In combination, green roofs and cool roofs can reduce 2-m ambient air temperatures by 3,8–4,8°C depending on the building characteristics, urban environment, and meteorological and geographical conditions.[8]

Increases in roof albedo from 0.50 to 0.85 would reduce the urban heat island effect from 2.2°C-5.2°C, therefore, 0.210% of the deaths attributed to summer heat could be avoided.[4]

WHITE VS GREEN

WHITE

INCREASING THE REFLECTION OF INCOMING SOLAR RADIATION [6]

Provide 50-year net savings of $25/m² [1]

- Reductions of more than 20% in cooling costs (Albedo increased from 10–20% to about 60%) [6]
- Installation costs 22 ($/m2)
- Maintenance cost: 0,2
- Roof life: 20 years

CON

Not applicable at night (no sun - no reflection)

If dirty, reduced effectiveness (Albedo-decrease first year: 0.15 to 0.25 or about 20 to 30%)[5]

Colder house temperatures in winter leading to more heating costs. For every 1 °C of environmental cooling, demand for heating energy increases by 3–15%.[3]

PRO

Significant increase of Albedo

Increased cooling as the density of urbanization increases[8]

Cooling effects= coincident with the hottest time period of day[8]

Reduced heat storage in the daytime - effects for the night

Cheap construction (Saving: $1/m²/year when annualized) [7]

e.g. converting 100m² of dark roof to white offsets the emission of 10 tons of CO_2. In hot summers: potential of 24 Gt CO_2= 300 million cars off the road for 20 years. [6]

RESULT

GREEN

INCREASING EVAPORATIVE COOLING AND DECREASING SENSIBLE HEAT EXCHANGE [6]

Provide 50-year net savings of -$71/m² [1]

- Green roofs save ~$11/m² more than white roofs in energy costs because of the extra cooling effect of evapotranspiration[7]
- irrigated green roof: cooling of around 1.5 times more than white [6]
- lower air temperature ≠ less heat stress[8]
- Installation costs 172 ($/m²)
- Maintenance cost: 2,9
- Roof life: 40 years

CON

- Heavy four-layer structure with a total depth of 50 cm
- Soil humidity (drainage) influences the effectiveness[4 6]
- Vegetation thick / same species / alive
- More air humidity leads to more heat stress
- Expensive Care

PRO

- water retention
- shading[2]
- cooling
- increasing air quality

The exacerbated urban heat island can be almost completely offset by adopting a widespread green roof strategy.[6]

Mitigation Roof Strategy

POPULATION-/		HEAT- INCREASE
By 2035, a 185% increase in global urban area is anticipated	IPCC - More extreme heat events	
Exposing highly vulnerable populations to land use-driven climate change	Demographic Change: More elderly people in the cities [3 6]	

URBAN		HEAT ISLAND
Pavements/roofs typically constitute over 60% of urban surfaces	black / dark-co- lored roofs absorb roughly 80% of incoming sunlight	
Reduction of vegetation and therefore, evapotranspiration	Greater heat storage capacity [1 5 7]	

HUMAN		HEAT STRESS
temperature radiant heat	Individual factors: age health	
physical activity metabolism	humidity wind speed [6]	

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