Designing roofs in European cities to reflect more solar energy would help prevent climate change, at little to no extra cost.

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The amount of solar energy that is reflected by different materials can have a significant impact on temperatures, both at a local level and across the globe. As **Tiziana Susca** *writes, cities generally have higher temperatures than surrounding areas, in part because the materials used in construction reflect less energy. She argues that by encouraging the construction of rooftops in European cities which reflect more solar energy, temperature increases could be mitigated within cities, potentially improving the welfare of local populations and contributing to the prevention of climate change. Moreover, if this policy were integrated into existing urban maintenance plans it would essentially be a cost-free intervention.*

Since pre-industrial times, global temperatures have increased by about 0.8°C world-wide and by about 1.3°C in Europe. The consequences of global warming are self-evident: flooding, coastal erosion, droughts. Cities, where most of the world's population live, and where most of the world's economic activities take place, are the most plagued areas. In addition, the constant urban sprawl, the substitution of natural materials with impervious ones, the decrease in natural ventilation due to buildings, and the decrease of the natural albedo (reflectivity of the earth) caused by the use of artificial materials – such as asphalt and concrete – provoke a local increase in temperature, the so-called Urban Heat Island (UHI) effect.

The increase in global and local temperatures strengthens natural phenomena, such as hurricanes, and causes heavy economic and social losses. In 2005, hurricane Katrina was responsible for around 1,500 deaths in Louisiana and damages of around $ 40-50 billion. In 2012, hurricane Sandy hit New York City causing damage worth about $50 billion. In Europe, between 1980 and 2011, extreme climate conditions caused more than €90 billion worth of damage due to flooding and more than 2,500 fatalities with high social costs. In 2003, Paris experienced a heat wave that provoked a severe increase in urban population deaths. Most of the people experiencing the consequences of rising temperatures are socially and physically vulnerable: old people, people with physical diseases and people who cannot afford air conditioning systems. In this way climate change exacerbates social inequity.

Rooftops in Lisbon, Credit: Peter Pearson (CC-BY-SA-3.0)

Planners and policy makers have been investigating and experimenting with various strategies for climate change mitigation and adaptation. Many of these strategies require long transition times to become effective, even though actions should produce beneficial and tangible effects in a short time in order to guarantee better and fairer living conditions. Many studies have already demonstrated the positive effects elicited by an increase in urban albedo (i.e. using materials which reflect more of the sun's energy and thereby reduce

temperatures). Moreover, the substitution of black roofs with high albedo ones (e.g. white coatings capable of reflecting more solar radiation) is a cost-free intervention since it can be integrated through existing building maintenance plans.

In 2011, the Mayor of New York signed a local law that aims to progressively increase the albedo in the city, providing benefits to the urban environment without exorbitant public investments. This law, supported by studies confirming the beneficial effect on the urban climate of the city, states that white coatings should be substituted for black ones in case of maintenance or substitution of roofs. Meanwhile in Europe, the project "Cool Roofs", which promoted the use of high albedo rooftops, has investigated the potential benefits to be gained from substituting traditional black-membrane roofs with cool ones. The aim was to promote the development of innovative legislation, codes and procedures concerning rooftops. However, the project has not given rise to any regulation for promoting the use of high albedo roofs.

In a recent study (co-authored with Felix Creutzig) on European cities, I have demonstrated that cool roofs can provide benefits to the local climate and contribute, albeit marginally, to preventing global climate change. Southern European cities have the best potential per unit of surface to mitigate climate change by increasing their albedo. Unexpectedly, Scandinavian cities display, on average, a higher albedo mitigation potential than in other Northern and Central European ones. This occurs because even though the incoming solar radiation in Scandinavian cities is lower than in other Northern and Central European cities, they also have lower cloud cover.

The study was extended from one unitary surface to the whole urban surface of three cities representing three geographical areas: Helsinki, Krakow and Porto. In a time-horizon of 100 years, the increase in urban albedo in Helsinki has the same effect on global warming as a reduction in CO_2 emissions of 13 million tonnes. The increase in albedo in Krakow and Porto has the same effect on global warming as a reduction in CO_2 emissions of 5.6 and 11.7 million tonnes. At the local level, the increase in albedo in Porto decreases summer temperatures by about 1°C, while in Helsinki and Krakow the increase in albedo reduces the maximum summer temperature by 0.34 and 0.15°C, respectively.

The potential decrease in summer temperature in Porto can have a positive effect on human health, in particular, decreasing natural mortality and mortality for respiratory and cardio-vascular diseases. Old people benefit most from summer peak temperature decreases. UHI mitigation in Helsinki and Krakow is negligible and hence has no influence on human health. A related, though small, benefit related to the mitigation of the UHI in Porto, is the reduction of the tropospheric ozone. The effect on energy use is not relevant in Helsinki and Krakow. In Porto it produces a decrease in energy use for cooling and an increase in energy for heating, resulting in an overall decrease in the annual use of energy. This means that the mitigation of the UHI can also produce a decrease in greenhouse gas emissions due to lower energy usage.

Taken together, the evidence suggests that increasing urban albedo can be a cost-free intervention that, depending on climatic and morphologic variables, can positively affect local and global climates, and provide benefits for urban populations. As a result, this potential contribution should be considered when municipal and European-wide climate-change strategies are shaped.

This article is part of our series on the Dahrendorf Symposium, which will be held in Berlin on 14-15 November 2013

This article also draws on material in the author's upcoming paper (co-authored with Felix Creutzig) for the First Annual Italian Society for Climate Sciences (SISC) conference in September 2013.

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Note: This article gives the views of the author, and not the position of EUROPP – European Politics and Policy, nor of the London School of Economics.

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