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Adrienne Arsht-Rockefeller Foundation Resilience Center

Beating the Heat: Passive Cooling Strategies

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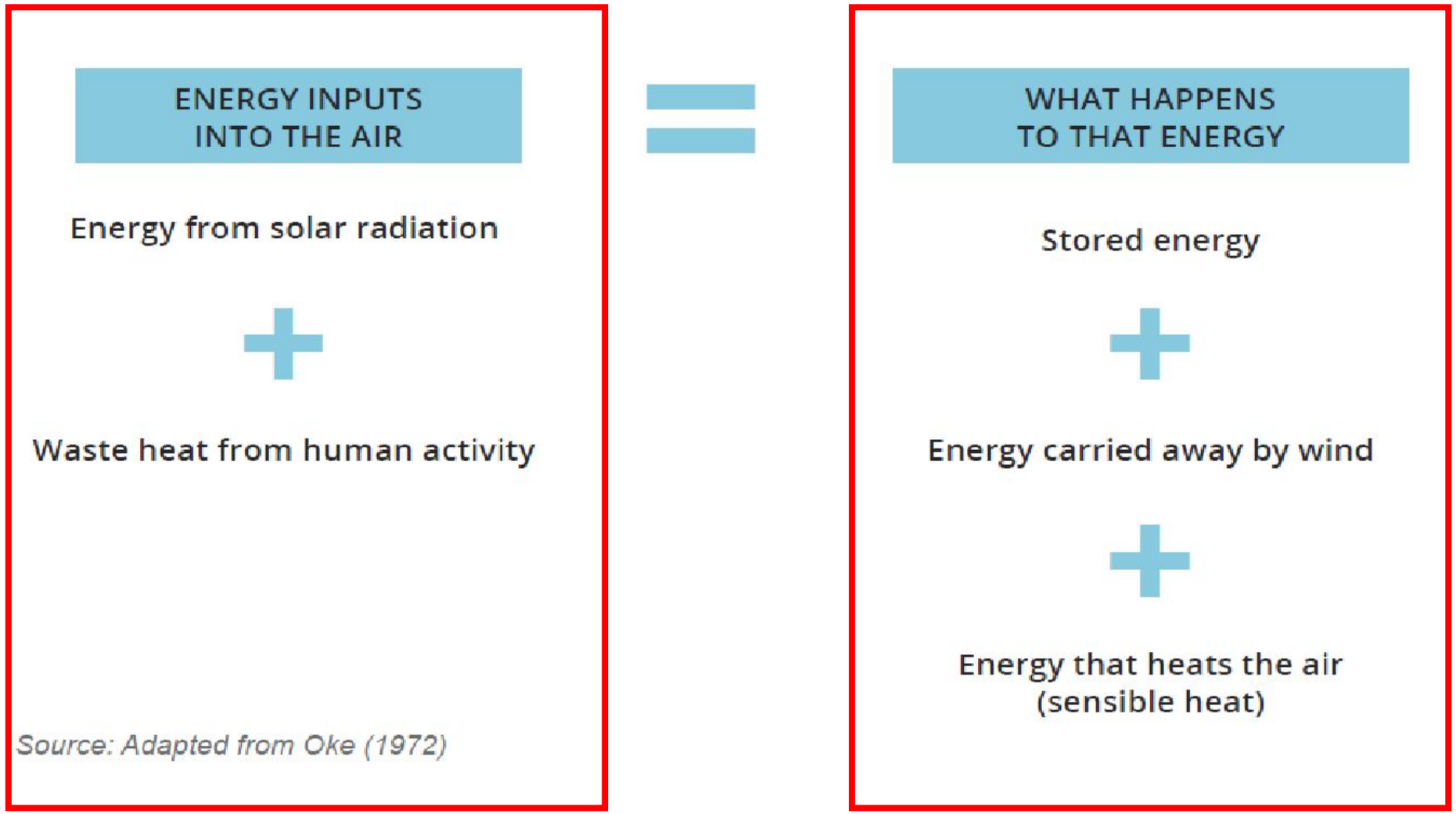
Who we are

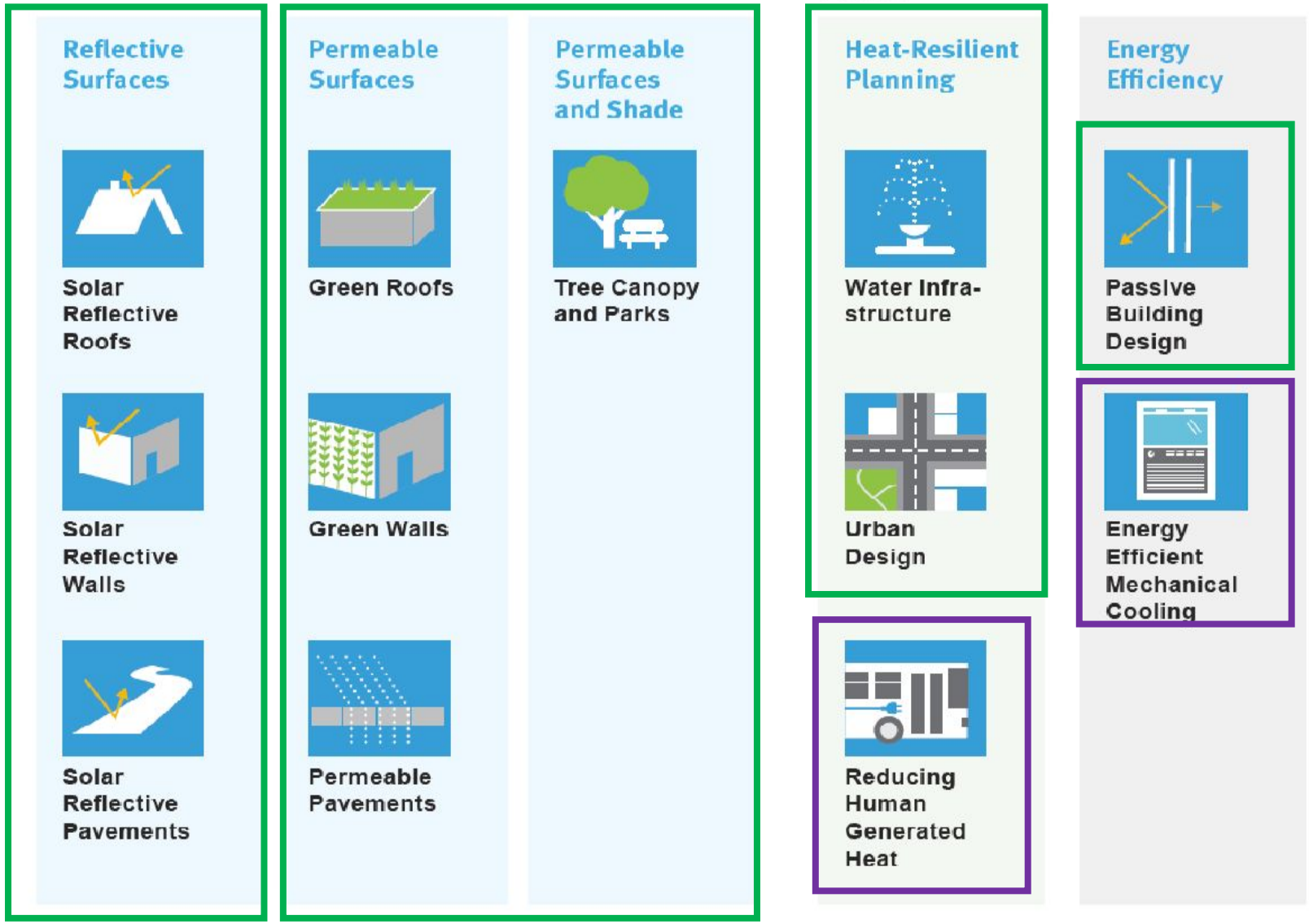
- Extreme Heat Resilience Alliance (EHRA)
- Heatwave Naming and Categorizing Initiative
- Economic Impact Analyses
- Knowledge Sharing and Events
- Heat Risk Reduction Projects
- Policy Engagement
- Partnerships

Cool math


ENERGY INPUTS INTO THE AIR
Energy from solar radiation
+
Waste heat from human activity
Source: Adapted from Oke (1972)
=
WHAT HAPPENS TO THAT ENERGY
Stored energy
+
Energy carried away by wind
+
Energy that heats the air (sensible heat)

Cooling options

Passive, non-mechanical cooling solutions:



Active, energy efficient cooling solutions

Passive cooling strategies make sense everywhere

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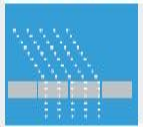
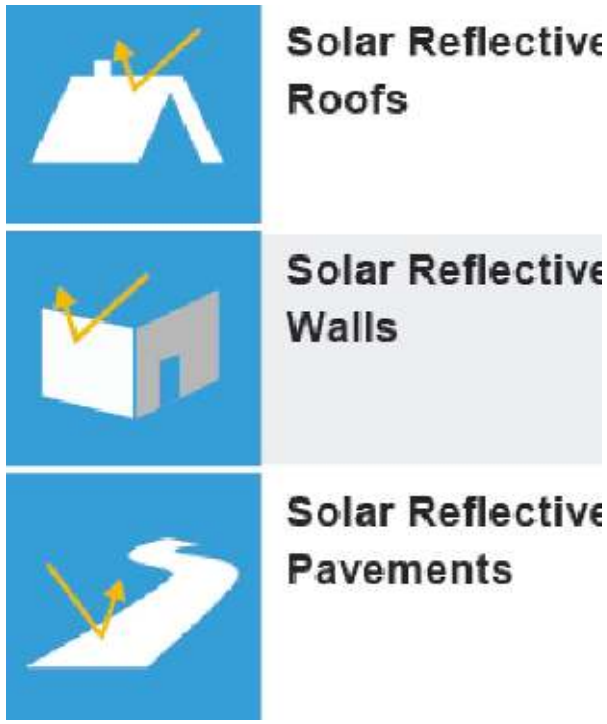
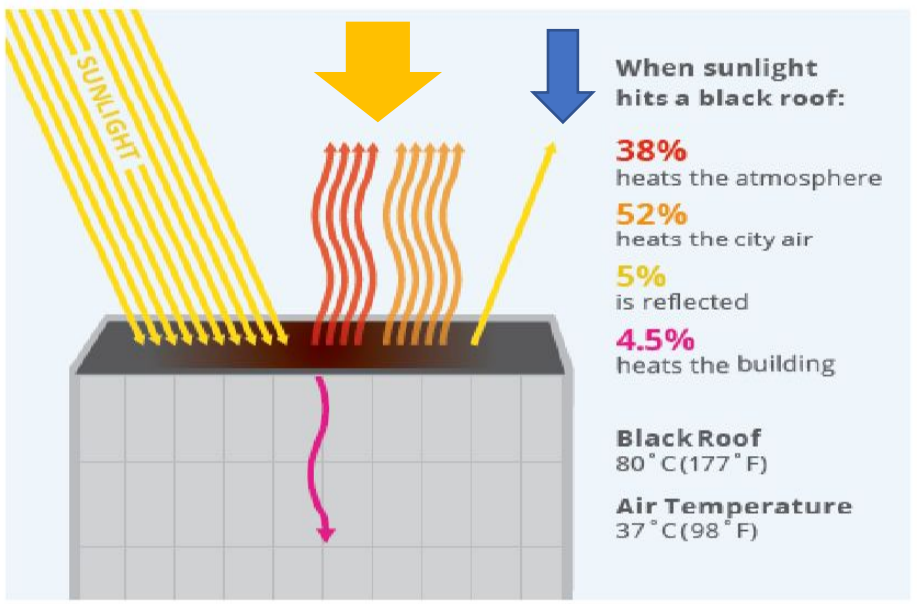
	STRATEGY	APPLICABLE CLIMATES FOR COOLING BENEFITS	APPROPRIATE USE CASES
	**Solar Reflective Roofs**	All but polar climates	All buildings
	**Solar Reflective Walls**	All but polar climates	All buildings
	**Solar Reflective Pavements**	All but polar climates	Site specific. Optimal benefit on pavements with little building interactions and sufficient shade over pedestrian areas.
	**Green Roofs**	All climates with sufficient rainfall or access to a low-cost water	Low-slope roofs with sufficient structure support for the roof system.
	**Green Walls**	All climates with sufficient rainfall or access to low-cost water	All buildings
	**Permeable Pavements**	Climates with summer rainfall	Pavements with sufficient drainage or catchment areas that are not receiving polluted stormwater runoff.

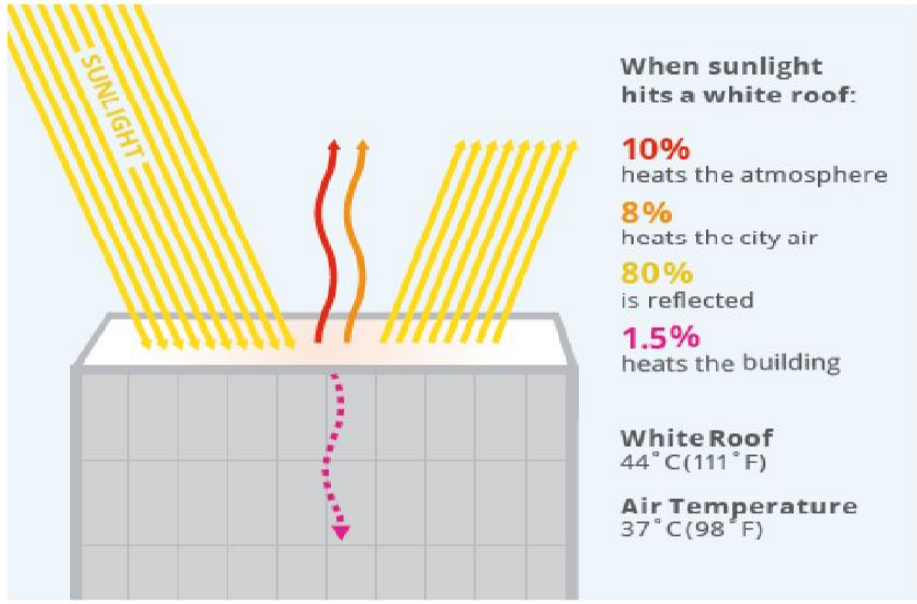
	**Tree Canopy and Parks**	All climates	All locations where sufficient space for root structures and tree canopy is available.
	**Water Infrastructure**	All climates	All locations
	**Urban Planning**	All climates	All locations, but especially in newly developing areas.
	**Reducing Waste Heat**	All climates	All locations
	**Thermal Insulation**	All climates	All buildings
	**Appliance and Other Active Energy Efficiency**	All climates	All buildings

Cooling by reflecting solar energy



Comparison of a black and white flat roof (outdoor air temperature 37℃)





Benefits of reflective surfaces

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Cost effective (and comparable to dark options)

Applicable on nearly every roof type

Reduced indoor air temperatures

Energy savings when active cooling is present

Global cooling

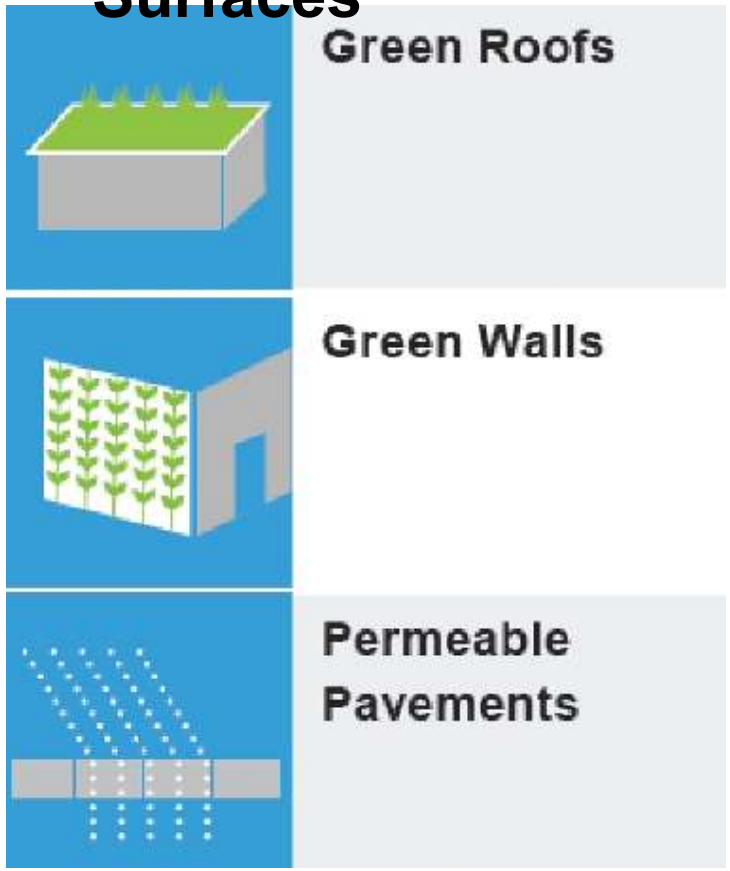
Reduced outdoor air temperatures

Things to consider

- Potential for increased heating energy demand
- The effects of aging and weathering
- Effects of insulation on energy savings
- Potential to reflect solar radiation onto other buildings and pedestrians
- Aesthetics

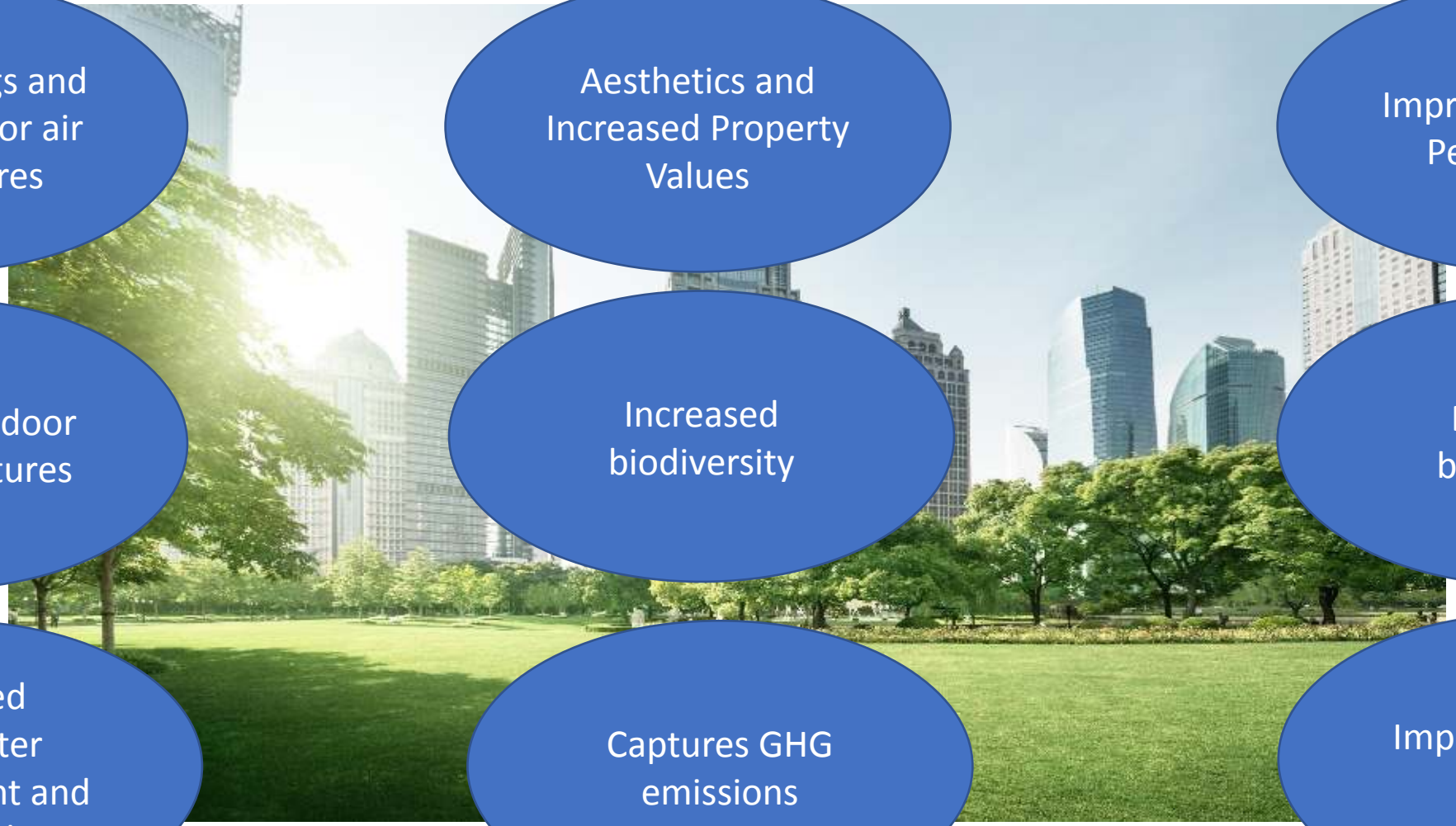
Cooling by evaporation

Permeable Surfaces



Cooling with nature and shade

Benefits of natural solutions



Energy Savings and reduced indoor air temperatures

Aesthetics and Increased Property Values

Improved Solar PV Performance

Reduced Outdoor Air Temperatures

Increased biodiversity

Enhanced biodiversity

Improved stormwater management and water quality

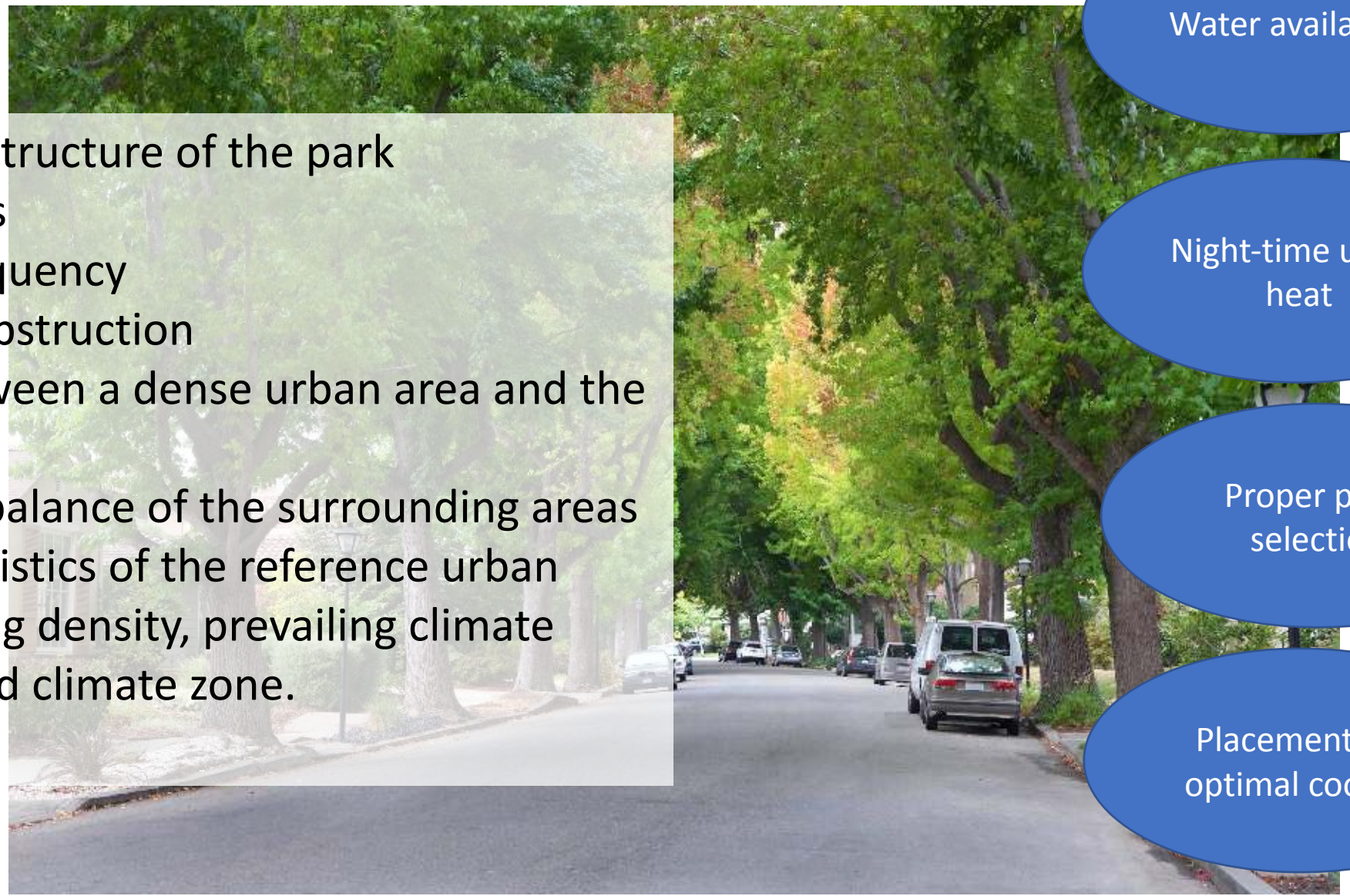
Captures GHG emissions

Improved human lives

Considerations for permeable surfaces

- Building characteristics
- Water usage
- Competing effects on thermal comfort
- Cost premiums

Considerations for natural spaces



- the size and structure of the park
- type of plants
- irrigation frequency
- level of sky obstruction
- distance between a dense urban area and the park
- the thermal balance of the surrounding areas
- the characteristics of the reference urban area, including density, prevailing climate condition, and climate zone.

Water availability

Night-time urban heat

Proper plant selection

Placement for optimal cooling

Cooling with urban design

- Aligning building corridors with the prevailing wind
- Connecting open spaces
- Prioritizing open spaces near water bodies
- Arranging buildings to channel wind
- Avoiding monolithic wall space where possible
- Increasing building setback from property lines
- Encouraging stepped building height profiles

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Thanks!

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