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Analysis of intelligent green building policy and developing status in Taiwan

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HIGHLIGHTS

- Aggregate and analyze the results of Intelligent Green Building policy in Taiwan.
- Chi-square Test of Independence is used for inspecting successful factors.
- Organize experiences and propose recommended feasible scheme for future.

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ABSTRACT

In 2010, Taiwan launched a program dubbed "four emerging intellectual industries" that lists intelligent green buildings. The aim of promoting of intelligent green building is to stimulate the architecture technology industry. This has been combined with Information and Communication Technology (ICT) and the concept of green building to provide a safe and healthy living environment. While doing this it will also aim to reduce carbon emissions and save energy. This study investigates intelligent green building policies and the promotion of progress in Taiwan. It probes into cases from 1988 to 2014. Key success factors are derived from analyzing and summarizing intelligent green building experiences in Taiwan. This is done through Secondary Data Analyses by: 1. Establishing clear norms and standards for intelligent green building design and improvement; 2. First carrying out policies in public sector, in order to provide field trial and safeguarded market opportunities for industries; 3. Implementing rating-based assessments, in order to raise the quality of design; 4. Mandatory or incentive policies are introduced, depending on local specialties and conditions; 5. Respectively planning incentives for relevant interested parties in industrial chain; 6. Strengthening marketing efforts and proactively promoting policies.

1. Introduction

Cities and urban areas are estimated to use 75% of the world's energy and produce up to 80% of its greenhouse gas emissions (Khanna et al., 2014). Buildings have a significant impact on the environment; accounting for one-sixth of the world's freshwater consumption, one-quarter of its wood harvest and two-fifths of its material and energy flow (Chan et al., 2009). In recent years, the rapid development of emerging economies such as China, India and Southeast Asia has exacerbated the negative influences caused by urbanization. These include energy consumption, environmental impact and greenhouse gas emissions, which beget extreme weather and lead to floods, storms and food production issues. On current trends, average global temperatures will rise by 2–3 °C within the next fifty or so years. This will cause one-sixth of global population to be at risk from flooding and water scarcity, extinction of 15–40% of the earth's species. It will also leave 1–2 billion people facing the danger of infectious diseases. Last but not least, marine ecosystems will lose balance and collapse (Nordhaus and National Bureau of Economic Research., 2006; OECD, 2003).

In line with estimates, inaction would be equivalent to losing at least 5% of global GDP each year. If a wider range of hazards is taken into account, the predicted damage could rise to 20% of GDP or more. Conversely, the cost of reducing greenhouse gas emissions in order to mitigate the worst impacts of climate change can be restricted to around 1% of global GDP each year (Chan et al., 2009; Nordhaus and National Bureau of Economic Research, 2006; Yang and Li, 2013). Over the past 200 years mankind has been pursuing economic growth while ignoring the toll of carbon emissions. Mass production, mass consumption and mass disposal

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have formed a vicious circle, as well as brought imbalance for market order.

Construction, building, and urban development activities account for 40% of greenhouse gas emissions. Therefore, acting on carbon emissions from these activities via formulating policies should become an important energy conservation strategy. Moreover, green building, intelligent building and ecological community or intelligent green city development programs could encourage resources and development in urban development. At the moment, Taiwan's urban development is still growing. According to the statistics from Taiwan DGBAS (Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Taiwan, R. O. C.) in 2014, new constructions, additional constructions and altered constructions increased annually from 19,000 to 34,000 between 2008 and 2014. Construction area has grown 199.2–397.2 million m^2 each year (Directorate General of Budget Accounting and Statistics, 2014). Statistics published by the International Energy Agency (IEA) have also indicated that Taiwan emitted 255 million tons carbon dioxide in 2005, which is 22nd highest in the world (Huang and Lee, 2009). At the end of 2008 Taiwan's total GHG emission levels accounted for 1% of all emissions globally. Moreover, CO_2 emissions per person in Taiwan were also found to be 18th highest in the world (Liou, 2011). To meet the challenge of carbon reduction, the Taiwan government promoted green building in 1995, green building materials in 2004, and intelligent green building in 2010 (Feng, 2014; Ju et al., 2014; Chen et al., 2011). Taiwan government's policy of intelligent green building has three features, as shown in Fig. 1.:

1. Hierarchically promoting policies and starting from green building material to Green Building Label, and then Intelligent Building Label for a friendly environment. Furthermore, linking every single green building and intelligent building to form an eco-community and achieve the goal of intelligent green cities, as shown in Fig. 2.
2. Carrying out the aim of carbon reduction and environmental sustainability by conducting different design methods. The Green Building Evaluation and Labeling System has capitalized on passive design to make the most of available resources. On the other hand, Intelligent Building Evaluation and Labeling System has seen to the integration of ICT to maximize the efficiency of carbon reduction, and living quality (Kaklauskas et al., 2012; Ralegaonkar and Gupta, 2010; Tokbolat et al., 2013; Werner, 2013).

Fig. 2. Intelligent Green Building promoting policy hierarchy diagram.

3. Ensuring policies create maximum synergy; for example, connect the Green Building Material Label and the Indoor Environmental Quality Index to invent green building material. This will promote industry interests and opportunities. Alternately, integrate Green Building Label and Evaluation Index of Intelligent Building Label to enlarge benefits of carbon reduction by applying ICT to green buildings, as shown in Fig. 3.

2. Methodology and approach

Taiwan has promoted the Green Building Evaluation and Labeling System since 1999, the Green Building Promoting Program and the Intelligent Building Evaluation and Labeling System since 2003 (Excutive Yuan, 2004). The Green Building Material Evaluation and Labeling System since 2005, Eco-city and the Green Building Promoting Program since 2008 (Executive Yuan, 2011). The Intelligent Green Building Promoting Program has been supported since 2010 (Executive Yuan, 2011), and all of these have proven to be effective in promoting intelligent green building (Cheng, 2009; Ho and Chiu, 2006; Huang et al., 2008; Julie et al.,

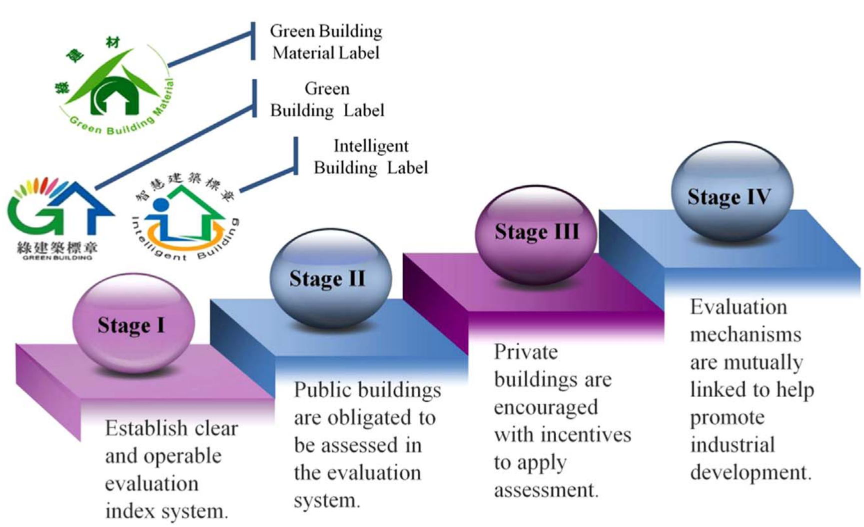

Fig. 1. Policy steps of promoting Taiwan intelligent green building.