Development of a Comprehensive City Assessment Tool Applicable to Various Type of Cities Around the World: CASBEE-City (worldwide use version)

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ABSTRACT

This paper introduces the concept and assessment framework of a sustainability assessment tool for cities around the world, called Comprehensive Assessment System for Built Environment Efficiency (CASBEE)-City (worldwide use version). CASBEE offers systemized tools that can be applied to a variety of spatial scales, such as individual buildings, urban districts, and cities. CASBEE-City (worldwide use version) is specifically designed for city-scale assessment and can be applied to various types of cities globally. The tool enables users to understand target cities comprehensively based on environmental load and quality, comprising environmental, social, and economic quality and activities. A city that achieves high quality measures while imposing a low environmental load is recognized as a more sustainable city within the framework. Assessment items and indicators must be carefully selected to enable assessment of cities in both developing and developed countries. To this end, candidate indicators were selected after reviewing various materials issued by international organizations such as the United Nations and its related organizations (UN-Habitat, UNESCO, World Bank, World Health Organization), the International Organization for Standardization, and the Organisation for Economic Co-operation and Development. Indicators were selected taking several key criteria into account, including data availability, simplicity, reliability, policy relevance, and balance among items. Cities were assessed by aggregating the information from selected indicators. Seventy major cities in the world were assessed using the tool and practicality of the tool has been verified.

Keywords: *green rating tool, sustainable cities, comprehensive assessment*

1. INTRODUCTION

Twenty fifteen was an important year for reconsidering how we can achieve sustainable development globally. The Sendai Framework for Disaster Risk Reduction 2015–2030 (HFA2) was adopted in March, the Addis Ababa Action Agenda (AAAA) was adopted in July, the Sustainable Development Goals (SDGs), officially referred to as Transforming our world: the 2030 Agenda for Sustainable Development, were adopted in September, the Paris Agreement under the United Nations Framework Convention on Climate Change was adopted in December.

As highlighted in Goal 11 of the SDGs, making cities and human settlements inclusive, safe, resilient, and sustainable is currently a priority. Cities and local and subnational governments (referred to as cities and communities hereafter) are key players in achieving sustainable development by implementing effective local policies, promoting financing, developing high-quality infrastructure, delivering basic services for the citizens, and functioning as a hub of meta-governance or multi-level governance.

To make steady progress toward achieving SDGs, it is vital to assess the effectiveness of implemented policies, and to understand the current conditions in cities and communities by using appropriate indicators and publically collectable data. Consequently, the Committee for the Development of an Environmental Performance Assessment Tool for Cities (2015) has developed a tool that enables all stakeholders to assess cities and communities.

2. STUDY METHODOLOGY

The Comprehensive Assessment System for Built Environment Efficiency (CASBEE)-City (pilot version for worldwide use) tool was developed for assessing cities and communities around the world. CASBEE allows a comprehensive assessment of the target with respect to quality (Q) and environmental load (L). CASBEE calculates the Built Environment Efficiency (BEE) value, defined as Q divided by L as shown in Fig. 1. Cities and communities with high BEE values are more sustainable.

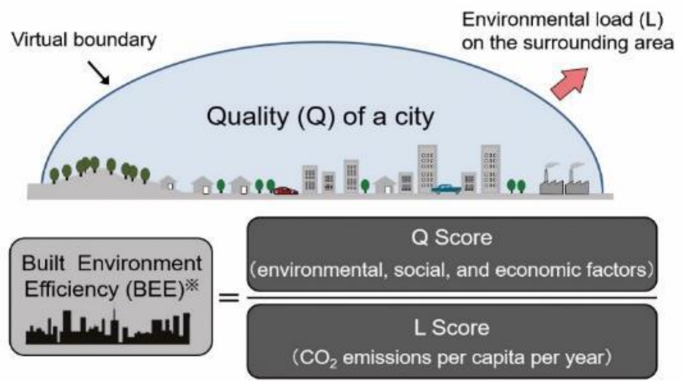

Figure 1: Overall structure of CASBEE-City (pilot version for worldwide use)

The assessment of Q is based on the concept of the triple bottom line, in which the quality of a city or community is comprehensively assessed from environmental, social, and economic perspectives that are the three pillars of sustainability. Assessment of L is based on greenhouse gas (GHG) emissions resulting from daily human activities. Decarbonization requires urgent action, and cities and communities that emit less GHGs are more eco-friendly.

The assessment results for cities and communities are plotted on a two-dimensional graph, called a BEE chart, with the Q score on the vertical axis and the L score on the horizontal axis (left side of Fig. 2). Cities and communities where Q is high and L is low are plotted on the top left of the BEE chart and are more sustainable (right side of Fig. 2). In contrast, cities and communities with low Q and high L are less sustainable under the CASBEE assessment structure.

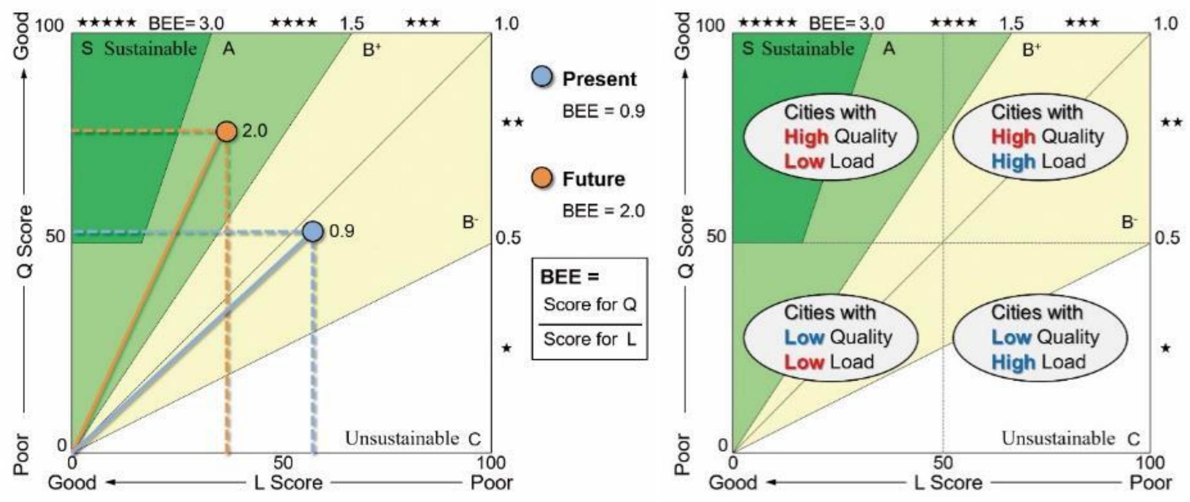

Figure 2: Visualization of assessment results on BEE chart

CASBEE uses a relative assessment system, and a city or community is assessed by each indicator on a scale of 1–5. The CASBEE-City tool was initially developed to assess municipalities in Japan and the worst scoring city or community was assigned as 1 on the scale, 3 indicated an average score, and 5 was the highest score (Murakami et al., 2011; Kawakubo et al., 2011). In this study, the assessment targets are cities and communities all over the world (Fig. 3). These scores are multiplied by a weighting coefficient and the score for Q on the five-point scale is obtained. Finally, 1 is subtracted from the score for Q, and then multiplied by 25 to convert it to 100-point scale (Q Score).

The assessment of L in CASBEE-City is limited to GHG emissions. GHG emissions are converted to their carbon dioxide equivalents and evaluated based on annual GHG emissions per capita (t-CO2 eq/person/year) to ensure a fair assessment regardless of the population size. A L Score on a scale of 0 to 100 is calculated by applying a logistic function where the global emissions average per capita (approximately 5 t-CO_2 eq/person/per year) is represented as a median value of 50.

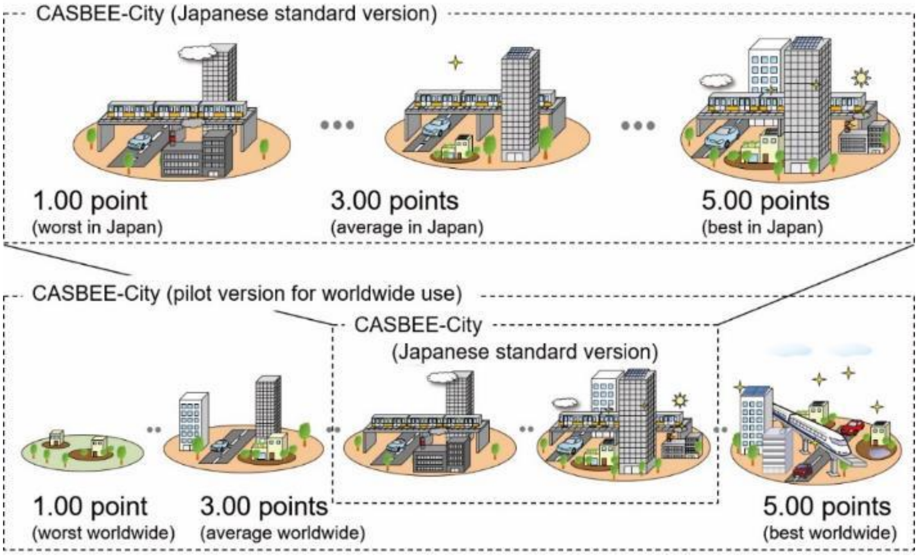

Figure 3: Relative assessment system of CASBEE-City (pilot version for worldwide use)

Assessment indicators that are applicable to cities and communities were selected from the SDGs indicators and ISO 37120 indicators, and some indicators were altered slightly (Fig. 4) (IAEG-SDGs, 2015; ISO, 2014).

Initially, there were more than 300 candidate indicators. The indicators were selected considering the following criteria: 1) data availability, 2) simplicity, 3) reliability, 4) applicability to public policy, and 5) balance among assessment items. The selected indicators are shown in table 1.

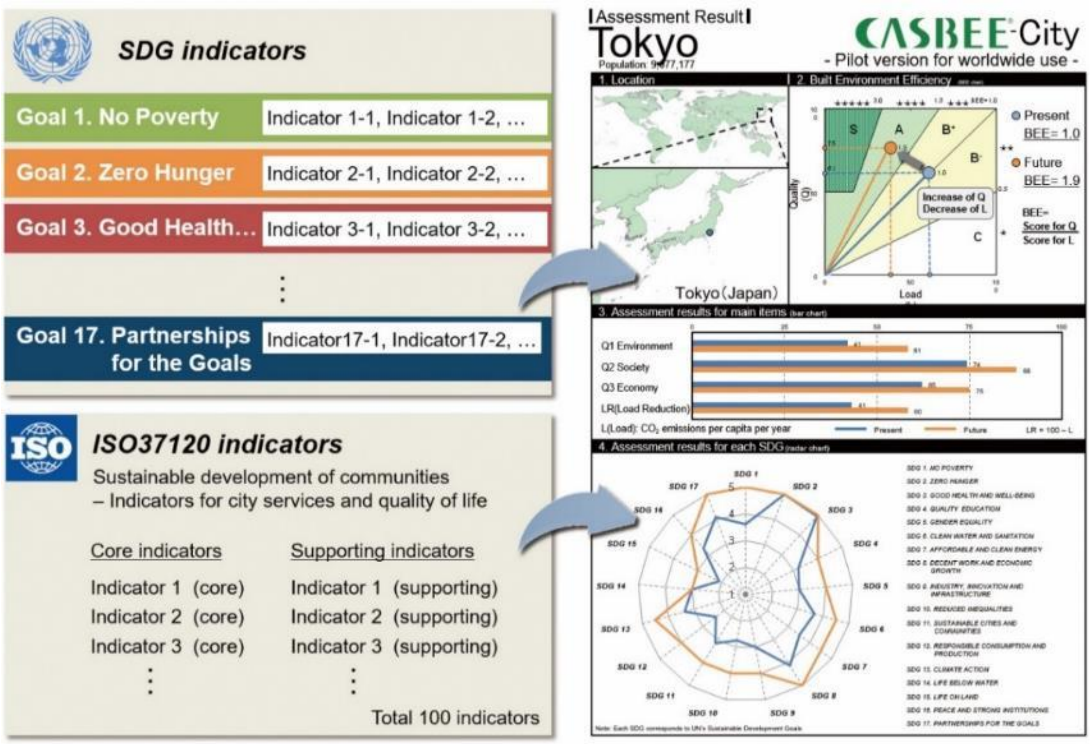

Figure 4: Selection of indicators from SDGs indicators and ISO 37120 indicators

Q1: Quality (environmental aspect)		
	Q1.1	Percentage of population using safely managed water services
	Q1.2	Percentage of population using safely managed sanitation services
	Q1.3	Annual domestic water consumption per capita
	Q1.4	Percentage of a city's total energy consumption derived from renewable sources
	Q1.5	Mean urban particulate matter air pollution (PM2.5)
	Q1.6	Area of public green space as a proportion of total city space
	Q1.7	Percentage of urban solid waste regularly collected and well managed
	Q1.8	Consumption of ozone-depleting substances per capita
	Q1.9	Percentage of the urban solid waste that is recycled
	Q1.10	Implementation of a transparent and detailed deep decarbonization strategy
	Q1.11	Share of coastal and marine areas that are protected
	Q1.12	Percentage of forest area under sustainable forest management
	Q1.13	Red List Index
Q2: Quality (social aspect)		
	Q2.1	Total fertility rate
	Q2.2	Proportion of population below minimum level of dietary energy consumption
	Q2.3	Prevalence of stunting in children under 5 years of age
	Q2.4	Infant mortality rate
	Q2.5	Death rate associated with HIV/AIDS, death rate associated with all forms of tuberculosis, death rate associated with malaria
	Q2.6	Probability of dying between exact ages of 30 and 70 from cardiovascular disease, cancer, diabetes, or chronic respiratory disease
	Q2.7	Road traffic deaths per 100,000 population
	Q2.8	Average life expectancy
	Q2.9	Number of physicians per 1,000 population
	Q2.10	Preprimary enrollment rate (% of relevant age group)
	Q2.11	Primary completion rate (% of relevant age group)
	Q2.12	Tertiary enrollment rate (% of relevant age group)
	Q2.13	Percentage of women aged 20-24 who were married or in a union before age 18
	Q2.14	Primary enrollment rate of girls (% of relevant age group)
	Q2.15	Women as a percentage of total elected to city-level office
	Q2.16	Annual number of public transport trips per capita
	Q2.17	Number of fire related deaths per 100,000 population
	Q2.18	Violent deaths per 100,000 population
	Q2.19	Percentage of children under age 5 whose birth is registered with a civil authority
	Q2.20	Existence of a national law or constitutional guarantee on the right to information
	Q2.21	Number of homicides per 100,000 population
Q3: Quality (economic aspect)		
	Q3.1	Proportion of population below $1.25 (PPP: purchasing power parity) per day
	Q3.2	Proportion of population living below national poverty line
	Q3.3	Share of the population using reliable electricity
	Q3.4	GNI per capita (PPP: purchasing power parity)
	Q3.5	Youth employment rate (aged 15–24)
	Q3.6	Unemployment rate
	Q3.7	Mobile broadband subscriptions per 100 population
	Q3.8	Number of internet connections per 100 population
	Q3.9	GNI share of richest 10%
	Q3.10	Percentage of urban population living in slums or informal settlements
	Q3.11	Domestic revenues allocated to sustainable development as percent of GNI
	Q3.12	Debt service ratio (debt service expenditure per municipality's own source revenue)
	Q3.13	Share of SDG Indicators that are reported annually
L: Environmental load		
	L	Annual CO_2 emissions per capita

Table 1: Selected assessment indicators for CASBEE-City (pilot version for worldwide use).

Seventy major cities in the world were assessed to check how the tool works, its feasibility, and the accuracy of the assessment results. Cities were chosen from every continent, and included developing and developed countries to determine the progress of SDGs in each region. The tool is theoretically applicable to all cities and communities, including small towns and villages where statistical data exists; however, major cities were chosen as assessment targets because it is easier to collect data for the assessment and to evaluate whether results are reasonable. Figure 5 shows the number and distribution of the assessed cities.

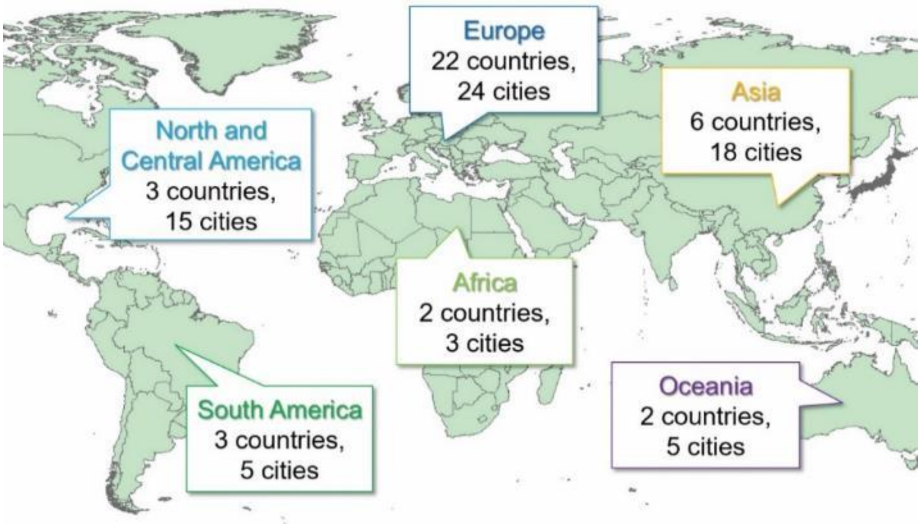

Figure 5: Number and distribution of the cities assessed with the CASBEE tool

3. ASSESSMENT RESULTS

Selected major cities were assessed with CASBEE, and the results are plotted on the BEE chart. Figure 6 shows the assessment results by region, and a single plot represents a city.

Cities in developing regions, such as Southeast Asia and Africa (except some exceptions such as Singapore), tend to have lower Q scores than other cities. In contrast, many cities in developed regions, such as Europe, North America, East Asia, and Oceania, have higher Q scores. However, these results are reversed for L. Many cities in developing regions emit less GHGs than the world average, whereas many cities in developed regions emit more than the world average. Therefore, some cities in developing regions have better BEE (= Q/L) values than cities in developed regions, indicating that more decarbonization is required for cities in developed regions.

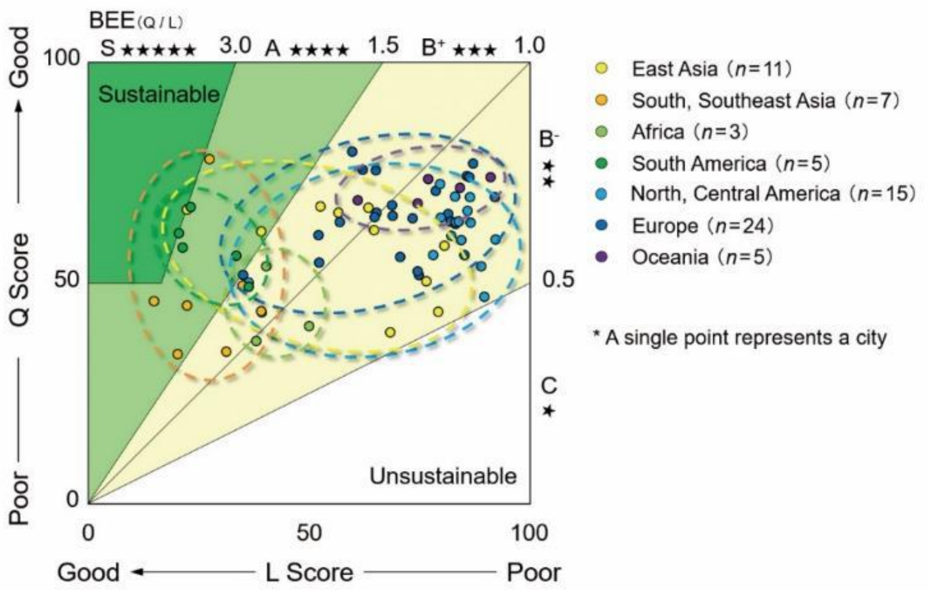

Figure 6: Assessment results for selected cities using the CASBEE tool

Preferred development paths for each city or community group are shown in Fig. 7. Cities and communities in developed regions should drastically reduce L, whereas those in developing regions should increase Q without increasing L. Further international collaboration is required to achieve this goal.

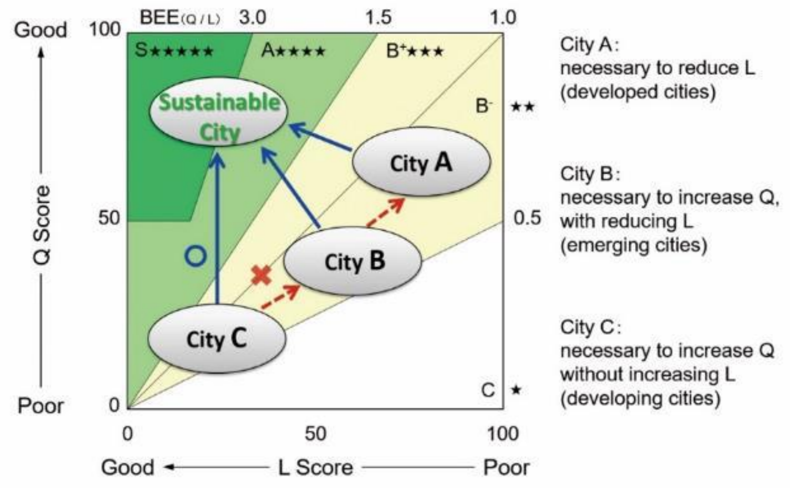

Figure 7: Preferred development paths for each city or community group

4. CONCLUSIONS

The concepts and assessment framework for a sustainability assessment tool for cities around the world, called CASBEE-City (worldwide use version) have developed. The tool consists of approximately 50 indicators that are selected from SDGs and ISO 37120 indicators. The trial assessment of major cities with the tool confirmed that cities in developed regions achieve a high Q score by emitting large amounts of GHGs, whereas cities in developing regions show the opposite trend.

This type of assessment should be performed continuously to monitor progress toward achieving SDGs and other global agendas in cities and communities. It is also important to determine best practices and share the experience of the most sustainable cities and communities to be sustainable in more efficient manner. International collaboration among countries and also at a subnational scale is critical for achieving global agendas.

Although a tool for assessing cities and communities have described to support all stakeholders in understanding the status of their cities and communities, and to help them identify key problems, it is still necessary to improve the assessment structure of the tool. For example, the selection of indicators should be reconsidered because it strongly affects the assessment results. Developing effective, easy-to-use assessment tools is essential for sustainable management of cities and communities, and thus further studies are required in this field.

REFERENCES

[1] Committee for the Development of an Environmental Performance Assessment Tool for Cities, 2015. CASBEE-for Cities; Pilot version for worldwide use version (2015). Institute for Building Environment and Energy Conservation (IBEC), ISBN 978-4-9907-4259-1.

[2] International Organization for Standardization, 2014, Sustainable development of communities – Indicators for city services and quality of life, ISO 37120:2014(E).

[3] Inter-agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDGs), 2015. Agenda Item 4 - Review of proposed indicators - 2 Nov 2015, Second meeting of the IAEG-SDGs, Bangkok, 26–28 October.

[4] Kawakubo, S., Ikaga, T. and Murakami S., 2011. Nationwide Assessment of City Performance Based on Environmental Efficiency. International Journal of Sustainable Building Technology and Urban Development, 2(4), 293–301.

[5] Murakami, S., Kawakubo, S., Asami, Y., Ikaga, T., Yamaguchi, N., and Kaburagi, S., 2011. Development of a comprehensive city assessment tool. Building Research & Information, 39(3), 195–210.