# The Structure of the Green Certification Scheme for the Neighborhood and Application to Newtown Development: The Case of Magok, Seoul, Korea

**Kim, Hong-Bae[1, a]  Park, Jun- Hwa[2, b]**

[1] Hanyang University, Department of Urban Planning, Professor, Korea
[2] Hanyang University, Department of Urban Planning, Doctoral Student, Korea
[a] hokim@hanyang.ac.kr, lilac523@hanmail.net

**ABSTRACT**

The green certification scheme for neighborhoods is believed to be a meaningful means to realistically and effectively achieve a low carbon city. Many advanced countries have already developed their own green certification scheme and typical examples are LEED, BREEAM, CASBEE, and so forth. However, there are few studies on green certification for neighborhoods in Korea. Therefore, this paper presents the structure of the green certification scheme that is applicable to the Korean neighborhood unit. The green certification scheme is developed through the 4 following steps: The first step identifies the mechanism of carbon generation within the neighborhood. Next, five sectors are determined based on the carbon emission mechanism and evaluation standards are derived from each sector. The five sectors include industry, transportation, households, green, and planning. The third step is weighing the evaluation standards through an analytical hierarchy process (AHP) method. Finally, the developed certification scheme is applied to the new town of Magok in Seoul, Korea.

**KEYWORDS**: green certification scheme, evaluation standards, low-carbon city

## 1. INTRODUCTION

Worldwide more countries are involved in efforts to reduce carbon dioxide emissions. For its part, the Korean government recently declared its intention to decrease greenhouse gas emissions by 2020, specifically reducing 30% of carbon dioxide emissions based on 2005 levels (MOTIE, 2009). Subsequently, the government has been working diligently to achieve this goal and efforts are currently taking place in various fields involving urban planning and law. Specifically, one of these endeavors includes the establishment of the ‘Framework Act on Low Carbon Green Growth and Green

Building Construction' which was implemented in 2012. This law was created to achieve the low carbon green growth on the city level.

Most advanced countries have already developed their own green certification schemes for the neighborhood unit, including LEED-ND in the U.S., BREEAM-Communities in the U.K., and CASBEE-UD in Japan. However, Korea has not yet introduced its own neighborhood unit green certification scheme, and in fact, research has rarely been conducted on this field. Recently, Yu et al. (2012) introduced green certification standards based on the US's LEED-ND. However, it is unfortunately unclear how those standards were derived. Kim and Park (2013) only suggested the concept of the green certification and the derivation method of evaluation standards.

It has often been noted that achievement of a low carbon city must begin with the neighborhood unit since it is spatially a basic unit of the city. The fact that Korea has only a few studies on neighborhood certification could be perceived as an indication that the country is not yet ready to develop its own green certification scheme. To fill this void, this paper attempts to enhance understanding of the green certification scheme in Korea which can be applied to the neighborhood unit. Strictly speaking, the paper is a first step toward legalization of the green certification scheme in Korea.

The paper is organized as follows: Section 2 explains the carbon emission mechanism which contains the generation and absorption of carbon within the neighborhood unit and subsequently the green certification standards are derived. Section 3 determines the weighing values for each standard. Section 4 applies the green certification standards to Magok newtown development in Seoul, Korea. Finally, Section 5 provides a summary.

## 2. STRUCTURE OF THE GREEN CERTIFICATION SCHEME

### *2.1 Establishing Carbon Emission Mechanism Categories*

Understanding the carbon emission mechanism within the neighborhood is essential since it provides the basis for specifying the standards of the green certification scheme. The mechanism can be understood through the IPCC guidelines which contain various $CO_2$ emission sectors and calculation methods. This paper premises that the carbon emission mechanism consists of five sectors: industry, transportation, household, green, and planning. Based on these five sectors, the structure of the green certification scheme is established. For this paper, the planning sector is added to the IPCC guidelines in order to reflect the role of the public sector. Here, the industrial waste sector which is included in the IPCC guidelines is excluded since it is rarely generated within a neighborhood. Instead, household waste (which is definitely generated in a neighborhood) is included in the household sector.

Each sector in the carbon emission mechanism is defined as follows: the industry sector refers to activities involving the production of goods and services; the transportation sector describes the transporting activities of goods, services, and the movement of people; the household sector is for activities related to consumption and living; the green sector means activities related to the sink effect which absorbs carbon dioxide in the atmosphere within the neighborhood; and the planning sector is for controllable planning and management actions needed to mitigate carbon dioxide in the neighborhood.

*2.2 Evaluation standards of the Green Certification Scheme*

As mentioned above, evaluation standards are derived from the carbon emission mechanism. When cases in the U.S., the U.K., and Japan are compared, what is revealed is that evaluation standards differ from each other and thus it is difficult to make direct comparisons among them. For instance, the number of evaluation standards in Japan's CASBEE-UD is eighty, whereas in the UK's BREEAM it is sixty three, and fifty one in the US's LEED-ND. Nonetheless, to compare the evaluation standards among countries, the evaluation standards are largely categorized into two parts: carbon efficiency evaluation and environmental efficiency evaluation. The former represents standards related to direct carbon emission within the neighborhood. The latter represents all other standards except carbon efficiency standards, and it is further subdivided into five specific areas including society-economy, land & ecology, design & community, living environment, and other as shown in Table 1. It is revealed that the average ratio of the carbon efficiency evaluation to environmental efficiency is 45.4% to 54.6%.

Table 1. Evaluation standards of the green certification scheme in other countries

| Division | Carbon efficiency evaluation | Environmental efficiency evaluation | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | Subtotal | Society-economy | Land & Ecology | Design & Community | Living & Environment | Other | |
| LEED-ND | 23 (45.1%) | 28 (54.9%) | 1 (2.0%) | 9 (17.6%) | 13 (25.5%) | 1 (2.0%) | 4 (7.8%) | 51 (100%) |
| BREEAM-C | 30 (47.6%) | 33 (52.4%) | 6 (9.5%) | 5 (7.9%) | 18 (28.6%) | 1 (1.6%) | 3 (4.8%) | 63 (100%) |
| CASBEE-UD | 35 (43.8%) | 45 (56.2%) | 1 (1.3%) | 10 (12.5%) | 13 (16.3%) | 17 (21.3%) | 4 (5.0%) | 80 (100%) |
| Average | 45.4% | 54.6% | 4.1% | 12.4% | 22.7% | 9.8% | 5.7% | 59 |
| Standards suggested in the paper | 22 (48.9%) | 23 (51.1%) | 2 (4.4%) | 4 (8.9%) | 10 (22.2%) | 5 (11.1%) | 2 (4.4%) | 45 (100%) |

The derivation process of the evaluation standards for the green certification scheme is shown in Figure 1. The specific evaluation standards for both carbon efficiency and environmental efficiency are structured by characteristic activities of the five sectors consisting of the carbon emission mechanism. That is to say, the evaluation standards of the industry sector are identified from facilities and people's activities related to producing goods and services; the evaluation standards of the transportation sector are from transportation, the sharing of transportation, traffic facilities, and transportation schemes; the evaluation standards of the household sector are from household activities; the evaluation standards of the green sector are from absorbing carbon dioxide in the atmosphere by green area. Lastly, the evaluation standards of the planning sector are from controllable activities to reduce carbon dioxide in the neighborhood as mentioned above.

Through the derivation process of evaluation standards, this paper finally draws 45 evaluation standards for the green certification scheme as shown in Table 2. Moreover, the ratio of the carbon efficiency evaluation to the environmental efficiency evaluation is 48.9% to 51.1%. It can be thus said that the distribution of the evaluation standards between these two evaluations derived in this paper differ little from the cases in other countries.

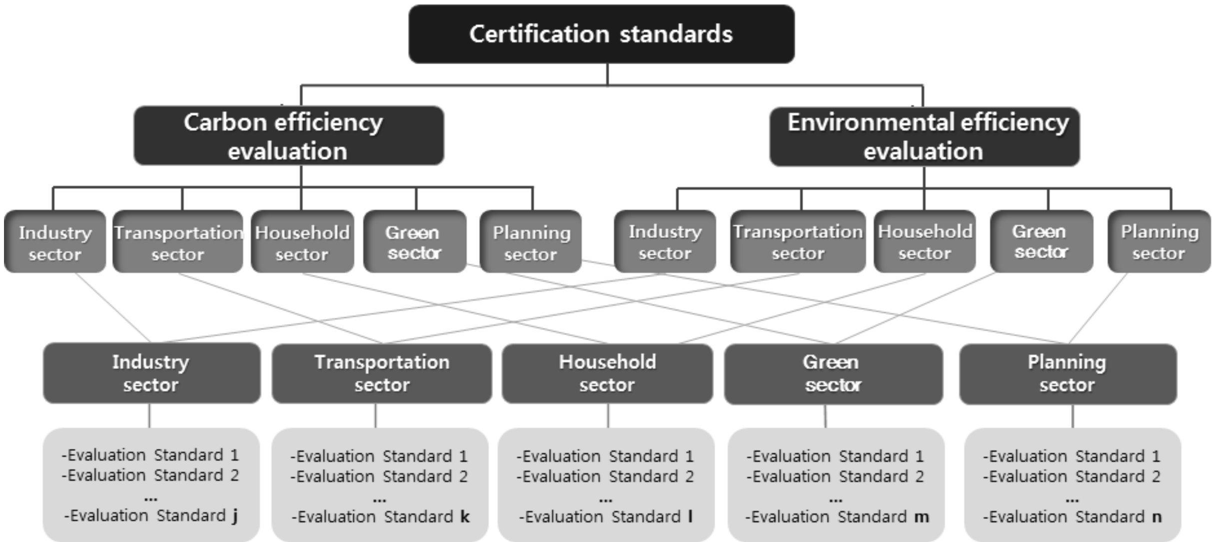


Figure1. Classification framework for the evaluation standards

To enhance the realistic effectiveness of the green certification, the paper suggests a 2-stage certification scheme, i.e., a preliminary stage certification (or a planning stage certification) and a main stage certification (or a completion stage certification). The former is used to certify the project plan including physical contents of neighborhood development, while the latter is employed to certify the neighborhood after completion of the development. The main reason for the 2-stage certification is due to the fact that development may differ from what was originally planned. The period for the preliminary stage certification would be before construction of the neighborhood development, while the period for the completion stage certification would be any time after completion of development. This paper differentiates the evaluation standards by stage as shown in Table 2.

The preliminary stage is evaluated by 23 standards, and the score of this stage is calculated using the equation (1) as below;

$$S_{pre-stage}^{A} = \sum_{i=1}^{23} \frac{100 \cdot w_i \cdot S_{pre-stage,i}^{A}}{\lambda}, \quad (1)$$

$S_{pre-stage}^{A}$ : preliminary stage total score of neighborhood A,

$w_i$ : weight of evaluation standard $i$,

$S_{pre-stage,i}^{A}$ : score of preliminary stage evaluation standard $i$ of neighborhood A ( $S_{pre-stage,i}^{A} = 1,2,3,4$),

$\lambda$ : adjusting coefficient ($\lambda = 4$).

The main stage which is the second stage of the green certification scheme for the neighborhood is evaluated, and the score of this stage is determined by the equation (2) as below:

$$S_{main-stage}^{A} = \sum_{i=1}^{45} \frac{100 \cdot W_i \cdot S_{main-stage,i}^{A}}{\lambda}, \quad (2)$$

$S_{main-stage}^{A}$ : main stage total score of neighborhood A,

$S_{main-stage,i}^{A}$ : score of main stage evaluation standard $i$ of neighborhood A ( $S_{main-stage,i}^{A} = 1,2,3,4$).

An evaluator in each stage can give a score on $S_{pre-stage,i}^{A}$ and $S_{main-stage,i}^{A}$ based on the project plan and data regarding the neighborhood A. Also, in equations of (1) and (2) the reason for multiplying by 100 is to set the basis for evaluation at 100.

Table 2. Evaluation Standards specified and Their Weights

| Sectors | Evaluation standards | | C-stage * | Remark ** |
|---|---|---|---|---|
| | Categories | Standards | | |
| Industry sector (0.155) | Certified green building (0.061) | -Class rate of certified green building inside designated area | MC | CEE |
| | Housing and jobs proximity (0.041) | -Overall employer –local employer ratio | MC | CEE |
| | Scale of commercial facilities (0.023) | -Rate of commercial facilities and an area per person | PC | EEE |
| | Low carbon industrial structure (0.030) | -Scale of industrial output value and high emissions of $CO_2$ company | MC | EEE |
| Transportation sector (0.171) | Car sharing clubs (0.025) | -Operation of car clubs and plan to vitalize carpool | MC | CEE |
| | Green mode of transportation and facility(0.056) | -Introduction of low carbon public transit<br>-Installation of low carbon energy charging station | MC | CEE |
| | Decreasing traffic volume through modal Share (0.045) | -The mean distance of a bus stop, subway station, transfer station<br>-The number of public transit route and the interval between public transits<br>-Installation of guide scheme at station<br>-Area of cycle lane per person<br>-Area of bicycle storage facilities per person | PC/ MC | CEE· EEE |
| | Reduction elements of vehicle speed (0.016) | -Plan to reduce the speed of automobile inside designated area | PC | EEE |
| | Pedestrian level (0.029) | -Area of pedestrians per person<br>-Design plan to prevent crime and care for the disabled person, the elderly and infant in pedestrian road<br>-Connected and open community<br>-Ratio of underground parking lots | PC | EEE |
| Household sector (0.255) | Rate of certified green home (0.144) | -Rate of certified green home inside designated area | MC | CEE |
| | Practice saving energy (0.054) | -Rate of household installed smart meters or automatic thermostats<br>-Practice saving electricity campaign inside designated area | MC | CEE· EEE |
| | Living environment (0.058) | -Planning guideline on atmosphere・sound environment ・vibration environment<br>-Management plan of facilities for induced noise, vibration, unpleasant odors<br>-Installation of a domestic waste disposal site and recycling center | PC/ MC | EEE |
| Green sector (0.152) | Green space (0.075) | -Area of public open space and waterfront<br>-Rate of planting species of street trees | PC/ MC | CEE |
| | Green infrastructure (0.040) | -Rate of using $CO_2$ reduction and materials for green building construction<br>-Rate of porous pavement | MC | CEE |
| | Bioenvironmental conservation (0.037) | -Site design for habitat or wetland and water body conservation<br>-Creation of ecological corridor | MC | EEE |

| | | | | |
|---|---|---|---|---|
| Planning sector (0.266) | Product renewable energy and improved energy efficiency (0.076) | -Self-sufficiency rate of renewable energy inside designated area<br>-Detention storage of rainwater detention facilities per land area<br>-Installation of rainwater and recycling water regeneration・supply scheme<br>-Public facility's energy control scheme installation<br>-Class rate of equipping public facilities with highly energy-efficient products | MC | CEE |
| | Consideration for right of light and wind path (0.054) | -Planning of building group to consider right of light<br>-Planning of building group to consider wind path | MC | CEE·EEE |
| | Conservation and reuse (0.053) | -Conserving and reusing rate of existing or historical building inside the designated area<br>-Rate of land change in process of -Brownfield redevelopment | MC | EEE |
| | Community vitality (0.031) | -Mixed-income diverse communities<br>-Local residents' participation in planning and management sector<br>-Installation of community facilities for residents' participation<br>-Development user guide | PC/ MC | EEE |
| | Monitoring and management scheme (0.052) | -Construction monitoring and management scheme to reduce energy usage<br>-Construction management scheme about natural disaster risk inside the designated area | PC/ MC | EEE |

* C-stage: Certification-stage, PC: Preliminary certification, MC: Main certification

** CEE: Carbon efficiency evaluation, EEE: Other environmental efficiency evaluation

## 3. EVALUATION PROCESS OF GREEN CERTIFICATE STANDARDS

### *3.1. Weight measurement of certification standards*

As mentioned previously, this paper suggested 45 certification standards for the neighborhood. The relative importance of each standard is not necessarily equal so that each must be weighed in order to evaluate the neighborhood. Here, the analytic hierarchy process (AHP) method is employed. 11 questionnaires were distributed among planning experts and 9 were collected.

Through the typical process of the AHP method, weights of evaluation standards were estimated as shown in Table 2. It reveals that the relative importance of the certified green home rate in the neighborhood is the highest with 0.144, while a reduction element of vehicle speed is lowest with 0.016.

### *3.2. Calculating Total Certification Score*

The level of the neighborhood in the green certification scheme is determined according to its total score acquired. Specifically, the paper suggests a 4-level scheme whose level is classified by the total score as shown in Table 3. Level Ⅰ indicates an outstanding neighborhood in terms of carbon and environmental efficiency. On the other hand, level IV is the opposite of level Ⅰ, namely because it indicates a poor neighborhood.

Table 3. Score level division

| Division | Total score | Remark |
|---|---|---|
| Level Ⅰ | $80 \leq A$ | Outstanding |
| Level Ⅱ | $70 \leq A < 80$ | Good |

| | | |
|---|---|---|
| Level Ⅲ | 60≤ A <70 | Average |
| Level Ⅳ | 60 > A | Unclassified |

## 4. APPLICATION TO MAGOK NEWTOWN

This section applies the green certification scheme presented in the second section to the Magok newtown in Seoul, Korea. The development area of Magok is 3.67 $km^2$ and its total units are 3,052. The design for Magok was rendered and its development plan was already permitted by the city of Seoul. It is still under construction. Thus, only the preliminary stage certification is possible.

It is premised that the development of the Magok newtown can be completed in order to demonstrate the usefulness of the green certification. The two scenarios that have been set up regarding the development accomplished in Magok are as follows:

·Scenario #1: the development of Magok is completed, meeting 100% of all standard requirements.
·Scenario #2: the development of Magok is completed, meeting 70% of all standard requirements.

The various reports for the Magok development project, e.g., the site planning, the energy saving plan, and so on, were collected and analyzed. The evaluation outcomes are summarized in Table 4. They indicate that the Magok newtown may acquire level Ⅰ in the preliminary stage certification and the completion stage certification in scenario #1. However, in scenario #2 the level of Magok is expected to fall to level Ⅱ. This outcome indicates that the 2-stage certification scheme is meaningful in the achievement of energy efficient and environment efficient neighborhood development.

Table 4. Certification score of Magok

| Division | Preliminary score | Main score | Total score | Level |
|---|---|---|---|---|
| Scenario #1 | 79.9 | 90.6 | 90.6 | Level I |
| Scenario #2 | 79.9 | 70.9 | 70.9 | Level II |

## 5. CONCLUSION

This paper presented the so-called green certification scheme for the neighborhood unit and demonstrated its usefulness. However, the paper is only the first step toward legalization of green certification scheme. Many parts of the scheme suggested must be further developed. For example, evaluation standards derived in the paper should be re-evaluated in terms of applicability to the neighborhood, and revised according to the evaluation. Also, the scoring basis for all standards must be realistically provided, and the basis for the level classification should be specifically given. Hopefully these parts will be strengthened by active studies so that the green certification scheme contributes to the decrease of greenhouse gas in Korea.

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