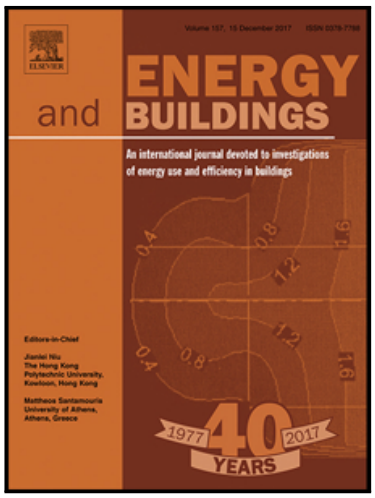

On the Energy Impact of Urban Heat Island in Sydney. Climate and Energy Potential of Mitigation Technologies

Mattheos Santamouris , Shamila Haddad , Maria Saliari , Konstantina Vasilakopoulou , Afroditi Synnefa , Riccardo Paolini , Giulia Ulpiani , Samira Garshasbi , Francesco Fiorito

PII: S0378-7788(17)33802-1
DOI: 10.1016/j.enbuild.2018.02.007
Reference: ENB 8323

To appear in: *Energy & Buildings*

Received date: 21 November 2017
Revised date: 6 February 2018
Accepted date: 9 February 2018

Please cite this article as: Mattheos Santamouris , Shamila Haddad , Maria Saliari , Konstantina Vasilakopoulou , Afroditi Synnefa , Riccardo Paolini , Giulia Ulpiani , Samira Garshasbi , Francesco Fiorito , On the Energy Impact of Urban Heat Island in Sydney. Climate and Energy Potential of Mitigation Technologies, *Energy & Buildings* (2018), doi: 10.1016/j.enbuild.2018.02.007

On the Energy Impact of Urban Heat Island in Sydney. Climate and Energy Potential of Mitigation Technologies

Mattheos Santamouris [a], Shamila Haddad [a], Maria Saliari [b], Konstantina Vasilakopoulou [a], Afroditi Synnefa [a], Riccardo Paolini [a], Giulia Ulpiani [a,c], Samira Garshasbi [a] , Francesco Fiorito [a,d,*]

[a] Faculty of Built Environment, University of New South Wales, Sydney, Australia; m.santamouris@unsw.edu.au (M.S.), s.haddad@unsw.edu.au (S.H.), f.fiorito@unsw.edu.au (F.F.), k.vasilakopoulou@unsw.edu.au (K.V.), a.synnefa@unsw.edu.au (A.S.), r.paolini@unsw.edu.au (R.P.), g.ulpiani@unsw.edu.au (G.U.), s.garshasbi@unsw.edu.au (S.G.)

[b] Department of Physics, National and Kapodistrian University of Athens, Athens, Greece; msaliari@phys.uoa.gr

[c] Department of Industrial Engineering and Mathematical Sciences (DIISM), Polytechnic University of Marche, Ancona, Italy; g.ulpiani@pm.univpm.it

[d] Department of Civil, Environmental, Land, Building Engineering and Chemistry (DICATECh), Polytechnic University of Bari, Bari, Italy; francesco.fiorito@poliba.it

* Corresponding author. E-mail: francesco.fiorito@poliba.it. Tel: +39 080 5963401

Abstract

Urban Heat Island (UHI) is a phenomenon resulting in the increase of ambient temperature in dense areas of cities in comparison with rural areas. UHI has been demonstrated to be relevant in the Sydney metropolitan area, with a peak intensity of up to 6 °C. This has the consequence of increasing of up to three times the cooling demand of buildings. With the general aim of mitigating the effects of UHI in Sydney, several strategies, involving the use of outdoor surfaces with high Solar Reflectance and the use of greenery on outdoor surfaces at ground level and on roofs have been implemented and tested. Moreover, the benefits due to the adoption of mitigation technologies, in terms of reducing both UHI intensity and building cooling demand have been predicted. Results have shown that solutions involving the increase of the global albedo of the city demonstrate the highest benefits, achieving a reduction of peak ambient temperature of up to 3°C and of peak cooling demand of residential buildings of up to 20%.

Keywords: *Urban Heat Island; Mitigation Technologies; Building Energy Demand; Residential Buildings; Albedo; Green Roofs, Greenery.*

1. Introduction

Urban Heat Island (UHI) is a well-recognized and documented phenomenon affecting cities [1-6]. UHI develops in conjunction with climate change, resulting in an even greater increase of hot periods in urban areas than in their rural corresponding parts [7]. Studies performed in the last three decades have demonstrated a worldwide spread of the phenomenon. In Europe, the average maximum UHI intensity recorded was between 0.3 °C and 6.8 °C (average of 2.6 °C), with absolute maximum peaks close to 12 °C [8, 9]. Similarly, studies performed in Asian and Australian cities have shown how UHI phenomenon is significant, with intensities varying between 0.4 °C and 11 °C [10].

UHI has an important effect on pollution [11], and on human health [12-16]. Baccini et al. [12], analysing the relationship between maximum daily apparent temperature and daily number of deaths for 15 European cities during the hot period (assumed to be between 1st April and 30th September), found that, above a threshold of 29.4 °C for Mediterranean cities and 23.3 °C for north-continental ones, an exponentially increasing excess of risk of death starts to take place. Similar studies performed in U.S. [14] have found a similar relationship between temperature and excess risk of mortality, with thresholds variable between about 23°C and about 26°C. Moreover, a study performed by Tan et