



Housing and Building National Research Center

HBRC Journal

<http://ees.elsevier.com/hbrcj>



# Cool city as a sustainable example of heat island management case study of the coolest city in the world



Reeman Mohammed Rehan \*

*Department of Architecture, Faculty of Engineering, Helwan University, Egypt*

Received 10 August 2014; revised 3 October 2014; accepted 27 October 2014

## KEYWORDS

Cool city;  
Heat island management;  
Green infrastructure;  
Green roofs;  
Greater Cairo

**Abstract** Urbanization negatively impacts the urban environment mainly by the production of waste heat from refrigeration systems, although industrial processes and motorized vehicular traffic have also been recognized as additional causes of the urban heat island (UHI) effect. The UHI negatively impacts the residents, with spillover effects for environmental aspects. In urbanized areas, it is a critical factor for air quality management and public health. The UHI and strategies to implement its mitigation are becoming increasingly important for governmental agencies and researchers. The problem is how to deal with UHI effects? Accordingly, the main aim of this paper is to determine the UHI mitigation strategies and their effectiveness in terms of cooling and temperature reduction in cities at the level of urban design. This goal is achieved through exploring the concept of the cool city, as it is the key factor, from the theoretical, analytical, and practical viewpoints, to diminishing the urban heat release. Then, the paper analyzes how the concept of the coolest city in the world (Stuttgart, Germany) is developed and explores a practical approach toward cool cities. Finally, it suggests a set of recommendations to develop the urban environment in Greater Cairo by applying the cool city concept.

© 2014 Production and hosting by Elsevier B.V. on behalf of Housing and Building National Research Center. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/3.0/>).

## Introduction

Urbanization negatively impacts the environment mainly by the production of pollution and the modification of the physical and chemical properties of the atmosphere. Considered to be a cumulative effect of all these impacts is the urban heat island (UHI). Defined as the rise in temperature of any man-made area, UHIs have been indirectly related to climate change due to their contribution to the greenhouse effect, and, therefore, to global warming.

\* Address: 2 Villa, 102 Street, 10 Dist., Gharb Samed, Egypt. Mobile: +20 01064032713.

E-mail address: [reeman\\_rehan@yahoo.com](mailto:reeman_rehan@yahoo.com).

Peer review under responsibility of Housing and Building National Research Center.



Therefore, this paper focuses on the cool city concept as it is one of the sustainable solutions for urban heat management and contributes to the development of the visual image of the city.

### The research problem

The world is increasingly urban. More than half of the world's population is living in urban areas. The number of urban residents is expected to continue to grow, especially in developing countries. The expanding urban population will require a whole range of infrastructure, services, housing, and jobs, not to mention land. The urban land expansion could threaten land supply, cause growth in the traffic volumes and increased pressure on the environment, and be massively unsustainable for any city.

Accordingly, there is an urgent need to act on a number of indicators that have reached critical levels, notably the UHI, greenhouse gases, water, and biodiversity, of which cities are the main source. In response, this paper answers the following questions:

- What are the consequences of the UHI effect in cities?
- What is the best strategy to cope with heat?
- How will individual cities become a cool city?
- What are the useful design principles to diminish the UHI effect in cities?

### Research objectives

The main aim of this research is to determine the main strategies to optimize urban areas regarding the UHI effect at the level of urban design and planning. This goal will be achieved through a group of secondary aims, as follows:

- Reduce the UHI effect for the Egyptian region under current and future climate conditions.
- Develop the visual image of cities by highlighting the importance of urban parks and green open spaces.
- Increase resilience against global warming by the establishment of green corridors at the level of urban design.
- Improve air quality and ventilation in cities through the application of green infrastructure principles.
- Create an attractive urban environment and reduce the temperature of cities through the use of water in the urban landscape.
- Generate applicable measures for urban designers to improve the urban microclimate with a focus on heat.
- Prepare the urban environment for future climate change.

### Research methodology

The research methodology is based on three approaches: the theoretical, analytical, and applied studies. The first stage in the methodology adopted for this paper was to identify the UHI and the concept of the cool city. This is followed by an analytical study of Stuttgart City in Germany as it is the coolest city in the world. Next, the paper suggests the design principles of the cool city based on the analytical study to

reduce the UHI through a framework to develop the urban environment toward a cool city. Then, it applies this framework to the Egyptian context. Finally, it suggests a set of recommendations to develop the urban environment with a special emphasis on Greater Cairo by the application of the cool city concept.

### Research hypothesis

The concept of the cool city can positively impact the UHI for the purpose of achieving sustainable urban development. That is because the cool city has sustainable solutions for urban heat management. Accordingly, this paper assumes that the cool city concept is a positive contribution toward sustainability.

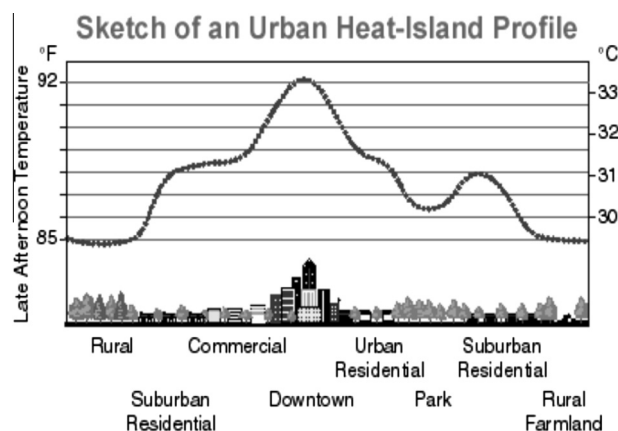
### The cool city as an approach to urban heat management

#### Definition of the urban heat island

The urban heat island (UHI) is defined as “those urban areas where the surface, sub-surface or air temperatures are higher than the corresponding temperatures in surrounding rural areas,” [5] due to the many facets of urbanization in cities and towns. Specifically, this effect is caused by a lack of natural evaporative surfaces (vegetation), physical characteristics of the surfaces, such as concrete and asphalt, which absorb rather than reflect solar radiation, human activities that produce heat produced mainly through the actions of heating and cooling plants and buildings, industrial activities, vehicles, etc. “This phenomenon causes a high level of pollutants that alter the radiative nature of the atmosphere and result in surface temperature and atmospheric temperature changes” [4]. In response, a set of strategies exists that can be implemented in order to minimize the negative effects of the UHI, which can be defined as urban heat management; one of these sustainable solutions is the concept of the cool city (Fig. 1).

#### Definition of the cool city

“The cool city is one of the sustainable urban solutions for the city of tomorrow that depends on the application of the principles of urban heat management. It is the key factor to



**Fig. 1** Sketch of an urban heat island profile. Ref.: M. Giguère, Urban Heat Island Mitigation Strategies, the Institute national de santé publique, 2009.

Download English Version:

<https://daneshyari.com/en/article/274592>

Download Persian Version:

<https://daneshyari.com/article/274592>

[Daneshyari.com](https://daneshyari.com)