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The impact of our changing climate on urban areas

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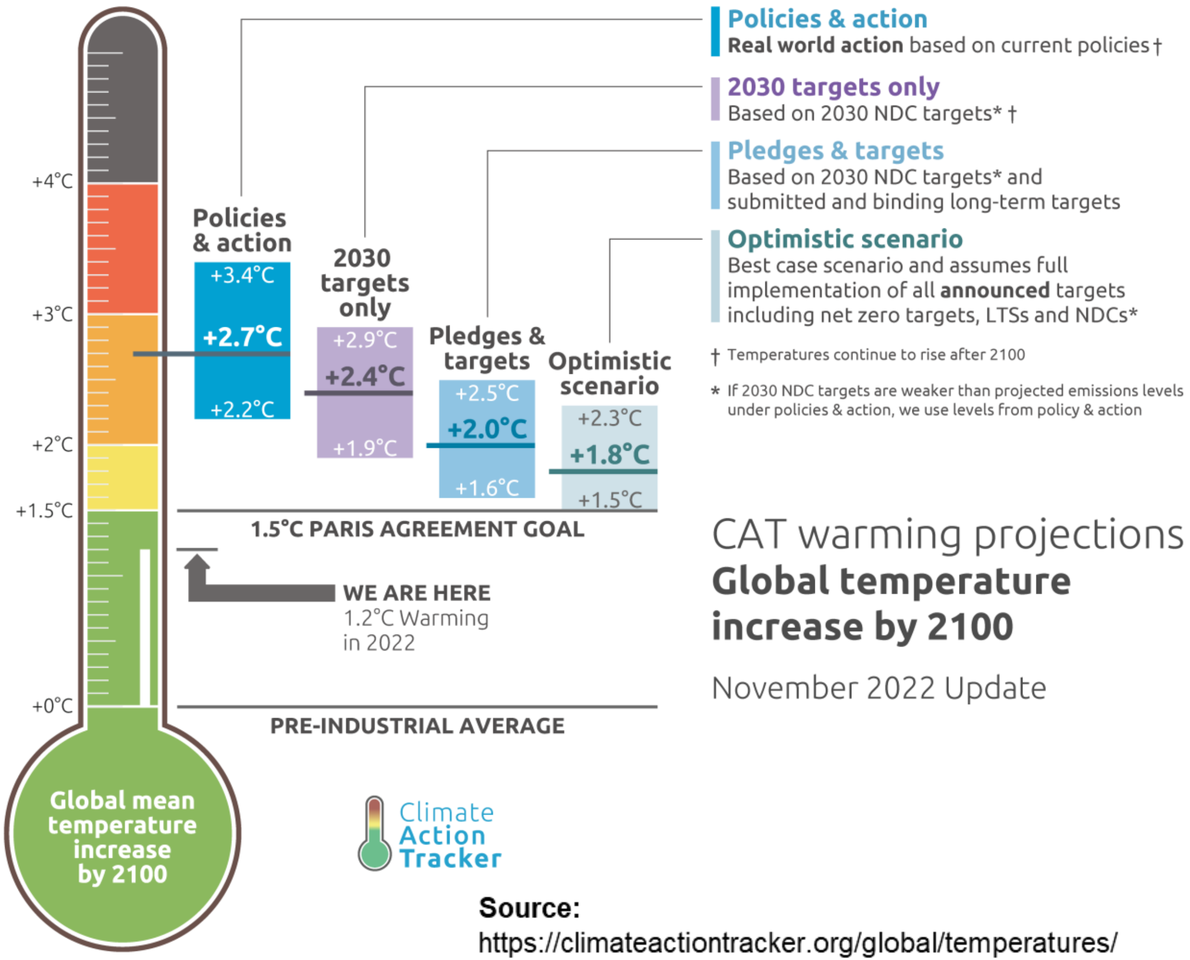
The CAT (climate action tracker) thermometer



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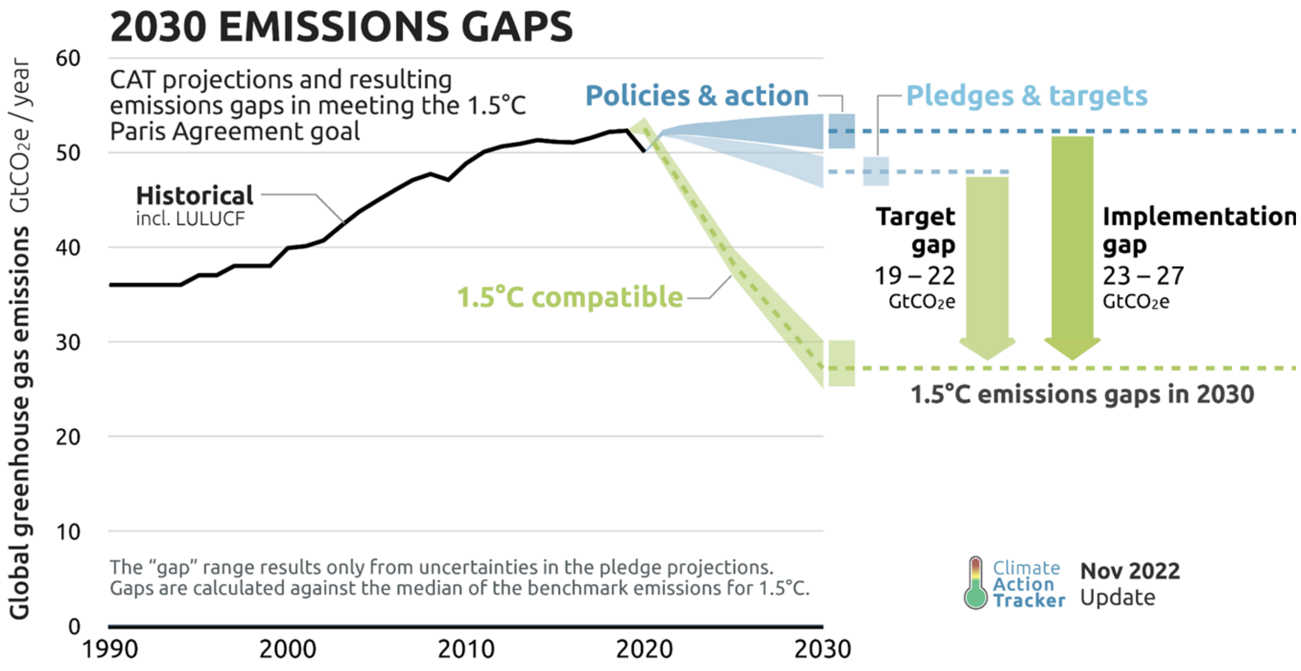
Source: https://climateactiontracker.org/global/temperatures/

Future greenhouse gas emissions



1. 1. We must mitigate (reduce emissions). Most dangerous impacts of climate change happen above 1.5ºC

2. We must adapt (be ready for a different future climate).

3. When using future scenarios need to consider 3ºC (or more) warming.

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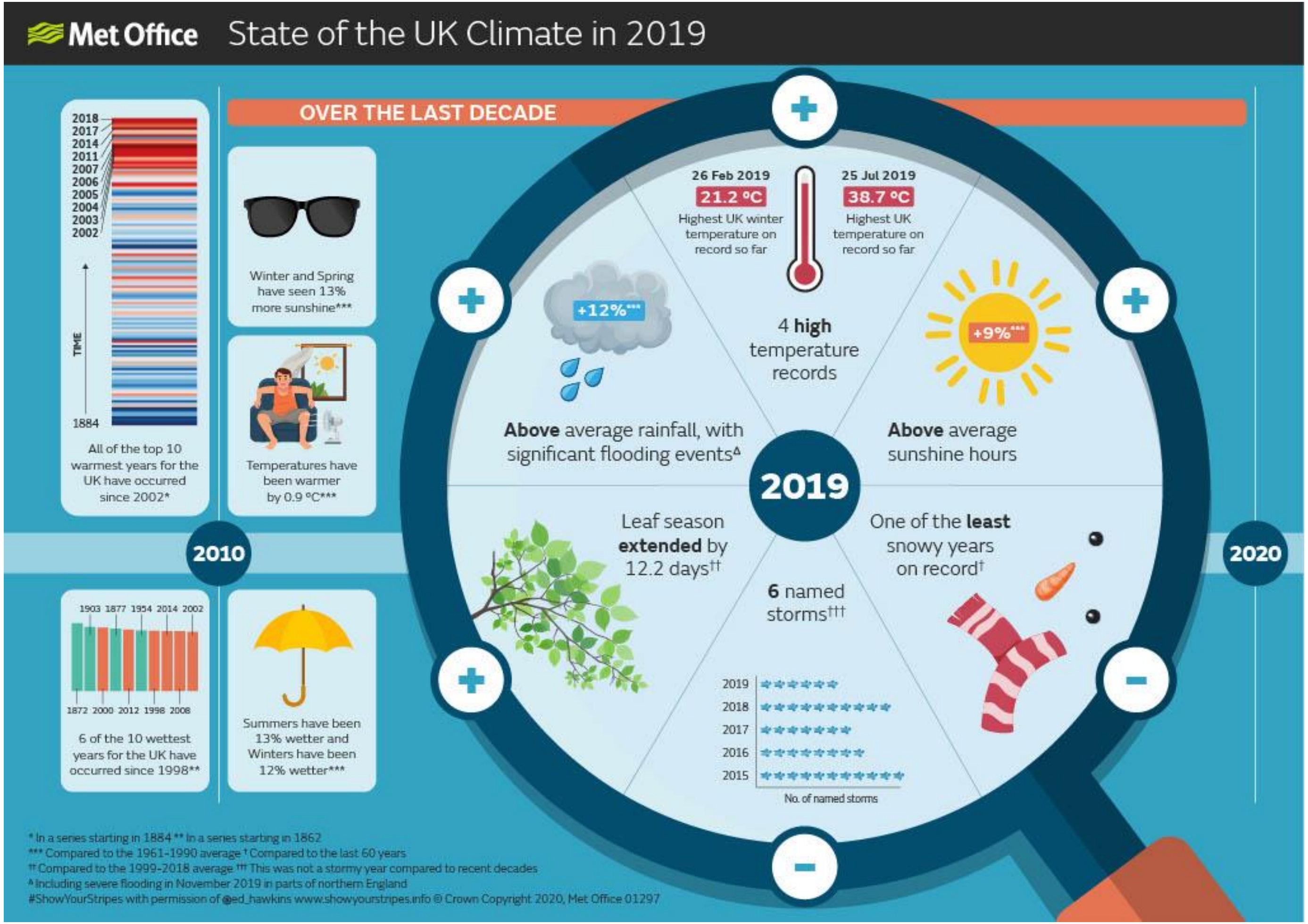
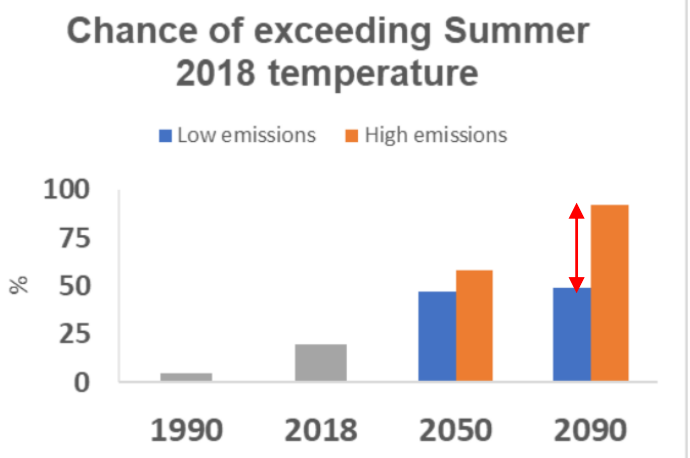
Source:
https://climateactiontracker.org/global/temperatures/



Source: https://www.rmets.org/news/report-shows-climate-change-exerting-increasing-influence-uk-climate

Future climate projections

- Met Office 2018 headline result: "*a greater chance of warmer, wetter winters and hotter, drier summers*"
  - More frequent heavy rainfall events, more rainfall in shorter period of time
  - Summers like 2018 happening every other year by 2050
  - Sea level rise (e.g. 70-115 cm (low vs high emissions) by 2100
  - **We can influence the future!**



Source Met Office:
https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-overview-slidepack-march21.pdf

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So what does this mean for our urban areas?

- Increased future flood risk *(pluvial, fluvial, coastal)*

"The risk of flooding to people, communities and buildings is one of the most severe risks from climate hazards for the UK population – both now and in the future" CCRA 2021

- Increased future overheating risk

"There is still little preventative action being taken to address health risks from overheating in buildings. In England, ~20% homes risk of overheating" CCRA 2021

Source: GETTY IMAGES
https://www.bbc.co.uk/news/uk-england-shropshire-59401743

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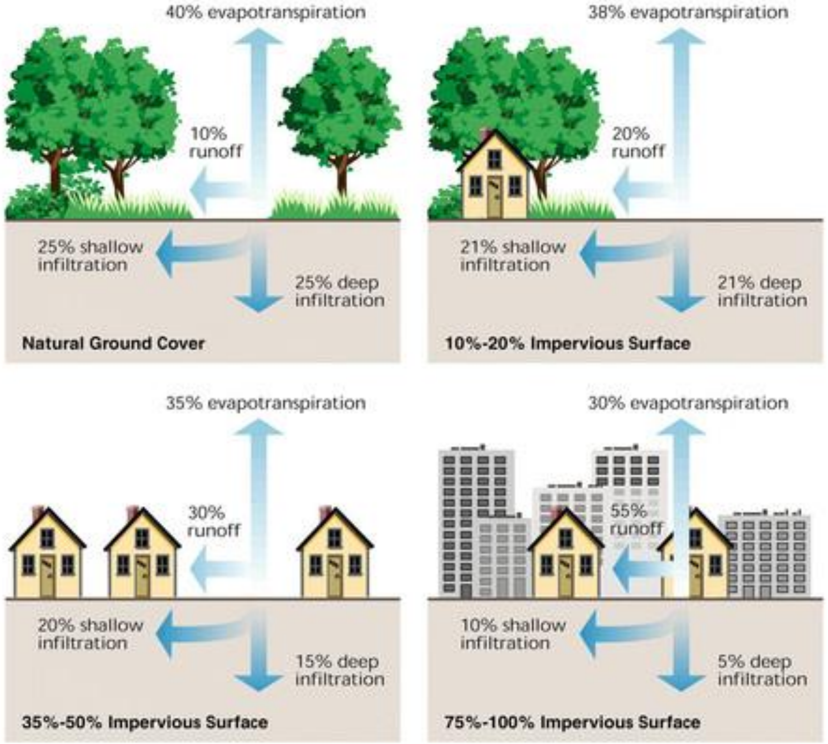
Flooding : importance of permeable surfaces

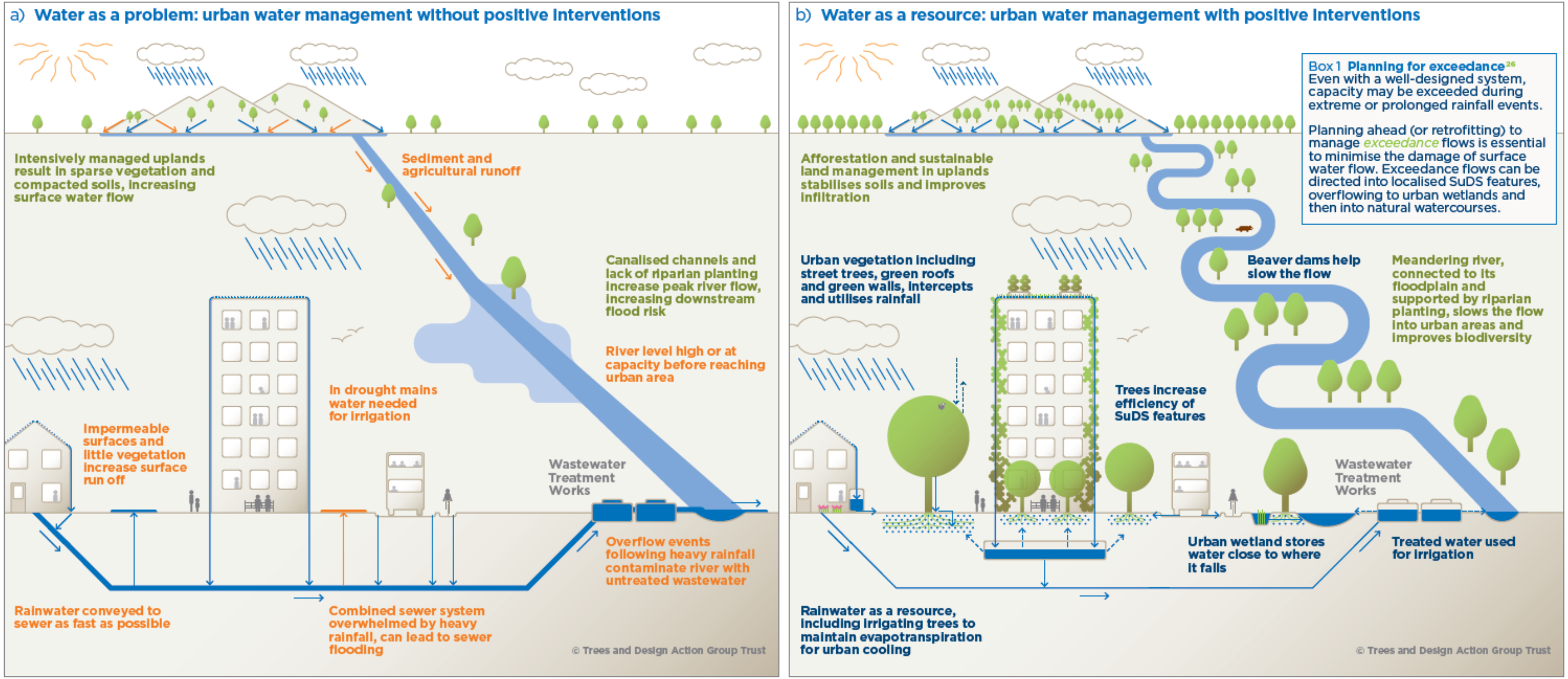


Source: http://thebritishgeographer.weebly.com/hydrographs-recurrence-intervals-and-drainage-basin-responses.html

- Greenspace has declined from 63-55% from 2001- 2018
- Impermeable surfaces increased by 22% since 2001

Source: CCC, 2019 Progress Report to Parliament
https://www.theccc.org.uk/wp-content/uploads/2019/07/CCC2019-Progress-in-preparing-for-climate-change.pdf

First Steps in Urban Water manging water as a resource



TDAG Seminar 15th Nov 2-4pm: https://www.tdag.org.uk/

First Steps in Urban Water: http://epapers.bham.ac.uk/4284/

First Steps in Urban Water

Key elements

1. Treat water as a resource
Value water: minimise use of potable water by appropriate use of rainwater and filtered and treated greywater.

2. Small changes have a large effect
The cumulative effects of multiple small-scale interventions can be substantial.

3. Integrated water management
Link water management with urban heat reduction, flood risk management and greenspace provision, using valuation tools[27] to maximise societal benefit. Include all key players early – design teams, utilities, planners, highway engineers, local communities, and other stakeholders.

4. Use trees wherever possible
Trees improve the performance of GI[28] and deliver a wealth of social, environmental and economics benefits[12].

5. Use of mapping and modelling
Make use of geographic information systems and hydraulic modelling software to help assess the most suitable interventions.

6. Design with maintenance in mind
Have a maintenance plan in place before supervised construction starts. Include regular inspections, components and how they work, identified disposal sites, action plan for accidental spills, and advice on how to undertake excavations (eg utilities). Co-design with relevant maintenance regimes where appropriate (eg soft landscape management).

7. Plan for SuDS adoption[29]
Water companies have the capacity to adopt SuDS that are predominantly used for drainage from buildings or their paved areas, provided they are designed according to their guidance[30].

Table 2 **Ensuring water management interventions are appropriate and effective**

Intervention	Planning considerations	Delivery	Management	Case studies
All SuDS options[31, 32]	- Suitability of area: Topography, geology, groundwater flows. - Discharge locations, bypass system for use while cleaning, disposal areas of organic arisings. - How they fit into wider design – amenity and biodiversity. - Maintenance plan.	- Use skilled and experienced contractors, following government guidelines[16].	- Clearing of inlets and outlets. - Vegetation management. - Littler picking. - Checks and maintenance of components.	Link
Tree planting pits[33, 34]	- Type of system, eg structural soils, rafted, crated. - Underground services. - Tree species: right tree right place. Order well ahead of time. - Irrigation system design. - Use of mulch to reduce evaporation.	- Adequate quantity and quality of growing media. - Timing of planting – autumn/ winter best for rainfall. - Ensure contractors have adequate environmental awareness (ISO 9001 certification).	- Irrigation of trees. - Pruning regime. - Tree safety inspections.	Link
Permeable paving[35, 36]	- System type: Total, partial or no infiltration. - Steepness of land. - Underground services. - Contaminated sites, designed not to drain water into water table. - Porosity of underlying soil.	- Use of type 3 sub-base. - Use of skilled and experience contractors[37].	- Suction sweeping. - Manual weed removal/weed burner (avoid weed killers as they may enter groundwater). - Permeable asphalt requires pressure wash or flushing every quarter.	Link Link
Swales, infiltration basins and rain gardens[32, 36]	- Soil permeability. - Connection to and from other features. - Catchment area – size needed. - Steepness of slopes.	- Integrate into surrounding landscape. - Use of appropriate planting – consider biodiversity, and visibility constraints if near highway.	- Grass cutting (less often if managed as meadow). - Litter picking. - Inspection of components. - Remove silts[38] – wildlife piles or compost.	Link Link
Rainwater harvesting	- Sizing of tank using rainwater figures against usage. - Connect overflow to other systems.	- Mesh/filters to stop insects and debris.	- Empty before heavy rainfall. - Clean mesh/filters.	Link
Green roofs and walls[39]	- Intensive vs extensive. - Overflow routes. - Irrigation system design.	- Appropriate planting for substrate and biodiversity. - Skilled and experienced contractors.	- Irrigation of plants and general plant maintenance. - Checks and maintenance of components.	Link Link Link
Designing for exceedance[23]	- Identify the flood pathways, incorporate them into emergency management plans. - Public awareness of pathways.	- Can alter pathways with groundworks. - Ensure subsequent works do not block designed pathways.	- Monitoring waterflow during storm events against assumed water pathways. - Keep pathways clear.	Link

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Increased hot days, max temperatures, & heatwave frequency increase overheating risk

Overheating determined by (CCRA 2021)

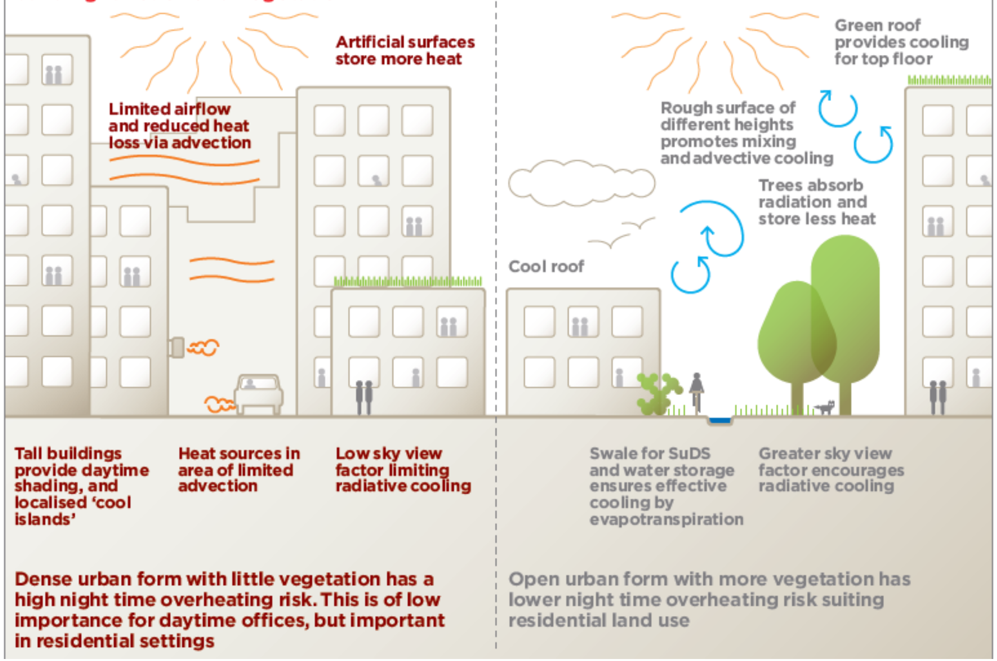
- Outdoor temperature (sky view factor, green space)
- Indoor temperature (building factors, function)
- Individual vulnerability factors

> Increased risk of overheating in flats & energy efficient dwellings

> Most vulnerable disproportionately impacted

Older people, pre-existing poor health – care homes, prisons, inequalities in ability to adapt

Fig. 1 Overheating risk for a given landscape and climate depends on urban form, building function and vegetation

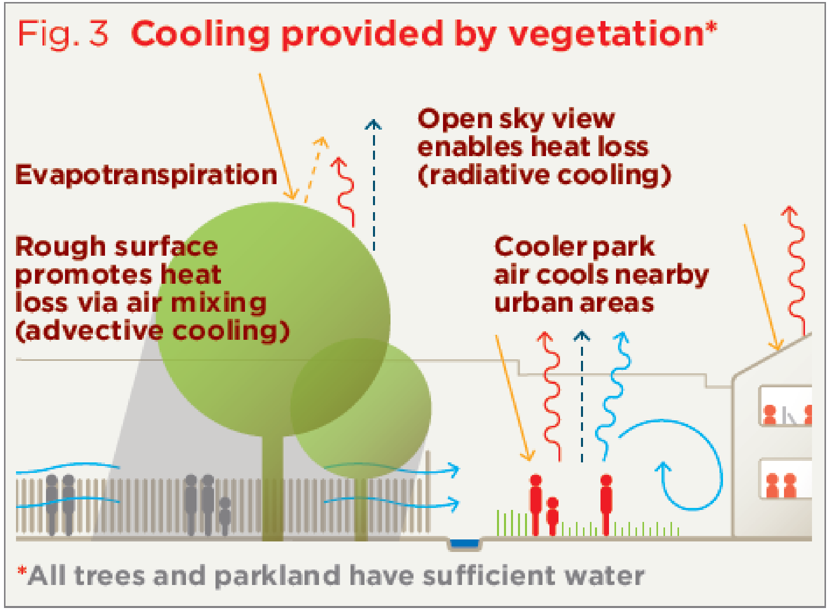


First Steps in Urban Heat
http://epapers.bham.ac.uk/3452/

Increased hot days, max temperatures, & heatwave frequency increase overheating risk

What can practitioners do?

1. Understand the urban heat island intensity – where is hottest?
2. Heat sensitive strategic planning – locate homes away from hottest areas
3. Consider site design and materials - sky view factor, green infrastructure, cooling materials
4. Assess building overheating risk
5. It is never too late to mitigate.



First Steps in Urban Heat
http://epapers.bham.ac.uk/3452/

We must adapt for urban heat & flooding

- Early action saves future costs and prevents maladaptation
- Active transport can be part of adaption (e.g. align with SUDs schemes, greenery for rainfall interception, shade and evapotranspiration) but must also be adapted
- Public transport is only resilient when the surrounding neighbourhood is resilient

BBC:

A perspective from Rio de Janeiro, Brazil

Climate Risk and Vulnerability Assessment

SCAN ME

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Birmingham City Council

Greenham, SV., Jones, SA., Ferranti, EJS., Acton, WJF., MacKenzie, AR., Grayson, N., 2023. Mapping climate risk and vulnerability with publicly available data. A guidance document produced by the WM-Air project, University of Birmingham. Funding provided by NERC innovation grant NE/S003487/1. Ferranti acknowledges EPSRC Fellowship EP/R007365/1.

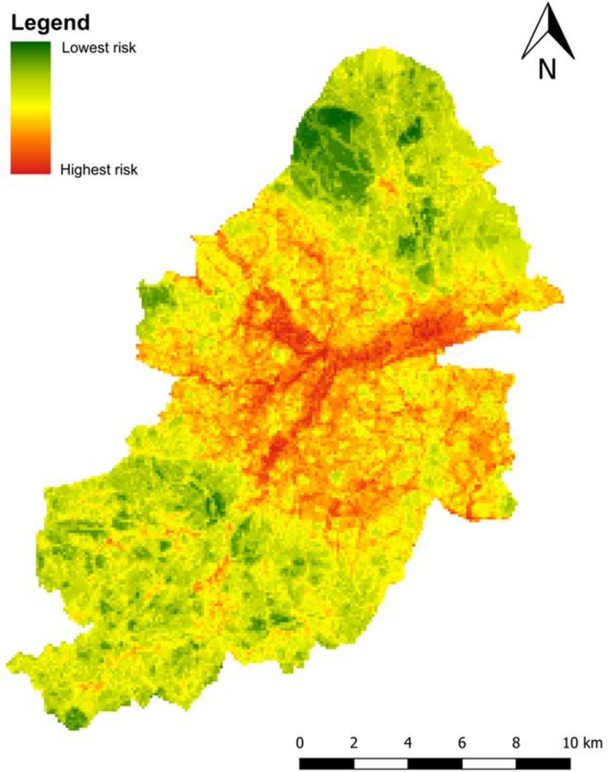
MAPPING CLIMATE RISK AND VULNERABILITY WITH PUBLICLY AVAILABLE DATA

Several factors affect climate risk. What these are and the extent of their influence varies from place to place. Therefore, climate action is needed on all fronts: “everything, everywhere, all at once.”[1]

- Built on Environmental Justice Map & heat vulnerability map to develop a CRVA map
- Produced with city GIS team
- Being trialled with City Planning and Design Team
- Data and map embedded within city GIS processes
- Map available on city webpage
- Map used for Carbon Disclosure Project (CPD) reporting by the city
- Open access methodology and data

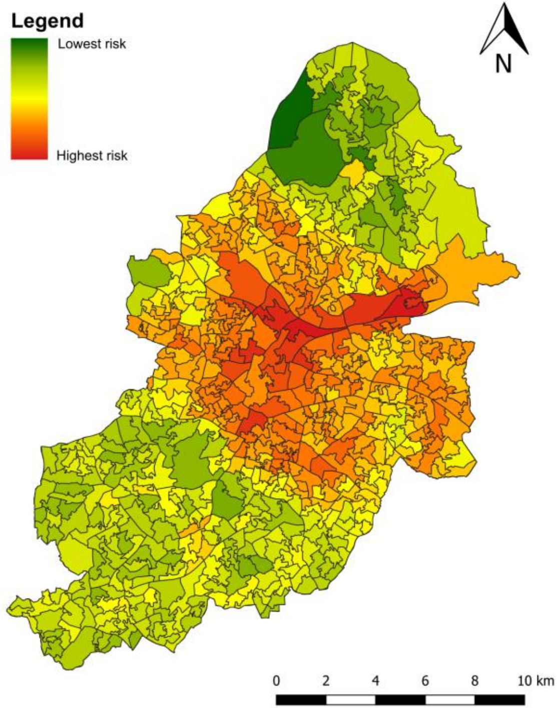
Climate Risk and Vulnerability Assessment

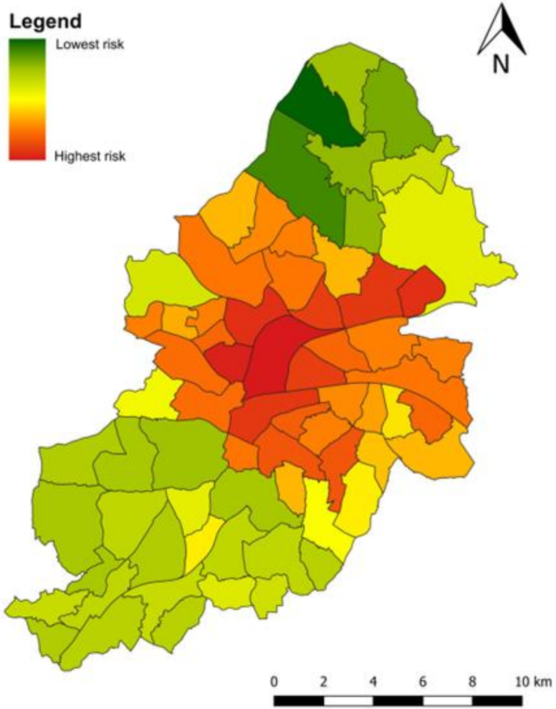
Layer	Data type
Fluvial flood risk (Flood zones 2 & 3)[7,8]	Physical
Pluvial flood risk (3.3 year return period)[9]	Physical
Open green space deficit[10]	Physical
Other green space deficit[11]	Physical
Tree canopy cover deficit[12]	Physical
Local climate zones[13]	Physical
Annual nitrogen dioxide (NO_2) concentration[14]	Environmental
Annual fine particulate ($PM_{2.5}$) concentration[14]	Environmental
Surface temperature (summer daily max)[15]	Environmental
Indices of Multiple Deprivation (IMD)[16]	Social
Excess years life lost[17]	Social



Greenham et al., 2023 http://epapers.bham.ac.uk/4259/

Climate Risk and Vulnerability Assessment





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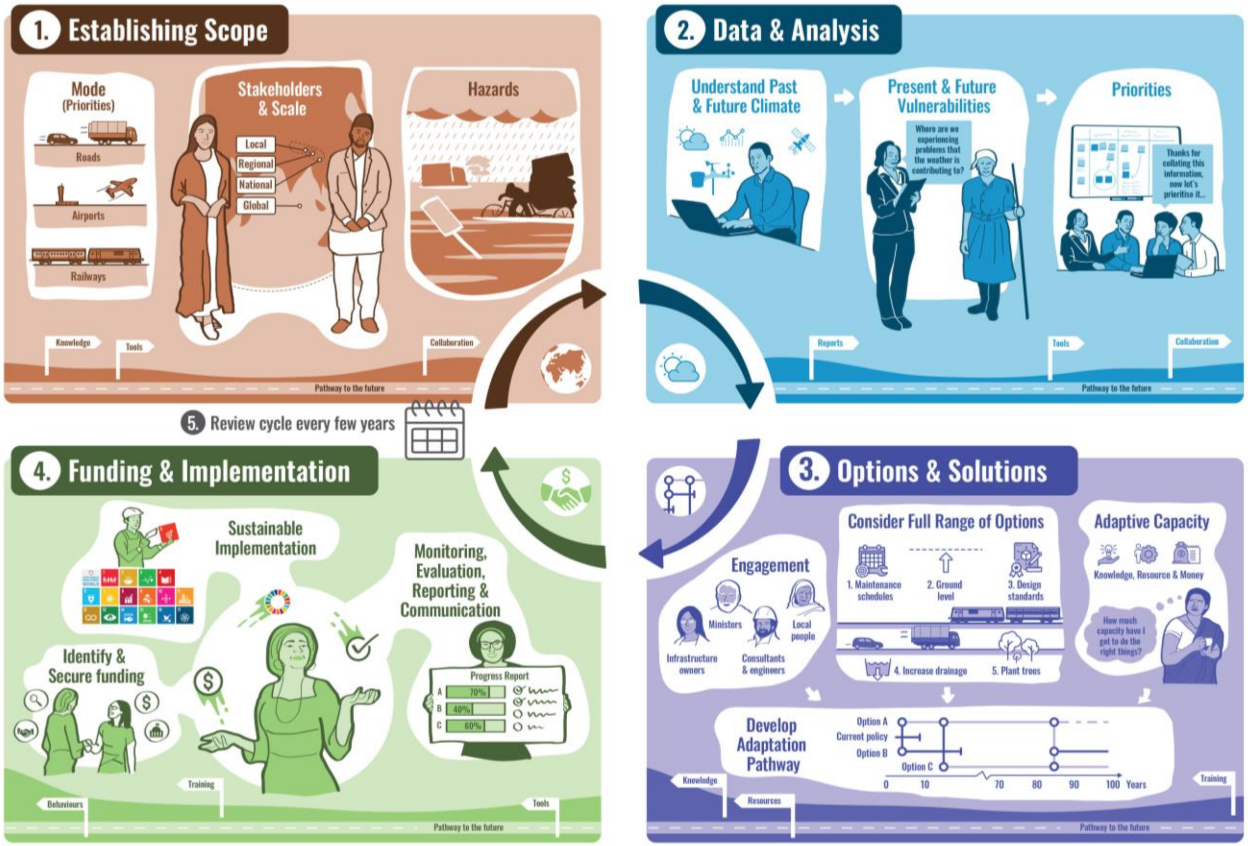
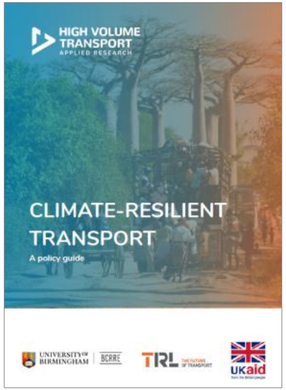
Greenham et al., 2023 http://epapers.bham.ac.uk/4259/

Policy Guide for Transport Resilience



Greenham et al. 2022a & b.



[Policy Guide]

[State of Knowledge Report]

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