



## Contribution of promoting the green residence assessment scheme to energy saving

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### HIGHLIGHTS

- ▶ Energy saving in residence development is important for sustainable urban development.
- ▶ Green residence assessment scheme contributes significantly to energy saving in residences.
- ▶ Green residence assessment promotes application of environmentally friendly building materials and technologies

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### ABSTRACT

Green residence development has been one of the important strategies for promoting sustainable urban development. Governments throughout the world have been encouraging property developers to deliver green properties. In line with this development, governments have been implementing various assessment programs to certify green residential buildings with the aim of contributing to sustainable urban development. With reference to the Chinese construction practice, this paper examines the effectiveness of the green residence assessment scheme toward its defined aim through investigating the contents and procedures of the green residence assessment scheme by referring to the practices of Chongqing city in western China. Based on the results of five case studies and five semi-structured interviews, this study reveals the significant contribution from implementing the green residence assessment scheme particularly to energy saving in residential buildings. Further, the green residence assessment scheme promotes the application of green building materials and green construction technologies in the entire process of delivering and operating residential buildings. The findings provide valuable references for further investigating alternative methods to achieve better energy saving in developing residential buildings.

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### 1. Introduction

It is generally acknowledged that energy is one of the most critical resources for sustainable development of any country worldwide. The shortage of energy has become more and more serious particularly for those major emerging economies such as China where huge amounts of urbanization and urban renewal schemes at different levels are currently in development and/or implementation. Urbanization in China is characterized by the growing volume of residential buildings built in urban areas. Building energy consumption in China grew from 10% of the national total in 1970s to 20% in 2006, and this is estimated to

increase to 35% by 2020. This proportion would inevitably continue to increase along with development of the national economy and people's living standard (Morrissey and Horne, 2011; Kang, 2008). It is acknowledged extensively that energy has been a core determinant influencing the future development of the Chinese economy (Ouyang et al., 2011). Exploring alternative methods for energy saving in residential buildings is therefore of particular significance to the achievement of overall energy saving, and ultimately to the sustainable development of the national economy.

Green building can be typically defined as a structure that is environmentally responsible and resource-efficient throughout its entire lifecycle: from project design through construction, operation, maintenance, renovation to demolition (Yan and Stellos, 2006). Green building has nowadays been promoted as one of the most important strategies for promoting energy saving

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in the process of developing and operating residential buildings. Realizing the importance of green buildings, the Chinese government has set ambitious energy targets for the building sector. The key target is to cut building energy consumption in all cities by 50% by 2010 and 65% by 2020, using the average energy efficiency of Chinese buildings in 1980 as the base point. It was widely reported that the 50% building-energy-reduction target was strictly followed and achieved by 2010 in most cities of the country. There are various interpretations on green building development in the literature. Zhou (2007) pointed out there would be an inevitable trend of replacing residential buildings developed by traditional construction means with green residential buildings. (Meng and Kong, 2010) argued that the green building which is environmentally friendly is the outcome of harmonious coexistence between human beings and nature. This kind of building consumes less energy by achieving better energy use efficiency, and simultaneously generates less pollution. Green building incorporates harmony between nature and human beings in building design, and more importantly, leads to the development of technologies toward more effective and cleaner energy use. Zhu (2009) analyzed the sustainable development of cities from the perspective of the ecological city and green building, and highlighted the importance of green buildings to sustainable city development in the long-run. In line with a typical definition provided by the Chongqing Municipal Construction Commission (CMCC) (2007), green residential building development is a healthy and comfortable living environment in harmony with the external environment, in which the principle of resource saving, including energy saving, is fully incorporated across the entire processes of project planning, design, construction and operation.

The Chinese government has been introducing a diversity of regulations for promoting the development of green residential buildings. For example, The Ministry of Housing and Urban-Rural Development (MOHURD) issued two important regulations in 2001 aiming at carrying implementation of green residential development forward, namely, 'The Key Elements and Technical Codes for Developing Green Residential Property' and 'The Assessment Manual for Green Residential Property'. In these two documents, the major objective and purpose of developing green residential buildings are stated as "...for saving energy, water and land, minimizing pollution, improving the harmony of social, economical and environmental performance".

In response to the national initiatives to develop green residential buildings, both industrial practices and governmental supports have been advanced to a certain extent. There has been a dramatic increase in the production of green residential buildings in China over the last decade, particularly in those large cities such as Beijing, Shanghai, Tianjin and Chongqing. It has been found that the supporting regulations and green residence assessment schemes launched by local authorities have made major contributions toward this development. For example, in 2005, the Chongqing government in western China promulgated a set of local regulation called 'Technical Guidance for Developing Green Residential Buildings [document code DBJ/T50-039-2005]' (thereafter referred to as 2005 Guidance) (CMCC, 2005). The 2005 Guidance provides detailed requirements in terms of how to develop a green residential building under different categories, including project planning and design, ecological environment, energy consumption system, atmosphere environment, noise, water quality, lighting environment, building material, and intelligent/digital services. This guidance was subsequently revised and the revised guidance was made effective in 2007 (thereafter referred to as 2007 Guidance). Further, in order to strengthen the overall effectiveness of the 2007 Guidance, the Chongqing government subsequently implemented 'The Green Residence Assessment Scheme' in 2008 through the CMCC (CMCC, 2008). The assessment scheme aims at promoting local green residence

practices and ultimately cultivating a better environment for green residence development. An advantage of this is to attract investment to deliver green properties from property developers. Through the green residence assessment scheme, the property developers having the capacity of delivering qualified green properties can be identified. It is therefore considered important to launch the green residence assessment scheme which serves as a useful tool to measure and benchmark the competence of property developers in developing green properties. The 2007 Guidance and the green residence assessment scheme (GRAS) have now been the pivotal driving forces to promote the implementation of green residence developments in Chongqing. According to the CMCC, there have been 31 residential building projects in Chongqing being certified as 'Green Residence' by July 2012.

Existing studies have investigated the application of green residential buildings from different perspectives. The MOHURD has proposed a series of indicators for differentiating the characteristics of green residential buildings from those of non-green residential buildings, such as the 2007 Guidance and 'The Technical Standard for Performance Assessment of Residential Building' (2007b). Lu et al. (2010) suggested that the green characteristics of residential buildings should be extended to a broader dimension which encompasses project planning, landscape and transportation. Xue et al. (2010) criticized the current practice of green residence development, which emphasizes the application of various advanced materials and technologies but places less emphasis on building management and maintenance issues across its lifecycle. As a matter of fact, the effectiveness of energy saving in relation to green residence development depends not only on the adoption of various advanced materials and technologies but also on proper management and maintenance. Wang (2011) provided detailed comparisons on green residence assessment indicators adopted in different countries including China, USA, Australia and UK. Zhu et al. (2010) proposed the key indicators for guiding the development of green residential buildings in China, typically covering building density, building energy saving and performance of sewerage treatment. Nevertheless, there is hitherto no investigation into the effectiveness of applying these indicators into practice to measure and benchmark the green performance of residential buildings.

A review of the literature provides theoretical basis for performing green residence assessment. It is claimed by Qiu Baoxing, who is China's vice minister for the ministry of construction and a strong green building advocate, that the domestic green building market is already worth 213 billion CNY (1 CNY=0.157 USD). In current practice, however, it is found that implications and benefits of green residential buildings have not been well appreciated by the public though the green concept has become popular. Meanwhile, there is a dearth of research investigating the effectiveness of green residence assessment schemes implemented. It is commonly appreciated that the objective of green residence assessment schemes is to promote application of both green and ecological characteristics in the process of residence development through adopting green and energy saving building materials and technologies, and therefore achieve energy saving across the lifecycle of buildings and ultimately improve the quality of the total living environment. The major aim of this study is to examine the effects of implementing the green residence assessment scheme on energy saving in residential buildings.

## 2. Research methodology

This study adopts a research methodology involving a combination of literature review, interviews and case studies. The review of

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