



# Korean ubiquitous-eco-city: A smart-sustainable urban form or a branding hoax?

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## ARTICLE INFO

### Article history:

Received 16 October 2012

Received in revised form 22 July 2013

Accepted 28 August 2013

Available online 30 September 2013

### Keywords:

Eco-city

Ubiquitous-eco-city

Ubiquitous technology

Ubiquitous infrastructure

Ubiquitous service

Ubiquitous management system

Sustainable urban development

Korea

## ABSTRACT

Ambitious eco-city initiatives of the 21st century are commonly branded as carbon-neutral, low-carbon, smart-eco, sustainable, ubiquitous-eco and zero-carbon emphasising their sustainability niches. This study focuses on one of these brands—ubiquitous-eco-city (u-eco-city). The principal premise of a u-eco-city is to provide a high quality of life and place to residents, workers and visitors with low-to-no negative impacts on the natural environment with support from the state-of-the-art technologies in their planning, development and management. The paper aims to put this premise into a test and address whether u-eco-city is a dazzling smart and sustainable urban form that constitutes an ideal 21st century city model or just a branding hoax. It, first, explores the recent developments and trends in ubiquitous technologies, infrastructures, services and management systems, and their utilisation and implications for the development of u-eco-cities. It, then, places Korean u-eco-city initiatives under the microscope, and critically discusses their prospects in forming a smart and sustainable urban form and becoming an ideal city model.

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## 1. Introduction

For over half a century, numerous global scale environmental, social and economic crises have significantly impacted our societies—e.g., life threatening natural disasters, loss of biodiversity, destruction of natural ecosystems, regional disparities, socio-economic inequity, and digital and knowledge divides [1]. Rapid population increase and expansion of resource-consumption, combined with industrialisation, urbanisation, mobilisation, agricultural intensification and excessive consumption-driven lifestyles are seen as the principal contributors of these crises [2]. This worrying situation has provoked many scholars, practitioners and policy-makers to look for solutions to mitigate impacts of these problems by considering the development more carefully and adopting a

holistic response to minimise harmful social, economic and environmental effects in order to maintain the health of ecosystems to which human beings are a part of [3].

Cities being branded as carbon-neutral, low-carbon, smart-eco, sustainable, ubiquitous-eco, zero-carbon and so on are a consequence of searching for a remedy to the problems caused by human activities—i.e., unsustainable development. These branded cities are seen as smart and sustainable development forms—such as a smart eco-city—with some similarities and differences in their approaches in achieving urban sustainability. A smart eco-city is, in a broad sense, described as an ecologically healthy city using advanced technologies and having economically productive and ecologically efficient industries, a systematically responsible and socially harmonious culture, and a physically aesthetic and functionally vivid landscape [4]. These cities are claimed to contain a healthy human ecological process leading to sustainable development within the carrying capacity of local ecosystems through changes in the production mode, consumption behaviour and decision instruments based on ecological economics and systems

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engineering [5]. Thus, a smart eco-city can be referred as an overarching or umbrella term for various types of cities targeting a sustainable future. A 'zero-carbon city' is a city that entirely runs on renewable energy and hence produces no carbon footprint. Similar to a zero-carbon city, but less ambitiously, a 'low-carbon city' is a city practicing a low-carbon economy, and seeking to establish a resource saving and environmentally-friendly society, and benignly sustainable energy ecosystem, including low-carbon production and consumption [6]. Thus, zero- and low-carbon cities are emission conscious and carbon-economy specialised smart eco-city types. A 'ubiquitous eco-city (u-eco-city)' is, on the other hand, also a smart eco-city in which urban information and services are provided to residents through high-tech ubiquitous computing, with sensors and communication resources embedded in urban elements, to increase the quality of life while minimising environmental impacts [7].

The theory behind the development of u-eco-cities is not new [8], nevertheless, achieving sustainable outcomes at a city-scale is not an easy task due to the complex and complicated nature of cities and their sustainable development. The recent technology advancements along with the positive perception and behavioural change in the public on the sustainability issues now provide some optimism in realising a sustainable urban form at the city scale. There are currently no fully-fledged u-eco-cities that exist. However, a number of ambitious initiatives are currently underway, and the premises of these cities—i.e., delivering sustainability—and their outcomes for a sustainable future have not been accurately evaluated yet. Moreover, without any concrete proof, these initiatives are imposed as solutions to the 21st century urbanisation problems due to the utilisation of new smart sustainable urban development support tools—e.g., ubiquitous technologies, infrastructures, services and management systems—being perceived highly optimistically.

This paper, firstly, thoroughly reviews the literature on the contemporary concepts of sustainable urban development and eco-cities. Secondly, it analytically scrutinises several dimensions—i.e., technology, infrastructure, service, and management—of a new type of eco-city originated from Korea—branded as u-eco-city. For the analysis, we adopt a framework examining the matter with a multidimensional and balanced perspective—i.e., economic, societal, spatial, and organisational perspectives. This approach is borrowed from the well-known quadruple-bottom-line sustainable urban development framework—i.e., economy, society, environment, and governance [9]. As for the methodological investigation, we select technology, infrastructure, service and management dimensions as they are the main building blocks of a u-eco-city. The paper, then, critically investigates the key aspects of Korean u-eco-cities thoroughly. In the light of the findings, lastly, it discusses and addresses the research question the study tackles—whether, as claimed to be, u-eco-city is a dazzling smart and sustainable urban form that constitutes an ideal 21st century city model or a branding hoax.

## 2. Smart and sustainable urban development

Rapid urbanisation—i.e., driving urban growth with high consumption patterns without fully considering the environmental and social needs and occupants' behaviour and

aspirations—along with the changing climate in many countries worldwide has become a major concern because of its detrimental effects on the environment and societies [10]. Sustainable urban development concept—a development seeking to respond to: integration of conservation and development; satisfaction of basic human needs; achievement of equity and social justice; provision of social self-determination and cultural diversity, and; maintenance of ecological integrity [11]—has been identified as the ultimate goal of many contemporary planning endeavours, and has become a central concept on which the urban development policies are formulated [12].

Sustainable urban development brought the sustainable urban form debate to the agenda that involve various types of urbanisation models and processes [13], which could provide energy efficiently, and establish environmentally-friendly settlements, mobility patterns and social cohesion mainly focusing on divergent spatial scales from metropolitan to neighbourhood levels. The first of these scales is the metropolitan scale. At this macro-level ideal population size for self-sufficiency, limits to urban growth, macro-level effects of the urbanisation pattern on energy consumption, locations of land-uses and their mix that supports a multi-modal transport system, and protection of habitats and water resources are strategically determined [14]. The second one is the urban scale. At this mezzo-level, in addition to the strategic level tasks, a number of issues, such as, energy efficiency and transport demand with regard to clustering of urban development, finer level of land-use mix and density, provision of equal opportunities in reaching urban services, vitality and prosperity of activity centres, and protection of environmental and cultural assets are determined [15]. At the neighbourhood scale, which is the micro-level, the relationship between urban form qualities—e.g., land-use mix, density, pedestrian friendly design—and travel patterns, enhancement of local characteristics, safety and community sense by design, and urban form dependent qualities of the buildings—e.g., solar orientation, imperviousness, efficient use of materials—are determined [16–18].

This classification can also be expanded to include a fourth individual parcel or building scale—i.e., the nano-level [19]. However, either three or four the classification does not imply that these scales are mutually exclusive and independent. In reality, macro-level patterns emerge from mezzo and micro-level processes and behaviours, and micro-level processes and behaviours are controlled by mezzo and macro-level constraints [20]. Due to complexity of the nature of sustainable urban development, it requires more than good strategic policies and behavioural change of the public for achieving a sustainable urban development in all these scales [21].

The concept of eco-city has been developed and promoted since 1970s as part of the sustainable urban development agenda. The original eco-city concept is introduced by Richard Register [22] featured the ecological carrying capacity of the bioregion surrounding the city as its key starting point. Especially, the recent years have seen the dramatic take up of the eco-city concept and an accelerated translation of the ideas and visions are now taking place in many practical initiatives [23]. These initiatives include—but not limited to—in India, the government selected pilot eco-city projects in 2001 aimed at retro-fitting six pilgrim cities (Kottayam, Puri, Thanjavur, Tirupati, Ujjain, and Vrindavan); this was followed in 2010 by plans for four new-build

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