an ecological balance
"the pursuit of global environmental sustainability"



The urban environment

**68% of the world population
projected to live in urban areas by
2050, says UN**

<https://www.un.org/uk/desa/68-world-population-projected-live-urban-areas-2050-says-un>



AILA declares



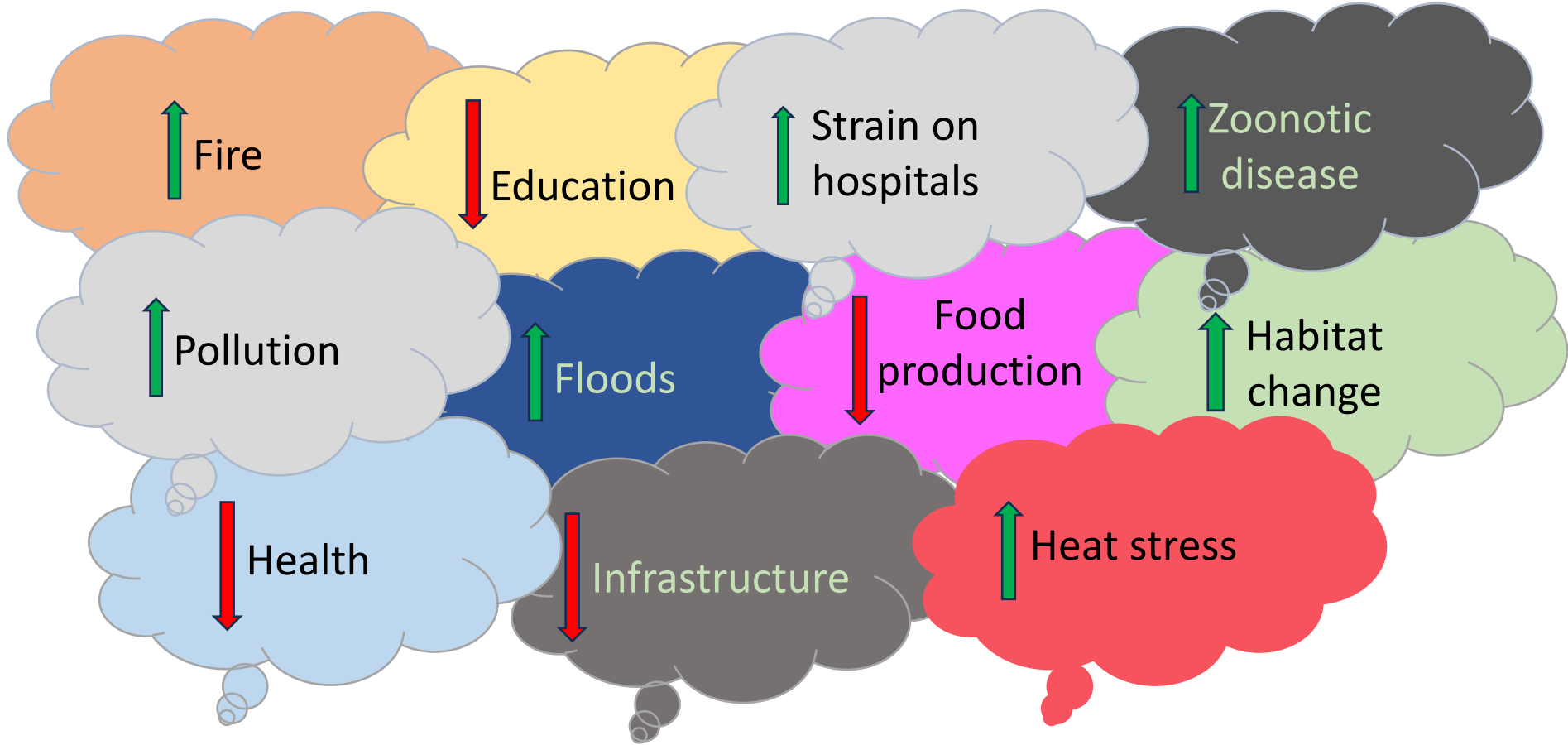
Architects Declare
Climate and
Biodiversity
Emergency

Climate &

Biodiversity Loss

Emergency

**Climate Emergency and Biodiversity
Crisis: Declaration and Call to Action**



Climate change has multiple impacts = environmental change

'Wicked' problem

Proposed by Rittel and Webber (1973) and applied to the complexities involved in identifying solutions to planning and social policy problems.

10 characteristics including multiple possible solutions, that the problem is symptomatic of other problematic issues and that defining an end point, i.e., when the 'problem' has been solved may be impossible.

Climate change is a good example - there is no simple solution.

Rittel, H.W.J. and Webber, M.M. (1973) Dilemmas in a General Theory of Planning. Policy Sciences, 4, 155-169

Identify Risk or Threat



```
graph TD; A[Identify Risk or Threat] --> B[Consider Potential Consequences]; B --> C[Identify Steps to Minimise Severity];
```

Consider Potential Consequences

Identify Steps to Minimise Severity

Climate and Environmental Change

Global warming

Extreme weather events

Heat waves Floods

Damage to Infrastructure

Loss of life and livelihoods

Reduce impact with blue/green infrastructure

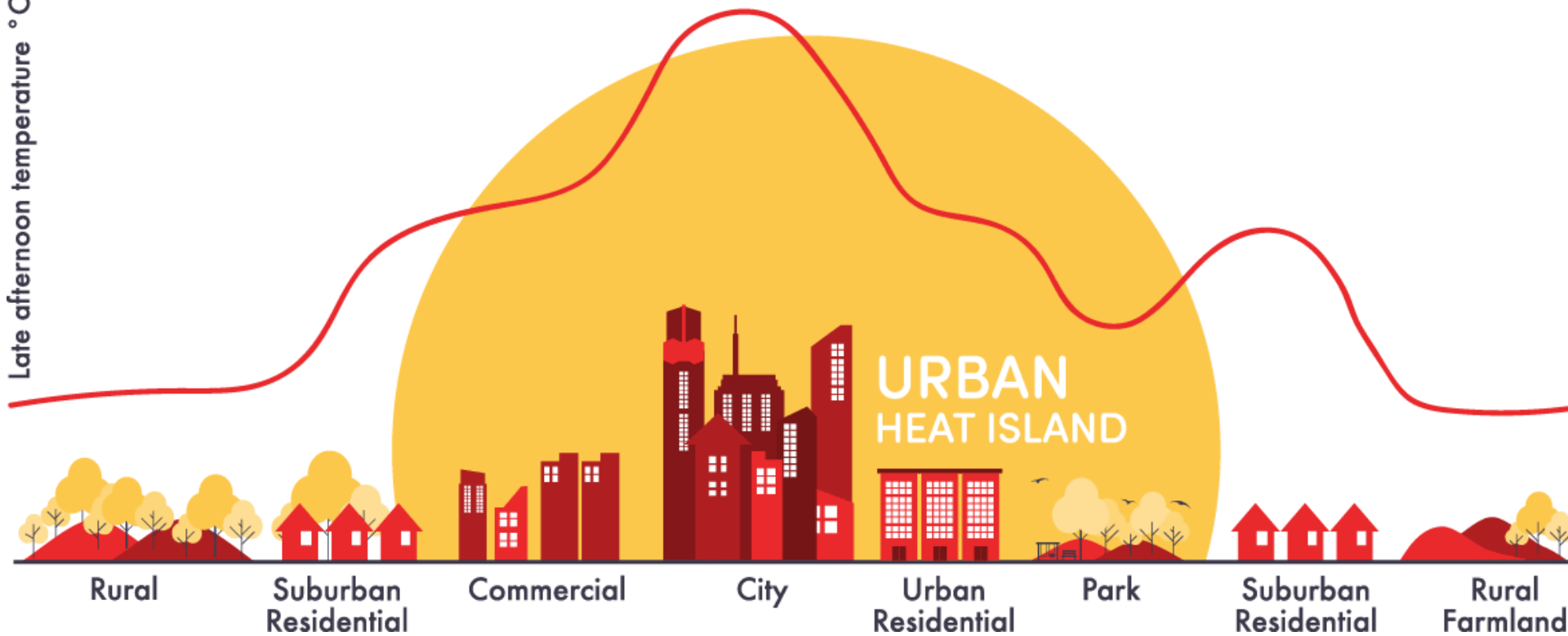
Nature Based Solutions

So what are heat waves?

- Periods of unusually warm weather
- Actual temperature depends on location
- Contrast with seasonal increase in average temperature
- Effect greatest in urban areas
- Urban Heat Island effect



Late afternoon temperature °C



This year 'virtually certain' to be hottest on record, finds EU space programme

Copernicus Climate Change Service says 2024 marks 'a new milestone' and should raise ambitions at Cop29 summit



📷 A fire burning over Lake Oroville in California during a heatwave in July. The US is the biggest historical polluter of planet-heating gas. Photograph: Josh Edelson/AFP/Getty Images

[This year 'virtually certain' to be hottest on record, finds EU space programme | Climate crisis | The Guardian](#)

The Economic Impacts of Heat/Climate Change



Heat stress causes substantial labour productivity loss in Australia

Kerstin K. Zander^{1*}, Wouter J. W. Botzen², Elspeth Oppermann¹, Tord Kjellstrom^{3,4}
and Stephen T. Garnett⁵

Industrial Health 2013, 51, 3–15

Review Article

Effects of Heat Stress on Working Populations when Facing Climate Change

Karin LUNDGREN^{1*}, Kalev KUKLANE¹, Chuansi GAO¹ and Ingvar HOLMÉR¹



Parsons L.A. *et al.* "[Increased labor losses and decreased adaptation potential in a warmer world.](#)" *Nature Communications* 2021.

[link](#)

In future productivity **lost to heat stress** could be 0.4% GVA around **£1.9 billion for London** .

Centre for Climate Change Economics & Policy/Grantham Research Institute
on Climate Change and the Environment (Costa et al, 2016)

July 2022

Heat effect on
infrastructure
Britain isn't built to
withstand 40°C –
here is where
infrastructure is
most likely to fail

[Airport runways melted.](#)

[Two UK rail mainlines have closed](#)

[Roads have buckled, or turned into “black goo”.](#)



<https://www.nytimes.com/2022/07/18/world/europe/hammersmith-bridge-foil-wrap-heat.html>

The Social Impacts of Heat/Climate Change



BMJ. 2003 Sep 6; 327(7414): 512-513.
doi: [10.1136/bmj.327.7414.512](https://doi.org/10.1136/bmj.327.7414.512)

Death in heat waves

Simple preventive measures may help reduce mortality

[William R Keatings](#), emeritus professor

[Curr Epidemiol Rep. 2014 Jun; 1\(2\): 67-74](#)
Published online 2014 Apr 5. doi: [10.1007/s40471-014-0009-1](https://doi.org/10.1007/s40471-014-0009-1)

PMID: [25422797](https://pubmed.ncbi.nlm.nih.gov/25422797/)

Health impacts of heat in a changing climate: how can emerging science inform urban adaptation planning?

[Elišaveta P. Petkova](#), DrPH, [Hanika Morita](#), MPH, and [Patrick L. Kinney](#), ScD¹

Press release

UKHSA and ONS release estimates of excess deaths during summer of 2022

Opinion
Education

Making school cool helps children do better in exams

Torsten Bell

Sun 3 May 2020
06.30 BST

Hot weather makes it harder for students to focus, and that shows in their results

Heat and Learning

[Jisung Park](#)
[Joshua Goodman](#)
[Michael Horowitz](#)
[Jonathan Smith](#)

AMERICAN ECONOMIC JOURNAL: ECONOMIC POLICY
VOL. 12, NO. 2, MAY 2020
(pp. 306-39)

10% lower achievement predicted medium warming scenario with long term impacts for macroeconomic growth



Five ways that climate change threatens human health

Published: November 15, 2024 10.11am GMT

1. New and emerging infectious diseases
2. Food security and nutrition
3. Access to healthcare
4. Air quality
5. Extreme heat

Morbidity

- Elderly
- Young

nature medicine

<https://doi.org/10.1038/s41591-024-03395-8>

Accelerated Article Preview

A systematic review and meta-analysis of heat exposure impacts on maternal, fetal and neonatal health

Received: 9 July 2024

Accepted: 31 October 2024

Accelerated Article Preview

Published online: 05 November 2024

Darshnika P. Lakhoo, Nicholas Brink, Lebohlang Radebe, Marlies H. Craig, Minh Duc Pham, Marjan M. Haghighi, Amy Wise, Ijeoma Solarin, Stanley Luchters, Gloria Maimela, Matthew F. Chersich, Heat-Health Study Group & HIGH Horizons Study Group

[Heatwaves put mothers and babies at risk](#)

Heat exposure raises the risks of preterm birth, stillbirths, congenital anomalies and obstetric complications. In the largest systematic review of its kind, researchers analysed 198 studies across 66, mostly high-income, countries. [For every 1 °C increase in heat exposure, there was a 4% increase in the risk of a child being born prematurely](#) — which is one of the leading causes of infant death or long-term disability. During a heatwave, the chance of preterm birth increased by 26%. “Protecting the health of pregnant women and newborns must become a priority in our response to climate change,” [said](#) physician-scientist and review co-author Darshnika Lakhoo in a statement.

[Nature Medicine | 53 min read](#)

Heat & violent Crime

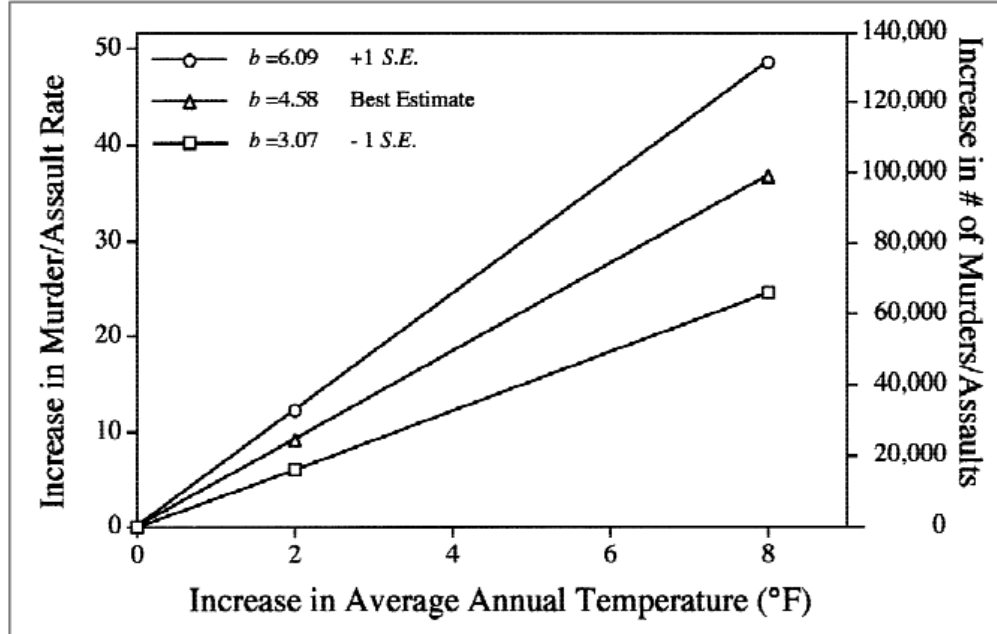


Fig. 2. Estimated effect of global warming on murders and assaults in the United States. The graph shows the estimated increase in the murder-assault rate and in the number of murders and assaults (for a population of 270 million) based on three estimates of the relation between temperature and violence. From Anderson, Anderson, Dorr, DeNeve, and Flanagan (2000).

nature

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[nature](#) > [comment](#) > article

COMMENT | 05 October 2021

Deploy heat officers, policies and metrics

Cities need heat governance to plan for extreme temperatures and protect those most at risk.

[Ladd Keith](#) , [Sara Meerow](#), [David M. Hondula](#), [V. Kelly Turner](#) & [James C. Arnott](#)



Urban trees feeling the heat as climate change threatens survival

A new study raises concerns that climate change is putting many city-dwelling trees worldwide at risk.

The Environmental Impacts of Heat/Climate Change

UK heatwave triggers 'false autumn' as trees shed leaves early

► Experts say two thirds of Europe is under drought alert and dry conditions will remain until November



A man sits on a deckchair among brown leaves fallen from the trees in St James's Park, central London, on Wednesday. AFP

[link](#)

Falling birds and dehydrated hedgehogs: heatwave takes its toll on UK wildlife

Animals and insects have been casualties of recent extreme heat, but the true impact will only be known over time, experts say



[link](#)

[link](#)

Heatwave may have killed "generation" of baby bats

© 21 hours ago



PIERS SANGAN

| The grey long-eared bat is listed as "critically endangered"

Impacts of increasing heat

- **Economic impacts**
- **Damage to infrastructure**
- **Social impact**
 - **Health – death and morbidity**
 - **Outdoor workers**
 - **Learning ability**
 - **Violent crime**
- **Environmental – food production and wildlife**

So what can we, as
urban design
professionals, do to help
with this enormous
problem?

COOL TOWNS

Interreg 
EUROPEAN UNION
2 Seas Mers Zeeën
European Regional Development Fund

COOL TOWNS

Towards heat resilient cities

Liveability of cities is under threat worldwide

UK is no longer a cold country and must adapt to heat, say climate scientists

Experts call on UK officials to prepare for periods of extreme heat or risk thousands of excess deaths

Extreme UK weather - live updates



People shelter from the sun on the South Bank in London on Monday. Photograph: Alberto Perrotti/Corbis

Source: guardian.com

UK is no longer a cold country and must adapt to heat, say climate scientists

Delhi suffers at 49C as heatwave sweeps India

By The Associated Press & the Guardian

10:00 AM

Climate change



Twitter: @guardian via @the_earth_magazine via @the_earth_magazine

Source: bbc.com

Delhi suffers at 49°C as heatwave sweeps India

Japan swelters in its worst heatwave ever recorded

10:00 AM

Climate change



Twitter: @guardian via @the_earth_magazine via @the_earth_magazine

Source: bbc.com

Japan swelters in its worst heatwave ever recorded

Perth swelters through record six consecutive days over 40C temperatures

West Australian capital also setting records for most days above 40C in a summer with the tally now at 11 days

Follow our Australia news live blog for the latest updates

Download the free Guardian app: get our morning email briefing



People cool off with a drink in Perth's Swan River on Saturday as the city baked in 41C heat - the 11th day in a row over 40C, before a sixth consecutive day on Sunday. A cool change is expected on Monday. Photograph: David Gray/Corbis Images

Source: guardian.com

Perth swelters through record six consecutive days over 40°C temperatures

Cool Towns Project

To provide cities and municipalities with knowledge and tools
to become heat-resistant Sept 2018 - Dec 2022

Decision makers

Elected
representatives

Financial
controllers

Technical advisors

Urban planners

Architects

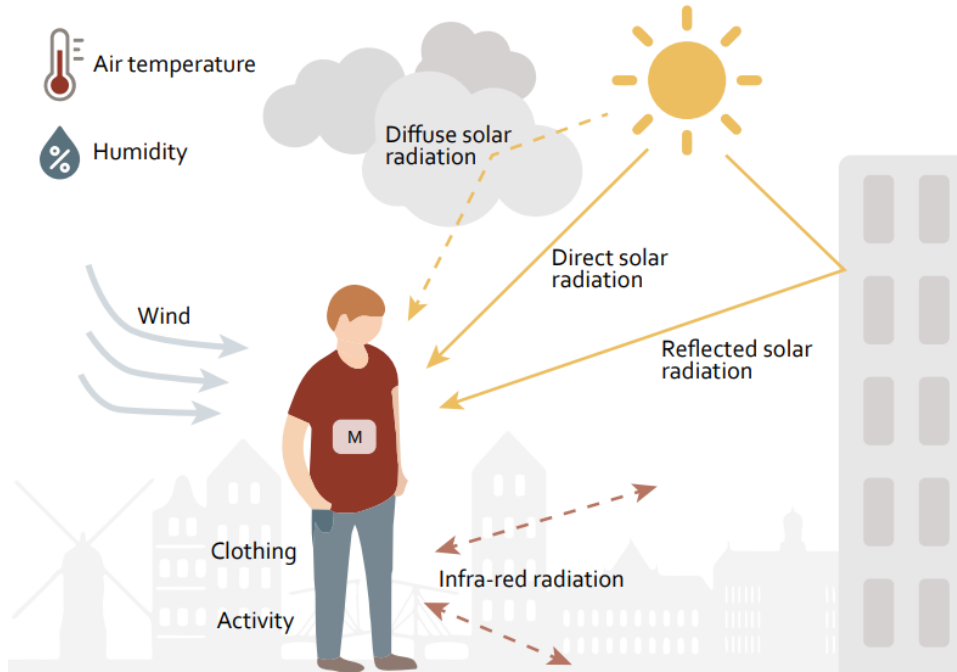
Landscape
architects

Maintenance
teams

Local people

Consultation
Need to approve

Physiological Equivalent Temperature



Adapted from Havenith (1999)

PET	Stress Category
<4	Very high cold stress
4 – 8	High cold stress
8 – 13	Moderate cold stress
13 – 18	Slight cold stress
18 – 23	No thermal stress
23 – 29	Moderate heat stress
29 – 35	High heat stress
35 – 41	Very high heat stress
>41	Extreme heat stress

Vulnerable spatial typologies

City centres / Shopping areas



Veemarktstraat, Breda, NL

Schools / Playgrounds



de Reigers School, Zelzate, BE

Residential neighbourhoods



Waverley Road, Margate, UK

Mobility hubs



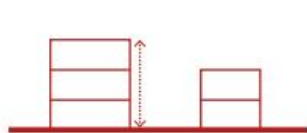
Bus station, Middelburg, NL

Pedestrian / Cycling routes

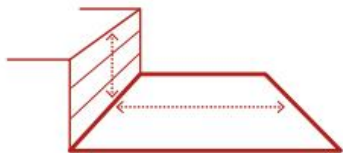


Coehoornstraat, Breda, NL

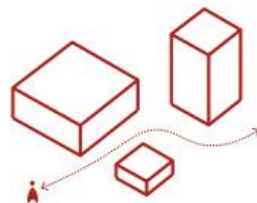
- Identifying vulnerabilities in and between outdoor spaces
- Resolving through tactical small-scale interventions as a start



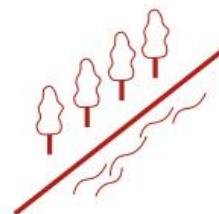
Urban Geometry



Height-Width Ratio



Social Movement



Green-blue infrastructure



User-groups

Vulnerable health groups

- Elderly
- Children
- Ill people
- Living alone (social isolation)
- Low socio-economic status

Vulnerable activity groups

- Commuters (on foot & bike)
- Leisure (escape the heat)
- Sport players
- Shoppers (daily)

Vulnerable places

Schools

Playgrounds

Care homes

Train + Bus
stations

Shopping
areas

Festival
grounds

Vulnerable Routes

- Towards amenities (e.g. pharmacy)
- Towards large cool places (e.g. parks)
- Towards train station
- Towards centrum area
- Towards bus station

Which places call for urgent action?



- **Market area** under Level 2 Extreme Heat stress
- Double row of plane trees, when 10-15 meter tall have a 15-17 °C PET heat reduction capacity
- Aim to make the area car free



- **Bus station route** suffers from Level 2 Extreme Heat Stress
- Re-connecting existing green infrastructure: planting row of trees at the end of 2020 (maple, ornamental pear, rowan)



- **School yard's** forested area offers escape from the heat, heat stress reduced to Moderate level
- Area's exposed to heat serve as Cool Towns pilot sites



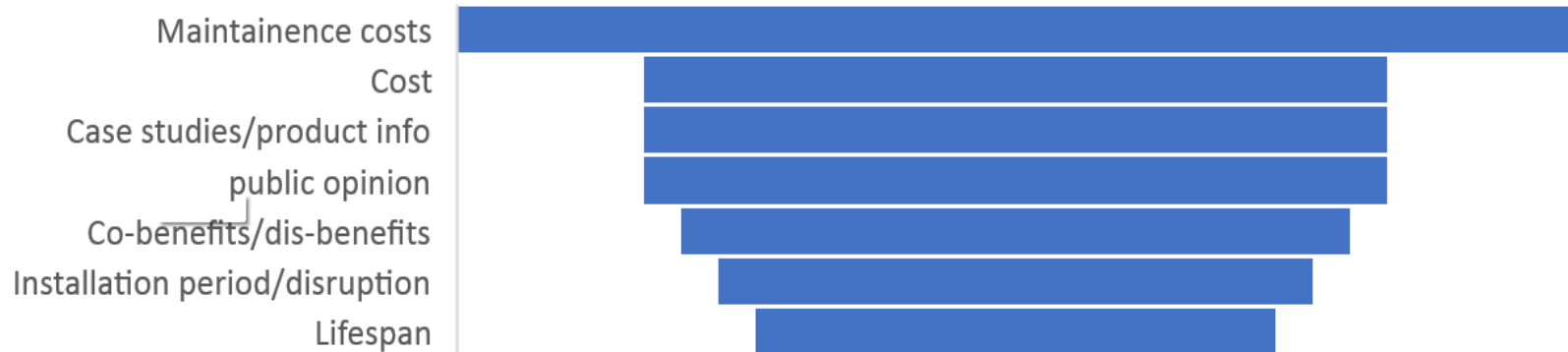
The Urban Heat Atlas

Gideon Spanjar, Debbie Bartlett,
Sába Schramkó and Jeroen Kluck

A standardised assessment
for mapping heat vulnerabilities
in Europe

Which intervention is most suitable?

Summary of key issues

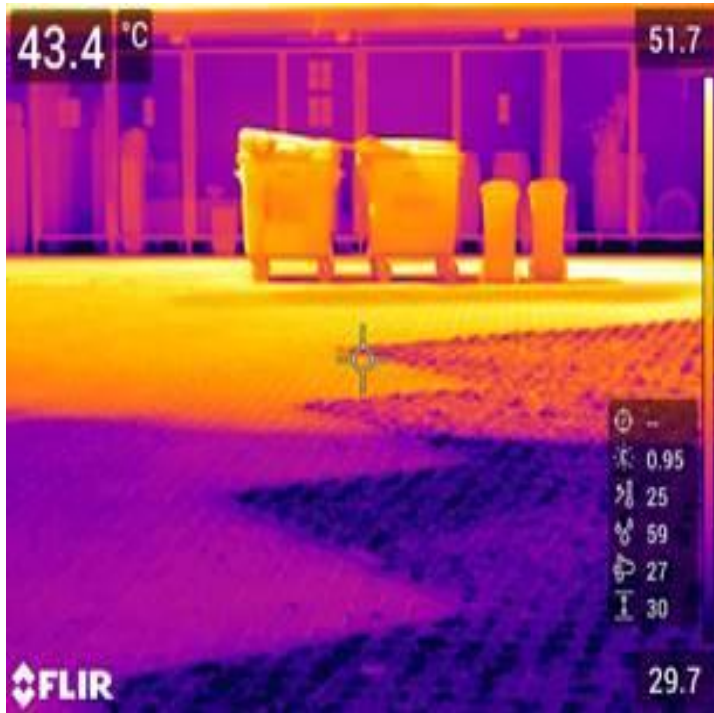


Which is most effective at increasing thermal comfort?





Types of pavement



solid
compared
with
vegetated
(permeable)
paving





Tree(s)



- single tree
- row of trees
- group of trees



Shelter Canopy



- shade sail
- awning
- pergola



Green Wall



- direct green façade
- indirect green façade
- living wall system
- free-standing green screen



Water Feature



- fountain
- smaller waterway
- misting



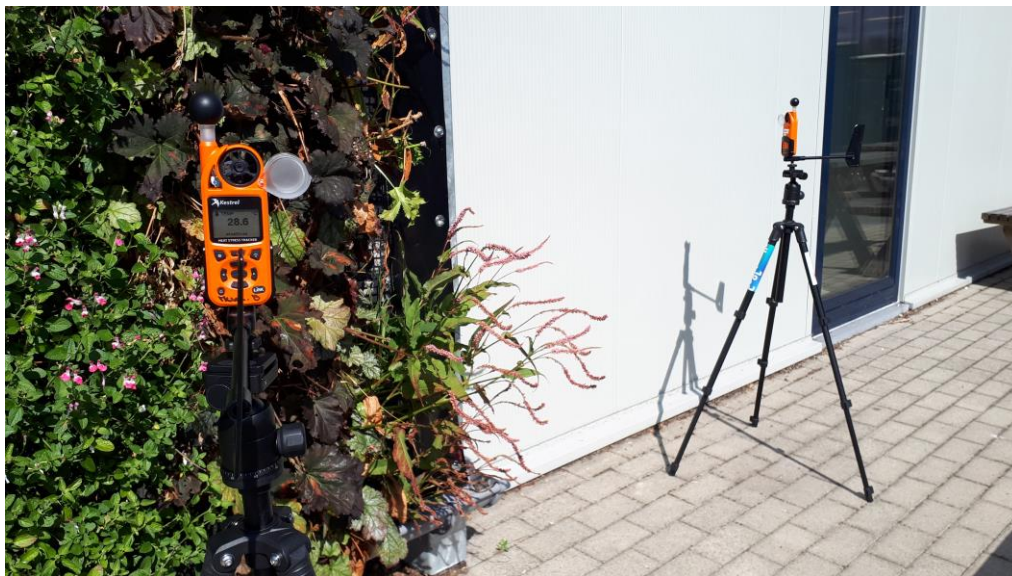
Cool Surface



- grass
- vegetated paving
- damped pavement



Measuring effect on PET



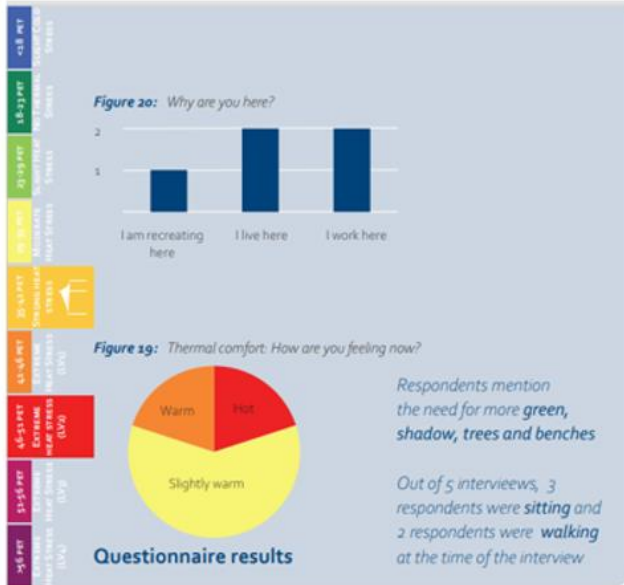
Cool Towns Heat Stress Measurement Protocol



Cool Towns Heat Stress Measurement Protocol

Gideon Spanjar, Luc van Zandbrink,
Debbie Bartlett and Jeroen Kluck

Thermal comfort
assessment at
street-level scale



Spatial characteristics

26-36 Kanaalweg, Middelburg, NL



Spatial typology	Mobility hub (in its proximity, in 200m)
Urban geometry	Open site with one high building at each short end of the linear pergola structure
Social use	Place to stay and sit on the benches. Cycling route runs next to the site

3.3.2 Pergola structure near Middelburg station

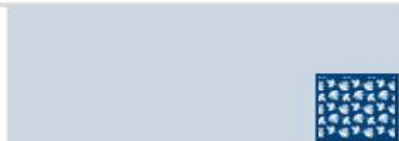
This 50m long metal pergola is located on an important walking and cycling route to the central train station area in Middelburg. It runs parallel with the Canal of Walcheren on an open site. The sole buildings tower over either end of the structure with a height of 20-25 metres, potentially blocking the wind that often fortifies as it sweeps above open canals. The measured wind speed corresponds to a light breeze on the Beaufort scale. It is at the threshold when people passing by may experience a touch of air on their skin. The still wind conditions with the low relative humidity point to a dry summer day that aggravates heat stress on the site. The pergola's effectiveness in reducing heat stress was measured during the late afternoon, near the evening rush hour when the sun is not at its highest anymore, while facades and concrete tiles already warmed up and radiate heat.

The pergola is densely overgrown with Wisteria, spreading over the edges of the supporting structure and creating a continuous shade. In the spring, the purple flowers of the Wisteria make the pergola especially attractive. Residents living, recreating or working in the area appreciated the pergola for walking along and resting underneath. The measurement and interviews underline the effectiveness of the pergola in reducing heat stress. Interviewees sitting or walking under the shade felt only slightly warm, while those in the sun reported feeling warm or hot. Even though the pergola reduced air temperature by less than 1° under the pergola, it greatly improved thermal comfort with around 13° lower PET in the shade. The pergola improved thermal comfort by two Physiological Stress Grades largely because it shaded the users and the hard surfaces from direct solar radiation.

Date	31 July 2020
Time	15:46
dPET	13,1 °C PET reduction
Intervention characteristics	
Species	Wisteria
Height	3m
Shade size	100m²
Ground	concrete tiles
Material	metal pergola structure
Transparency	85%

	PET (°C)	T _{air} (°C)	T _g (°C)	MRT (°C)	Wind (m/s)	RH (%)
Intervention	36,6	33,5	35,5	42,1	2,2	26,4
Reference	49,7	34	44,7	10,7	2,2	26,3
Difference	-13,1	-0,6	-9,2	-31,4	0,02	0,06
Int. grade	🟡 Strong heat stress					
Ref. grade	🔴 Extreme heat stress: Level 2					





Date	21 July 2021
Time	12:29
dPET	6,5 °C PET reduction

Intervention characteristics

Species	English Ivy (<i>Hedera helix</i>)
Height	2m
Width	3m
Orientation	North-South
Ground	Concrete tiles
Condition	Good
Coverage	50%

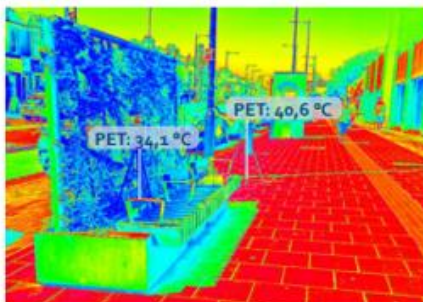
	PET (°C)	T _{air} (°C)	T _g (°C)	MRT (°C)	Wind (m/s)	RH (%)
Intervention	34,1	28,4	33	41,9	0,9	50,4
Reference	40,6	27,3	38	61	1,3	53,5
Difference	-6,5	1,1	-5	-19,1	-0,4	-3,1
Int. grade	Moderate heat stress					
Ref. grade	Strong heat stress					



Southend-on-Sea Municipality



Southend-on-Sea Municipality



Fisheye photo above
intervention point



Green bench Southend England



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



The Roadmap

1. What is heat stress ?

2. What places have heat stress potential ?

3. How can heat stress be reduced ?

4. What is the best option to reduce heat stress in your area?

5. Case studies

6. Developing a city-wide strategy



The Urban Heat Atlas

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A standardised assessment for mapping heat vulnerabilities in Europe



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Proven solutions to mitigate heat stress at street-level

Free downloads

Heat Atlas

[https://pure.hva.nl/ws/portalfiles/portal/35821514/Spanjar et al 2022 The Urban Heat Atlas.pdf](https://pure.hva.nl/ws/portalfiles/portal/35821514/Spanjar_et_al_2022_The_Urban_Heat_Atlas.pdf)

Measurement protocol

[https://pure.hva.nl/ws/portalfiles/portal/16987054/Cool Towns Heat Stress Measurement Protocol.pdf](https://pure.hva.nl/ws/portalfiles/portal/16987054/Cool_Towns_Heat_Stress_Measurement_Protocol.pdf)

Intervention Catalogue:

[https://pure.hva.nl/ws/portalfiles/portal/41700065/Spanjar et al. 2023 Cool Towns Intervention Catalogue 175dpi.pdf](https://pure.hva.nl/ws/portalfiles/portal/41700065/Spanjar_et_al._2023_Cool_Towns_Intervention_Catalogue_175dpi.pdf)

Publications

- **Bartlett D (2024) Five ways to keep towns cool in a heatwave.** The Conversation. <https://theconversation.com/five-ways-to-keep-towns-cool-in-a-heatwave-224776>
- **Bartlett D and Spanjar G (2023) Thermal comfort and its significance for landscape practice** Landscape summer 2023 pages 57-60 available at https://issuu.com/landscape-institute/docs/the_hospitable_landscape_summer_2023
- Qureshi A M, Rachid A & **Bartlett D (2023) Quantifying the Cooling Effect of Urban Heat Stress Interventions** s International Journal of Global Warming, 30 (1). pp. 60-80. ISSN 1758-2083 (Print), 1758-2091 (Online) (doi:<https://doi.org/10.1504/IJGW.2023.130493>)
- **Bartlett D (2021) Chapter 15 Community resilience to climate change** in Climate Change: the Social and Scientific Construct Ed Bandh S. Publisher: Springer Nature Switzerland
- **Bartlett D (2021) Chapter 13 A Risk Assessment Approach to Urban Resilience** in Improving Urban Resilience and Sustainability by integrating Blue-Green Infrastructure across Asian Countries. Ed Dhyani S, Basu M, Santhanam H & Dasgupta R. Springer Nature.
- **Bartlett D (2020) Chapter 6 Landscape Character Assessment: A method to include community perspectives and ecosystem services in landuse planning** in Nature based Solutions: Science, Innovations and Strategies in South Asia. Ed Dhyani S, Gupta A K and Karki M. Volume 1 in the Springer Nature series Disaster Resilience and Green Growth <https://link.springer.com/book/10.1007/978-981-15-4712-6>

Summary

Late afternoon temperature °C



Rural

Suburban Residential

Urban Residential

Rural Farmland

YES WE CAN - PASS THE CLIMATE AND NATURE ACT

<https://www.zerohour.uk/yeswecan/>

**TACKLING THE
CLIMATE &
NATURE CRISIS
TOGETHER**

Zero Hour is the campaign for the Climate and Nature Bill – formerly the CE Bill and the CEE Bill – a plan for a new UK law that addresses the full extent of the climate and nature crisis in line with the most up-to-date science. The Bill is the only proposed legislation before the UK Parliament that ensures a comprehensive and joined-up approach to the emergency.

[READ THE BILL](#) →

[CAN BILL BRIEFING](#) →

[READ MORE](#) ↓

Thank you for listening

If you require any further information

Please email me d.bartlett@gre.ac.uk

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<https://www.linkedin.com/in/debbie-bartlett-30a75b1b/>