CASBEE® for Cities

Comprehensive Assessment System for Built Environment Efficiency

●Pilot version for worldwide use (2015)

Edited by : Committee for the Development of
an Environmental Performance Assessment Tool for Cities

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Contents

Introduction

Today, more than half of the world's population lives in cities and approximately 70% of the GDP is produced from activities in those cities. According to the UN's world urbanization prospects, the percentage of people living in cities will keep increasing and reach 70% by 2050. City-related activities will grow bigger, and thus the role of cities in creating a sustainable future is becoming more important. A city is the core of economic, cultural and other human activities and whether a city can thrive or not greatly depends on city policy led by local governments.

Various international organizations, research institutes and private companies are now trying to assess the effectiveness of implemented city policies, and to understand the current real conditions of cities in the world by taking the abovementioned circumstances into account. These city-scale assessments can be conducted by various stakeholders such as governmental officers and researchers with citizens supporting their decision-making, understanding the real conditions of their cities, finding problems to be solved and pursuing livable and sustainable cities.

There are many studies focusing on city-scale assessment; however, many of them only focus on megacities in developed countries as it is easier to collect data for assessment than small cities and cities in developing countries. In other words, at this moment, the application of city-scale assessment is very limited in many cases.

Consequently, the Committee for the Development of an Environmental Performance Assessment Tool for Cities was launched in November 2008 for the purpose of contributing to the improvement of city-wide comprehensive environmental performance by developing and utilizing an environmental performance assessment tool tailored to cities, in which a framework for a city evaluation suitable for the era of the global environment will be studied. The committee adopted the principle and method of the Comprehensive Assessment System for Built Environment Efficiency (CASBEE) for the basic assessment tool in view of clarity, fairness, reliability and usefulness. CASBEE is a unique Japanese system that is widely known as an environmental performance assessment tool for the built environment.

The city assessment tool "CASBEE-City" also focuses on evaluating cities from two perspectives: quality inside a city (Q = quality) based on the triple bottom line perspectives of environmental, social and economic aspects, and environmental load emitted from a city on the external environment (L = load), in accordance with the principle of the conventional CASBEE. These are the unique characteristics of CASBEE, and the Japanese government started to utilize the tool to monitor the status and assess the effectiveness of implemented city measures in 2013.

The Committee for the Development of an Environmental Performance Assessment Tool for Cities, decided to develop the new city assessment tool "CASBEE-City (Pilot version for worldwide use)" that can be applied to various types of cities in both developing and developed countries around the world after experience has been gained through assessing a large number of cities throughout the country.

Assessment items and indicators are carefully studied from various aspects in a comprehensive manner, in light of the urgent and important task of promoting a sustainable future. The UN's SDGs (Sustainable Development Goals) and ISO 37120 were reviewed as important references when developing the tool.

In view of the global trend in environmental issues and with the discussions by IPCC (Intergovernmental Panel on Climate Change) and COP-FCCC (Conference of Parties - Framework Convention on Climate Change), environmental load emitted from a city (L) is assessed based on greenhouse gas emissions. Other environmental aspects such as nature conservation and resource recycling are considered in the quality inside a city (q) aspect.

We have now compiled and released the “CASBEE-City (pilot version for worldwide use, 2015 Edition)” brochure. Assessment indicators in the tool consist of publicly available statistics by municipalities. While the original tool was developed for cities in Japan, the newly developed tool is universally applicable and relevant in any region or country.

We hope that this tool will be utilized in various fields and will help enhance urban environmental improvement in harmony with global environmental issues.

October 2015
Shuzo Murakami
Chairman of the Committee for the Development
of an Environmental Performance Assessment Tool for Cities

PART Ⅰ Outline of CASBEE-City

1. What is CASBEE?

CASBEE is a method of assessing and rating the environmental performance of a built environment Assessment tools for CASBEE were developed in accordance with the following three concepts: (1) Evaluating a built environment through its entire lifecycle, (2) Evaluating a built environment from the two aspects of quality (Q) and environmental load (L) and (3) Evaluating a built environment according to the "Built Environment Efficiency (BEE)," an assessment index, which was newly developed based on the idea of eco efficiency. The rating system has five grades; Excellent (S), Very Good (A), Good (B^+), Fairly Poor (B^-) and Poor (C), with each grade represented by a certain BEE value. CASBEE, for which development began in 2001, used to consist of environmental performance assessment tools used for individual buildings including "CASBEE-New Construction." Currently, CASBEE is comprised of various tools tailored to specific purposes, such as CASBEE for Urban Development for building block assessment and CASBEE-City for environmental assessment at the city scale. These are collectively known as the CASBEE Family.

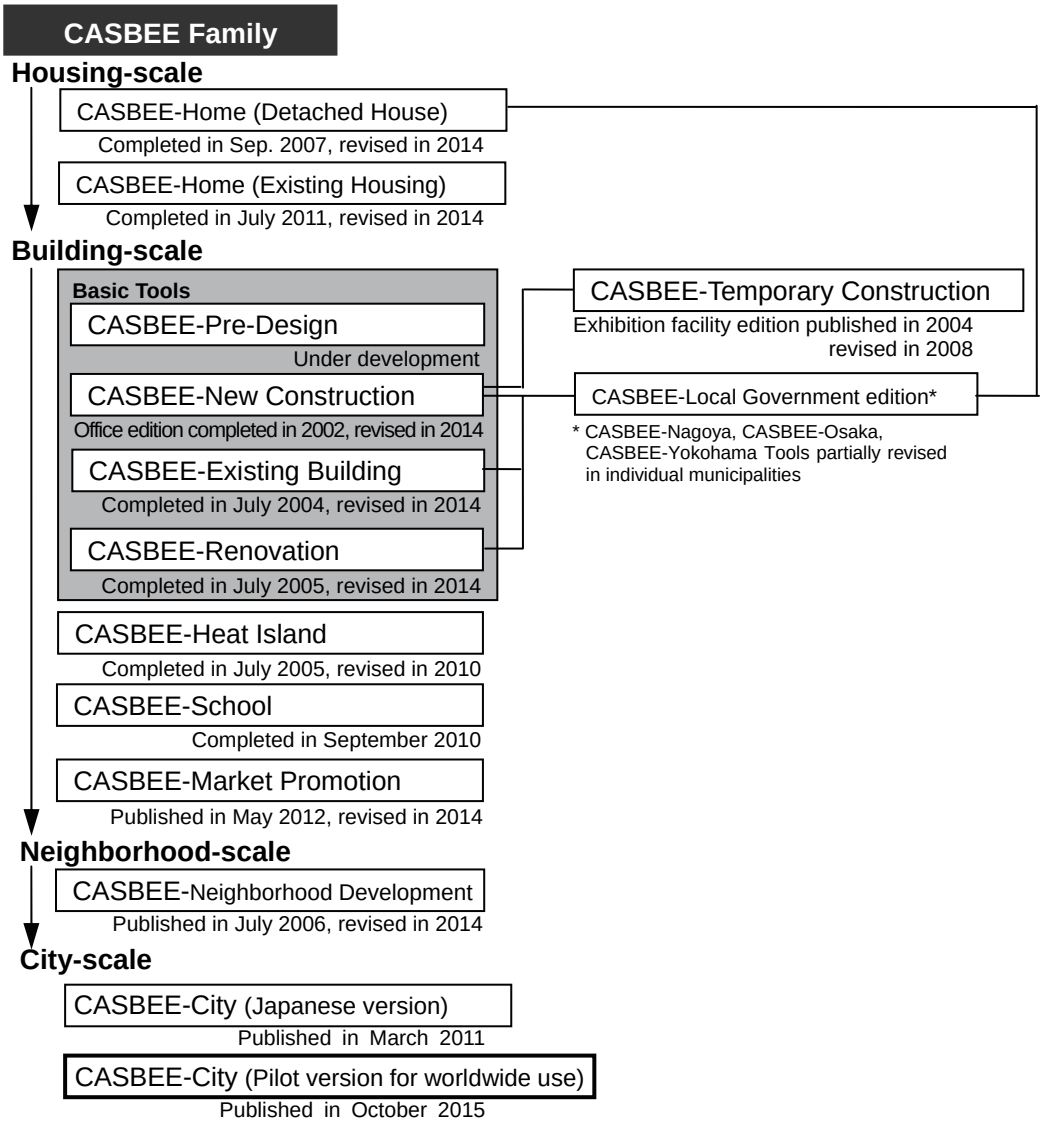


Figure Ⅰ.1. CASBEE Family

Moving Cross-Scale: The major environmental assessment tools were initially developved to assess individual buildings. Recently, these tools have introduced versions that address a broader context e.g., LEED for Neighbourhood Development, BREEAM Communities, Green Star – Communities. CASBEE has also expanded its tools to a broader context after experience has been gained in assessing individual buildings. As shown in the following figure, CASBEE-Housing and CASBEE-Building are applied for individual houses and buildings to assess their environmental performance. CASBEE-Urban Development is used to evaluate environmental performance of urban blocks and town development. CASBEE-City evaluates environmental performance on a local government scale. These are assessed based on BEE indicators by CASBEE.

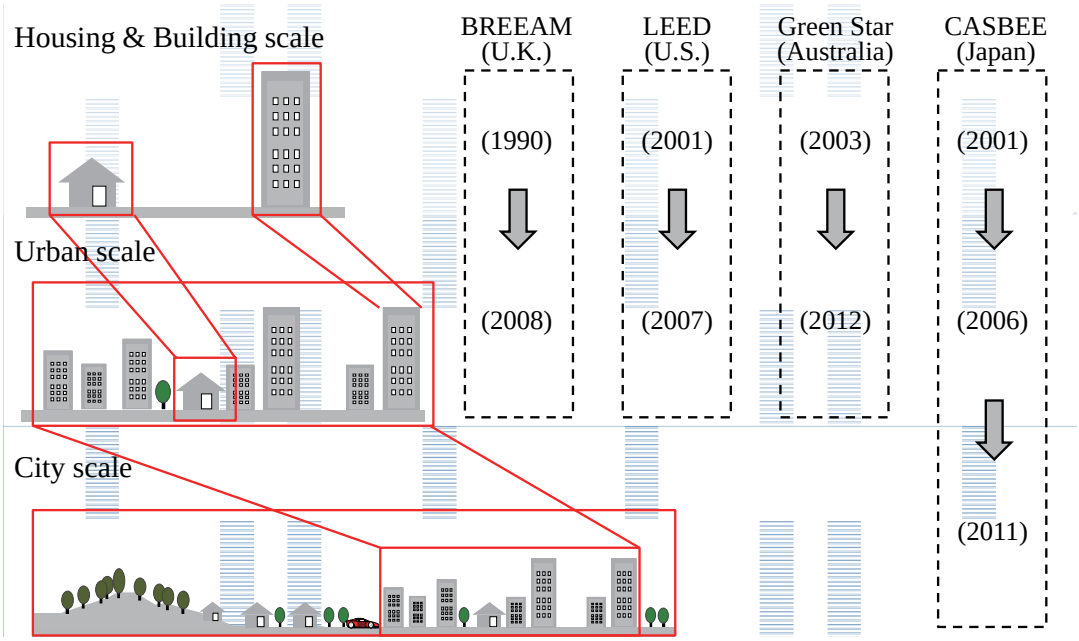


Figure Ⅰ.2. Cross scale structure of CASBEE and other tools in the world

2. Framework of CASBEE-City

2.1 Basic policy for development

2.1.1 Basic principles

CASBEE-City is a system that comprehensively evaluates the environmental performance of a city. When evaluating environmental performance, environmental concern is a major perspective, but ensuring a convenient and comfortable life for city dwellers and the development of the local economy should not be overly restricted, simply due to the higher priority on the reduction of environmental burden. Accordingly, CASBEE-City looks multilaterally at the quality and performance of a city from a triple bottom line perspective of the environment, society and the economy.

The assessment is conducted at the municipal level, the foundation of a society. In order to clearly define the assessment target, a hypothetical boundary is set around the city (municipality) to be evaluated, so that a hypothetical closed space in three dimensions is created around the city. The higher the Q value representing quality and the lower the L value representing environmental load on the external environment are, the higher the BEE (the Built Environment Efficiency=Q/L) value becomes, which indicates that the city is highly regarded for its excellent environmental efficiency.

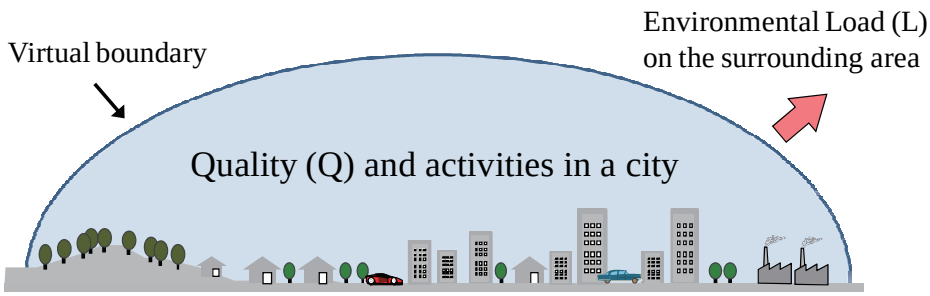


Figure Ⅰ.3. Concept of a hypothetical closed space in CASBEE-City

2.1.2 Assessment items and indicators for CASBEE-City (Pilot version for worldwide use)

CASBEE-City (Pilot version for worldwide use) is a tool specifically developed for city-scale assessment applicable to various types of cities in both developing and developed countries around the world. Thus assessment items and indicators for the tool were carefully selected by referring to previous studies and documents published by international organizations such as the UN's Sustainable Development Goals (SDGs) indicators and ISO 37120 (Sustainable development of communities – Indicators for city services and quality of life). As most of the indicators implemented in CASBEE are based on SDGs indicators and ISO 37120 indicators, the tool users such as local governmental officers, citizens and other stakeholders can understand the actual conditions of their cities and progress toward achieving global SDGs. Such visualization of city status would help tool users in detecting the problems to be urgently solved in their cities and to make their cities more livable and sustainable.

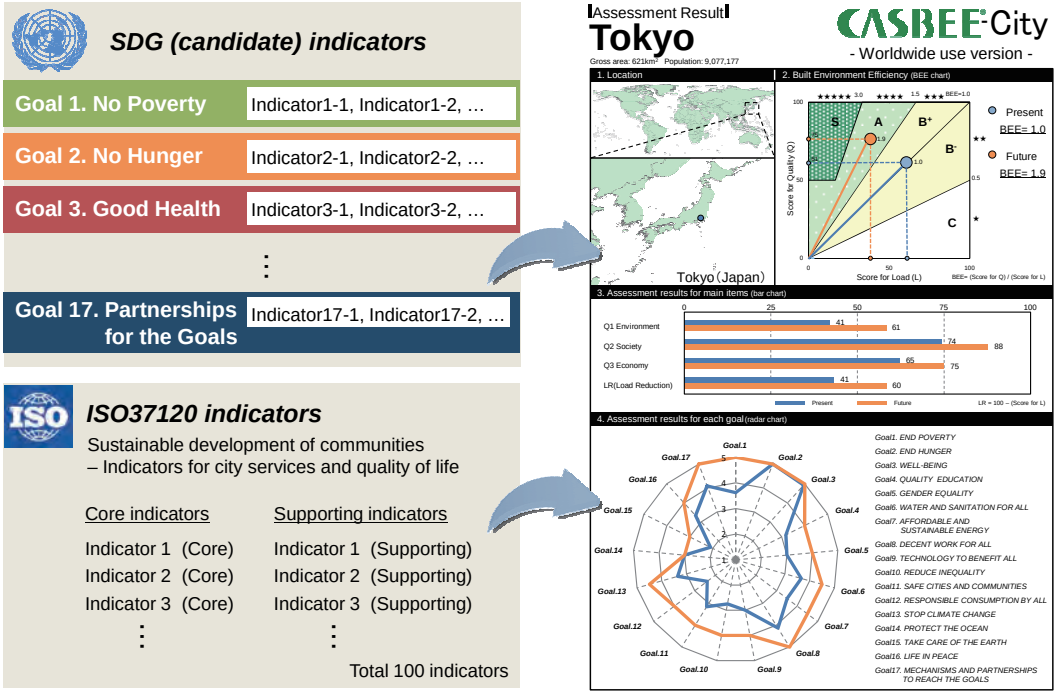


Figure Ⅰ.4. CASBEE-City tool based on SDGs and ISO 37120 indicators

Tip 1: What are Sustainable Development Goals (SDGs)?

Sustainable Development Goals (SDGs) are an intergovernmental set of goals (17 goals) with 169 targets. The 17 goals are as follows: 1. End poverty in all its forms everywhere, 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture, 3. Ensure healthy lives and promote well-being for all at all ages, 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all, 5. Achieve gender equality and empower all women and girls, 6. Ensure access to water and sanitation for all, 7. Ensure access to affordable, reliable, sustainable and modern energy for all, 8. Promote inclusive and sustainable economic growth, employment and decent work for all, 9. Build resilient infrastructure, promote sustainable industrialization and foster innovation, 10. Reduce inequality within and among countries, 11. Make cities inclusive, safe, resilient and sustainable, 12. Ensure sustainable consumption and production patterns, 13. Take urgent action to combat climate change and its impacts, 14. Conserve and sustainably use the oceans, seas and marine resources, 15. Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss, 16. Promote just, peaceful and inclusive societies, and 17. Revitalize the global partnership for sustainable development

Tip 2: What is ISO 37120?

ISO 37120 is the group of indicators for city services and quality of life. It became an IS (International standard) in May 2014. It consists of 100 indicators including 46 Core indicators and 54 Supporting indicators. These 100 indicators are categorized into the following 17 themes: 1. Economy, 2. Education, 3. Energy, 4. Environment, 5. Finance, 6. Fire and Emergency Response, 7. Governance, 8. Health, 9. Recreation, 10. Safety, 11. Shelter, 12. Solid Waste, 13. Telecommunication and Innovation, 14. Transportation, 15. Urban Planning, 16. Wastewater, and 17. Water and Sanitation. It is expected to be a common language for reporting city services and quality of life.

2.2 Assessment structure

The assessment procedure consists of the following five major steps:

(1) Current assessment of Q and L

Quality (Q) within the hypothetical enclosed space and load (L) on the external environment of the space are each clearly defined, and the assessment is carried out from both the Q and L aspects. It is also based on multiple assessment items set according to the individual characteristics of Q and L. Results are expressed as scores rated and counted in line with a certain method and standard.

(2) Comprehensive assessment of environmental performance by BEE

The BEE value with the concept of environmental efficiency is derived from the results of step (1) by dividing the score for Q by the score for L, in order to express the environmental performance of the city in a comprehensive manner. When starting a calculation, total Q and L scores are first converted to a scale of 0 to 100, respectively. BEE is expressed as the gradient of a straight line on a graph having L plotted on the x axis and Q on the y axis as shown in Figure I.2.2. According to the value corresponding to the gradient, the degree of the environmental performance is labeled and color-coded in five grades: S rank, A, B+, B- and C. Even if the gradient is 3.0 or higher, the BEE value will not be ranked as S, the highest grade, unless the Q value is 50 (=average score) or higher. The higher the Q value and the lower the L value, the higher the BEE value becomes, indicating that the city is highly regarded in the assessment in terms of the overall environmental performance.

Because of the calculation systems, the BEE value may be close to +∞ (infinity). However, from a practical perspective of the assessment, the BEE value can be as high as 10 (even when the value of Q/L far exceeds 10, the result is shown as BEE = 10).

(3) Assessment of the future estimated value and target value for Q and L

(Please refer to 2.3 regarding purposes of future assessment.)

(4) Calculation of the future BEE value

(5) Comparison of the current Q, L and BEE values in Steps (1) and (2) with the future values in Steps (3) and (4). These comparisons are intended to determine the feasibility of improvements for achieving the city's long-term goals.

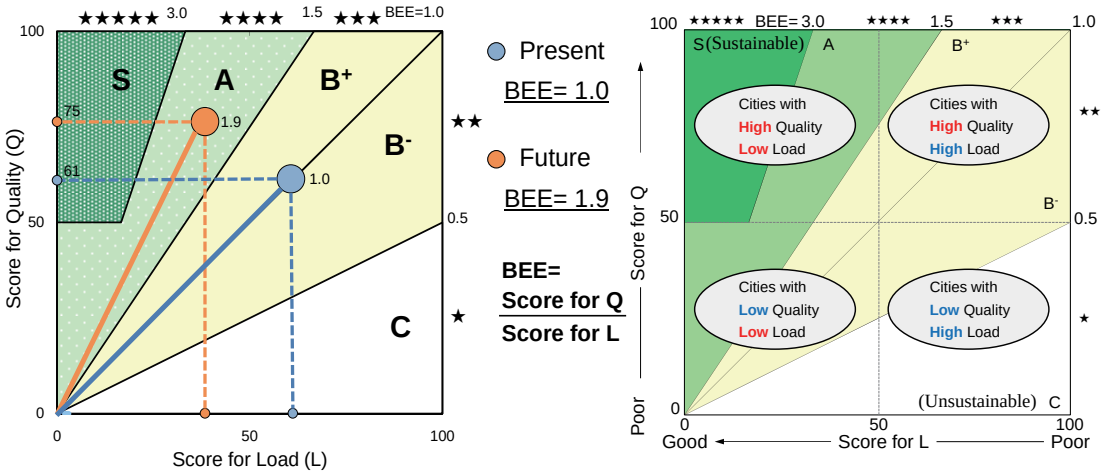


Figure Ⅰ.5. Visualization of assessment results on BEE chart (Image)

2.3 Current assessment and future assessment

As seen in arguments made in the UN (United Nations), COP-FCCC (Conference of Parties - Framework Convention on Climate Change) and IPCC (Intergovernmental Panel on Climate Change), individual countries have been seeking ways to substantially reduce their environmental load and to improve their city conditions over the medium and long term, while implementing measures having an immediate effect on the current situation. Consequently, CASBEE-City adopts an assessment method focusing on future predictions. Specifically, CASBEE-City is a system designed to evaluate the current situation with absolute accuracy, while also estimating the future environmental performance in order to evaluate the effectiveness of measures (i.e., the degree of future expectations) in a visible manner by comparing the current situation with future projections. Figure I.2.3 shows this assessment system covering the current and future situations expressed on a BEE chart.

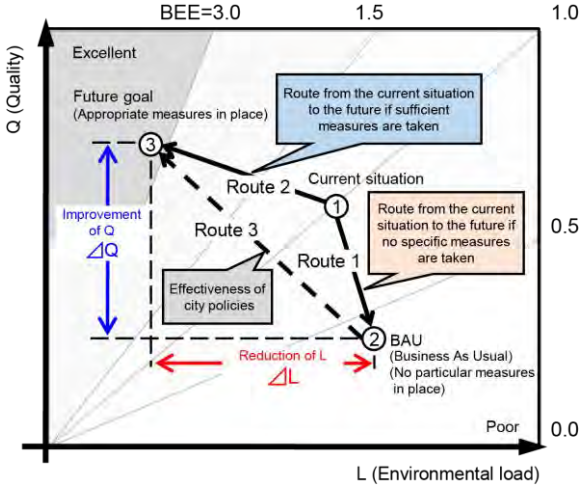


Figure Ⅰ.6. Positions of the current assessment and future assessment on a BEE chart

(1) Current assessment value: The Q, L and BEE values on this point represent the current assessment of the city.
(2) Tendency value: Future assessment in cases when no special additional measures are taken (BAU = Business As Usual)
(3) Future assessment value with appropriate measures in place: The Q, L and BEE values on this point represent the future assessment of the city.

On the BEE chart, Route 1 represents the change from the current situation to the BAU, and Route 2 is for the change from the current situation to the future, whereas Route 3 leading from (2) to (3) via the BAU represents the policy effect. Consequently, the difference between (2) and (3) in values on the x axis and the y axis, respectively, indicate the improvement in quality (ΔQ) and reduction of environmental load (ΔL), which represent the policy assessment. Therefore, the 2D display with Q and L enables the assessment of an urban policy effect from two separate aspects of Q and L.

The following are formulae expressing the above chart:

Estimated future value of Q → $Q_{\text{Future value}} = Q_{BAU} + \Delta Q$

Estimated future value of L → $L_{\text{Future value}} = L_{BAU} + \Delta L$

Q_{BAU}, L_{BAU}: Future values in cases when no special additional measures are taken (BAU)

ΔQ: Expected increase or reduction in quality by implementing urban policies

ΔL: Expected increase or reduction in environmental load by implementing urban policies

(Positive values indicate increase; negative values indicate reduction)

3. Assessment method

3.1 The time of assessment

In order to conduct a predictive assessment of the effect of future measures, policies and efforts, as well as the current assessment of the city, in CASBEE-City, as described above, it is necessary to obtain estimated future values of Q and L and the estimated difference between the respective future value and the BAU value (ΔQ and ΔL).

Assessment items, as described below, usually focus on the amount of accumulation generated by an activity over a certain period of time in a city. Therefore, the assessment is basically conducted annually.

3.1.1 Year of the current assessment

The "current" status in this case indicates the city's recent performance. However, as it also serves as the base year for assessing future performance, an assessor may adjust the appropriate year for current assessment to suit specific circumstances of each assessment.

3.1.2 Year of future assessment

An assessor may establish an appropriate year for future assessment, generally between 2015 and 2035 (short- to mid-term future).

3.2 Degree of operability used for future assessment

Whether or not a city's future target is actually achieved depends on the extent of systematic implementation of the appropriate measures in each city. As such, CASBEE-City now includes an index of operability.

As mentioned above,

$$Q_{\text{Future value}} = Q_{BAU} + \Delta Q$$

$$L_{\text{Future value}} = L_{BAU} + \Delta L$$

Furthermore,

$$\Delta Q = \Sigma \Delta Qi \times Xi$$

$$\Delta L = \Sigma \Delta Lj \times Xj$$

- i : Number corresponding to minor items in Q
- ΔQi : Target increase (a negative value for target reduction) in Item i, an assessment item of Q, set by individual cities
- Xi : Degree of operability of a measure regarding Item i (0-1.0)
- j : Number corresponding to mid-level item in L
- ΔLj : Target increase (a negative value for target reduction) in Item j, an assessment item of L, set by individual cities
- Xj : Degree of operability of a measure regarding Item j (0.0-1.0)

The value of the degree of operability (Xi or Xj) is determined within the range of 0.0 to 1.0 depending on the number of corresponding items on a list of prepared check items in terms of measure, policy and approach. The actual procedure for Q differs from that for L, the details of which will be described later in sections 3.4 and 3.5.

3.3 Population data

Many assessment items in CASBEE-City are expressed by an index on a per-capita basis in order to ensure neutrality of the assessment in spite of the differences in scale among various cities.
Conventionally, the various performances and greenhouse gas (GHG) emissions of a city are expressed as the product of the amount of activity and a basic unit per activity. The amount of activity and the basic unit per activity are based on a variety of indices including the population, number of households, product output, gross floor area and duration of activity, depending on each field. Strictly speaking, there is another possible method using different indices for each field and totaling the amount of activity calculated separately for each field with the weighting coefficient in mind, but the method used in CASBEE-City uses the population as a representative value for the amount of activity in view of simplicity and feasibility.

3.4 Assessment items for Q

3.4.1 Basic idea regarding Q

Q (quality) is, in principle, the sum of unique added values of the city created by the operation and maintenance of the urban area. In order to express the Q value by a simple and precise index, a single economic index may be adopted, which includes the city's gross regional product (GRP) or the land price of a representative location.
However, economic indices sometimes depend greatly on elements with a tenuous connection with global environmental issues. Moreover, assessment in terms of the quality of life (QOL) of the people cannot be fully expressed by the economic index alone.
Accordingly, based on a triple bottom line of the environment, society and the economy, which is one of the major ideas when understanding the sustainability of a region, assessment items are selected in order to represent a group of explanatory variables of the city's added values.

3.4.2 Structure of Q assessment items

The overall structure consists of the major category with the classifications of Q1 Environmental aspect, Q2 Social aspect and Q3 Economic aspect, and sub-category under the major category. The actual assessment is conducted at the sub-category level, the results of which are totaled in terms of the major category items, and all items, respectively, in order to derive assessment values. In cases where data for sub-category items is not available, national average values are applied. Assessment items and corresponding indicators are selected from SDGs (Sustainable Development Goals) candidate indicators and ISO 37120 indicators by taking data availability into account that is applicable to city-scale assessment. Candidate assessment items and corresponding indicators considered in the development stage of CASBEE-City (Pilot version for worldwide use) are shown in the following table.

Table Ⅰ.1. Candidate of assessment indicators for Q at the stage of pilot version (2015) based on SDGs and ISO 37120

Items		Indicators
Major	Sub	
Q1	Q1.1	Mean urban air pollution of particulate matter (PM10 and PM2.5)
Env.	Q1.2	Area of public and green space as a proportion of total city space
	Q1.3	Percentage of urban solid waste regularly collected and well managed
	Q1.4	Fine particulate matter (PM2.5) concentration
	Q1.5	Particulate matter (PM10) concentration
	Q1.6	NO2 (nitrogen dioxide) concentration
	Q1.7	SO2 (sulphur dioxide) concentration
	Q1.8	O3 (Ozone) concentration
	Q1.9	Noise pollution
	Q1.10	Percentage of city population with regular solid waste collection
	Q1.11	Total collected municipal solid waste per capita
	Q1.12	Percentage of the city's solid waste that is recycled
	Q1.13	Percentage of the city's solid waste that is disposed of in a sanitary landfil
	Q1.14	Percentage of the city's solid waste that is disposed of in an incinerator
	Q1.15	Percentage of the city's solid waste that is burned openly
	Q1.16	Percentage of the city's solid waste that is disposed of in an open dump
	Q1.17	Percentage of the city's solid waste that is disposed of by other means
	Q1.18	Hazardous Waste Generation per capita (tonnes)
	Q1.19	Percentage of the city's hazardous waste that is recycled
	Q1.20	Green are (hectares) per 100,000 population
	Q1.21	Annual number of trees planted per 100,000 population
	Q1.22	Disclosure of Natural Resource Rights Holdings
	Q1.23	Global Food Loss Indicator
	Q1.24	Consumption of ozone-depleting substances (MDG Indicator)
	Q1.25	Aerosol optical depth (AOD)
	Q1.26	Share of companies valued at more than [$1 billion] that publish integrated monitoring]
	Q1.27	Number of businesses per 100,000 population
	Q1.28	Share of coastal and marine areas that are protected
	Q1.29	Percentage of fish tonnage landed within Maximum Sustainable Yield (MSY)
	Q1.30	Annual change in forest area and land under cultivation (modified MDG Indicator)
	Q1.31	Area of forest under sustainable forest management as a percent of forest area
	Q1.32	Annual change in degraded or desertified arable land (% or ha)
	Q1.33	Red List Index
	Q1.34	Protected areas overlay with biodiversity
	Q1.35	Percentage change in number of native species
Q2	Q2.1	Percentage of urban population living in slums or informal settlements (MDG Indicator)
Soc.	Q2.2	Percentage of people within 0.5km of public transit running at least every 20 minutes
	Q2.3	Ratio of land consumption rate to population growth rate, at comparable scale
	Q2.4	Losses from natural disasters, by climate and non-climate-related events (in US$ and lives lost)
	Q2.5	Number of fire related deaths per 100,000 population
	Q2.6	Number of natural disaster related deaths per 100,000 population
	Q2.7	Square meters of public indoor recreation space per capita
	Q2.8	Square meters of public outdoor recreation space per capita
	Q2.9	Number of police officers per 100,000 population
	Q2.10	Number of homicides per 100,000 population
	Q2.11	Crimes against property per 100,000 population
	Q2.12	Response time for police department from initial call
	Q2.13	Percentage of city population living in slums
	Q2.14	Number of homeless per 100,000 population
	Q2.15	Percentage of households that exist without registered legal titles
	Q2.16	Areal size of informal settlements as a percentage of city area
	Q2.17	Proportion of population below minimum level of dietary energy consumption (MDG Indicator)
	Q2.18	Percentage of women of reproductive age (15-49) with anemia
	Q2.19	Prevalence of stunting and wasting in children under 5 years of age
	Q2.20	Percentage of children less than six months old who are fed breast milk alone (no other liquids or food)

	Q2.21	Percentage of women, 15-49 years of age, who consume at least 5 out of 10 defined food groups
	Q2.22	Crop yield gap (actual yield as % of attainable yield)
	Q2.23	Number of agricultural extension workers per 1000 farmers [or share of farmers covered by agricultural extension programs and services
	Q2.24	Nitrogen use efficiency in food systems
	Q2.25	Crop water productivity (tons of harvested product per unit irrigation water)
	Q2.26	Maternal mortality ratio (MDG Indicator) and rate
	Q2.27	Neonatal, infant, and under-5 mortality rates (modified MDG Indicator)
	Q2.28	Percent of children receiving full immunization (as recommended by national vaccination schedules)
	Q2.29	HIV incidence, treatment rate, and mortality (modified MDG Indicator)
	Q2.30	Incidence, prevalence, and death rates associated with all forms of TB (MDG Indicator)
	Q2.31	Incidence and death rates associated with malaria (MDG Indicator)
	Q2.32	Probability of dying between exact ages 30 and 70 from any of cardiovascular disease, cancer, diabetes, chronic respiratory disease, [or suicide]
	Q2.33	Percent of population overweight and obese, including children under 5
	Q2.34	Road traffic deaths per 100,000 population
	Q2.35	Consultations with a licensed provider in a health facility or the community per person, per year
	Q2.36	Percentage of population without effective financial protection for health care
	Q2.37	Proportion of persons with a severe mental disorder (psychosis, bipolar affective disorder, or moderate-severe depression) who are using services
	Q2.38	Contraceptive prevalence rate (MDG Indicator)
	Q2.39	Current use of any tobacco product (age-standardized rate)
	Q2.40	Average life expectancy
	Q2.41	Number of in-patient hospitals per 100,000 population
	Q2.42	Number of physicians per 100,000 population
	Q2.43	Under age five mortality per 1,000 live births
	Q2.44	Number of nursing and midwifery personnel per 100,000 population
	Q2.45	Number of mental health practitioners per 100,000 population
	Q2.46	Suicide rate per 100,000 population
	Q2.47	Transportation fatalities per 100,000 population
	Q2.48	Percentage of children (36-59 months) receiving at least one year of a quality pre-primary education program
	Q2.49	Early Child Development Index (ECDI)
	Q2.50	Primary completion rates for girls and boys
	Q2.51	Percentage of girls and boys who master a broad range of foundational skills, including in literacy and mathematics by the end of the primary school cycle (based on credibly established national benchmarks)
	Q2.52	Secondary completion rates for girls and boys
	Q2.53	Percentage of girls and boys who achieve proficiency across a broad range of learning outcomes, including in literacy and in mathematics by end of lower secondary schooling cycle (based on credibly established national benchmarks)
	Q2.54	Tertiary enrollment rates for women and men
	Q2.55	Percentage of students completing primary education : survival rate
	Q2.56	Percentage of students completing secondary education : survival rate
	Q2.57	Primary education student / teacher ratio
	Q2.58	Percentage of male school-aged population enrolled in schools
	Q2.59	Percentage of school-aged population enrolled in schools
	Q2.60	Number of higher education degrees per 100,000 population
	Q2.61	Prevalence of girls and women 15-49 who have experienced physical or sexual violence [by an intimate partner] in the last 12 months
	Q2.62	Percentage of referred cases of sexual and gender-based violence against women and children that are investigated and sentenced
	Q2.63	Percentage of women aged 20-24 who were married or in a union before age 18
	Q2.64	Percentage of girls and women aged 15-49 years who have undergone FGM/C
	Q2.65	Average number of hours spent on paid and unpaid work combined (total work burden), by sex
	Q2.66	Percentage of seats held by women and minorities in national parliament and/or sub-national elected office according to their respective share of the population (modified MDG Indicator)
	Q2.67	Met demand for family planning (modified MDG Indicator)
	Q2.68	Percentage of female school-aged population enrolled in schools
	Q2.69	Women as a percentage of total elected to city-level office

	Q2.70	Percentage of women employed in the city government workforce
	Q2.71	Percentage of population using safely managed water services, by urban/rural (modified MDG Indicator)
	Q2.72	Percentage of population using safely managed sanitation services, by urban/rural (modified MDG Indicator)
	Q2.73	Percentage of wastewater flows treated to national standards [and reused]
	Q2.74	Indicator on water resource management
	Q2.75	Proportion of total water resources used (MDG Indicator)
	Q2.76	Percentage of city population served by wastewater collection
	Q2.77	Percentage of the city's wastewater that has received no treatment
	Q2.78	Percentage of the city's wastewater receiving primary treatment
	Q2.79	Percentage of the city's wastewater receiving secondary treatment
	Q2.80	Percentage of the city's wastewater receiving tertiary treatment
	Q2.81	Percentage of city population with potable water supply service
	Q2.82	Percentage of city population with sustainable access to an improved water source
	Q2.83	Percentage of population with access to improved sanitation
	Q2.84	Total domestic water consumption per capita (litres / day)
	Q2.85	Total water consumption per capita (litres / day
	Q2.86	Average annual hours of water service interruption per household
	Q2.87	Percentage of water loss (unaccounted for water)
	Q2.88	Access to all-weather road (% access within [x] km distance to road)
	Q2.89	Mobile broadband subscriptions per 100 inhabitants, by urban/rural
	Q2.90	Index on ICT maturity
	Q2.91	Manufacturing value added (MVA) as percent of GDP
	Q2.92	Total energy and industry-related GHG emissions by gas and sector, expressed as production and demand-based emissions (tCO2e)
	Q2.93	Personnel in R&D (per million inhabitants)
	Q2.94	Average number of electrical interruptions per customer per year
	Q2.95	Average length of electrical interruptions (in hours)
	Q2.96	Number of firefighters per 100,000 population
	Q2.97	Number of volunteer and part-time firefighters per 100,000 population
	Q2.98	Response time for emergency response services from initial call
	Q2.99	Response time for fire department from initial call
	Q2.100	Number of internet connections per 100,000 population
	Q2.101	Number of cell phone connections per 100,000 population
	Q2.102	Number of landline phone connections per 100,000 population
	Q2.103	Kilometres of high capacity public transport system per 100,000 population
	Q2.104	Kilometres of light passenger public transport system per 100,000 population
	Q2.105	Annual number of public transport trips per capita
	Q2.106	Number of personal automobiles per capita
	Q2.107	Percentage of commuters using a travel mode to work other than a personal vehicle
	Q2.108	Number of two-wheel motorized vehicles per capita
	Q2.109	Kilometres of bicycle paths and lanes per 100,000 population
	Q2.110	Commercial air connectivity (number of non-stop commercial air destinations
	Q2.111	Violent injuries and deaths per 100,000 population
	Q2.112	Number of refugees
	Q2.113	Proportion of legal persons and arrangements for which beneficial ownership information is publicly available
	Q2.114	Revenues, expenditures, and financing of all central government entities are presented on a gross basis in public budget documentation and authorized by the legislature
	Q2.115	Percentage of children under age 5 whose birth is registered with a civil authority
	Q2.116	Existence and implementation of a national law and/or constitutional guarantee on the right to information
	Q2.117	Perception of public sector corruption
	Q2.118	Debt service ratio (debt service expenditure as a percentage of a municipality's own-source revenue)
	Q2.119	Capital spending as a percentage of total expenditure
	Q2.120	Own-source revenue as a percentage of total revenues
	Q2.121	Tax collected as a percentage of tax billed
	Q2.122	Voter participation in last municipal election (as a percentage of eligible voters)
	Q2.123	Number of convictions for corruption and / or bribery by city officials per 100,000 population
	Q2.124	Citizens' representation : number of local officials elected to office per 100,000 population
	Q2.125	Number of registered voters as a percentage of the voting age population
	Q2.126	Violent crime rate per 100,000 population

Q3	Q3.1	Domestic revenues allocated to sustainable development as percent of GNI - by sector
Eco.	Q3.2	Assessed value of commercial and industrial properties as a percentage of total assessed value of all properties
	Q3.3	Proportion of population below $1.25 (PPP) per day (MDG Indicator)
	Q3.4	Proportion of population living below national poverty line, by urban/rural (modified MDG Indicator)
	Q3.5	Multidimensional Poverty Index
	Q3.6	Percentage of eligible population covered by national social protection programs
	Q3.7	Percentage of women, men, indigenous peoples, and local communities with secure rights to land, property, and natural resources, measured by (i) percentage with documented or recognized evidence of tenure, and (ii) percentage who perceive their rights are recognized and protected.
	Q3.8	Losses from natural disasters, by climate and non-climate-related events (in US$ and lives lost)
	Q3.9	Total fertility rate
	Q3.10	Percentage of city population living in poverty
	Q3.11	Share of the population using modern cooking solutions, by urban/rural
	Q3.12	Share of the population using reliable electricity, by urban/rural
	Q3.13	Implicit incentives for low-carbon energy in the electricity sector (measured as US$/MWh or US$ per ton avoided CO2)
	Q3.14	Rate of primary energy intensity improvement
	Q3.15	Total residential electrical energy use per capita (kWh / year)
	Q3.16	Percentage of city population with authorized electrical service
	Q3.17	Energy consumption of public buildings per year (kWh / m2)
	Q3.18	The percentage of total energy derived from renewable sources, as a share of the city's total energy consumption
	Q3.19	Total electrical energy use per capita (kWh / year)
	Q3.20	GNI per capita (PPP, current US$ Atlas method)
	Q3.21	Country implements and reports on System of Environmental-Economic Accounting (SEEA) accounts
	Q3.22	Youth employment rate, by formal and informal sector
	Q3.23	Ratification and implementation of fundamental ILO labor standards and compliance in law and practice
	Q3.24	City's unemployment rate
	Q3.25	Percentage of persons in full-time employment
	Q3.26	Youth unemployment rate
	Q3.27	Jobs / housing ratio
	Q3.28	Indicator on inequality at top end of income distribution: GNI share of richest 10% or Palma ratio
	Q3.29	Percentage of households with incomes below 50% of median income ("relative poverty")
	Q3.30	Domestic revenues allocated to sustainable development as percent of GNI, by sector
	Q3.31	Official development assistance and net private grants as percent of GNI
	Q3.32	Private net flows for sustainable development at market rates as share of high-income country GNI, by sector
	Q3.33	Annual report by Bank for International Settlements (BIS), International Accounting Standards Board (IASB), International Financial Reporting Standards (IFRS), International Monetary Fund (IMF), World Intellectual Property Organization (WIPO), and World Trade Organization (WTO) [other organizations to be added] on the relationship between international rules and the SDGs and the implementation of relevant SDG targets
	Q3.34	Share of SDG Indicators that are reported annually
	Q3.35	Evaluative Wellbeing and Positive Mood Affect
	Q3.36	Number of new patents per 100,000 population per year

Reference: 1) SDSN: Indicators and a Monitoring Framework for the Sustainable Development Goals, 2015
2) ISO 37120:2014(E): Sustainable development of communities - Indicators for city services and quality of life, 2014

3.4.3 Weighting coefficient

In the CASBEE-City (Pilot version for worldwide use), based on the universal concept that any city seeks balanced, triple bottom line sustainability, weighting coefficients for the major assessment items (that is, Q1: Environment, Q2: Society and Q3: Economy) are equally set. In cases where multiple mid-level/minor items exist, weighting coefficients within such groups are equally set. However, weighting coefficients may be adjusted to suit the specific circumstances of each city.

3.4.4 Scoring method

Items are evaluated on a scale of 1.0 to 5.0 using an assessment index established for each item based on data such as statistics. The score scale, either in ascending or descending order, is set based on item-specific assessment results from all municipalities. As a general rule, each level (1-2, 2-3, 3-4 and 4-5) includes 25 percent of the number of municipalities.

3.4.5 BAU of Q (tendency value)

As many assessment items of Q are expressed by indices on a per-capita basis, the calculation is based on the idea that Q_{BAU} is equal to $Q_{Current}$ value. This means that the basic unit stays constant in the future unless special measures are taken. Assessors are also able to set their own BAU value if they have a more specific BAU value based on their own calculations.

3.4.6 Degree of operability used in future Q assessment

Degree of operability for the future quality target ΔQ for each item (Xi value described in 3.2) is determined by evaluating the degree of conformance in a municipality for the three items shown in Table Ⅰ.3.2.

Table Ⅰ.2. Degree of operability of the future target value

Check item	Number of items checked	Degree of operability
(1)Specific policies are established for achieving goals. (2)Simple and comprehensible explanatory materials regarding the credibility of the target values from the perspective of a third party are prepared. (3)Target values have been or will be made public.	0	0.5
	1	1.0
	2	
	3	

3.5 Assessment items for L

3.5.1 Basic idea regarding L

Assessment of environmental load (L) in CASBEE-City is limited to greenhouse gas emissions. Greenhouse gas emissions are converted into their carbon dioxide equivalents and evaluated based on annual greenhouse gas emissions per capita (t-CO2/person/year) in order to ensure a fair assessment regardless of the population size.

3.5.2 Structure of L assessment items

Assessment of L is conducted based on the assessment item shown in Table I.3.

Table Ⅰ.3. Assessment items for L

Items		Indicators
Major	Sub	
L	-	Annual CO2 emissions per capita

3.5.3 BAU value of L (tendency value)

L_{BAU} is estimated on the assumption that the efficiency of energy-consuming devices is generally maintained at the current level.

3.5.4 Degree of operability for future environmental load assessment

The degree of operability for the future load target ∆ L (Xj value described in 3.2) is determined by evaluating the number of low-carbon measurements and actions in two categories: government commitments and non-government commitments listed in Table I.3.5.1. The total number of applicable items on the list that are in place or under development is then converted to a score on a scale of 0.0 to 1.0 using Table I.3.5.2 to express the degree of operability (Xj).

Each action that has been implemented is counted as 1, and those that have been planned but have yet to be implemented are each given as 0.5. Those that fall under neither of the two are placed in a separate free description space in which the city's unique efforts can be described.

Table Ⅰ.4. List of measures, policies and efforts to be implemented for achieving goals

Item	Policy
Commitment of the local government	
(1) Completing the new action plan	- The implementation period of the plan includes the assessment year.
(2) Formulating a master plan and a medium- and long-term vision for achieving medium- and long-term goals stipulating a budget, timing and organization in charge	- The implementation period of the plan must include the assessment year AND the plan is to stipulate appropriate details.
(3) Setting controllable numerical targets, conducting ongoing monitoring and publishing it once or more a year	- The system, staff and budget required for implementing the target management, monitoring and publication should be secured. - Items subject to the monitoring should account for a certain proportion of the total emissions or the total reduction (that is, 50% or more).
(4) Establishing a promotion committee or town meeting consisting of public administration, citizens, companies and universities, and holding them twice or more a year	- The group should be well balanced, the members of which include people from different major backgrounds including the government, citizens, companies, universities and NPOs.
(5) Holding an environmental seminar for citizens and businesses twice or more a year	- Environmental seminars and workshops are held with appropriate frequency
(6) Lessons or programs regarding environmental education are included in the curriculum for elementary schools, junior high schools and high schools.	- Learning opportunities for environmental issues and corporate efforts are provided. - Environmental education lessons with people from outside the school such as companies or local communities as lecturers should be organized.
(7) Setting a public comment period before major decisions regarding budget or timing	- A public comment period for global warming initiatives has been held during the past few years, or is being planned for the assessment year.
(8) Other (unique measures that reflect local characteristics)	- To be specified if available (shown in "Environmental considerations in policymaking" on the Assessment Results Sheet included in the tool)
Commitment of nongovernmental organizations	
(1) Having an accurate monitoring system including direct data collection from each household and the promotion of BEMS and HEMS	- Items subject to monitoring account for a set percentage of GHG emissions targeted for reduction (for example, 30% or more).
(2) Personal goals and action plans for private companies, NPOs and individuals in the city are included	- Objectives of the new action plan reflect independent targets and action plans of residents and businesses.
(3) Intellectual contributions from research institutes and universities in the city are included	- A collaborative framework with research institutes or universities is in place and a project review and follow-up are conducted.
(4) Having commitments of nonlocal organizations including energy-saving activities and the promotion of carbon sinks by companies and NPOs operating in a wide area	- A framework for cooperation with organizations having a base outside the city should be established, such as companies and NPOs conducting activities in a wide area, the activities of which include energy-saving campaigns and the promotion of carbon sinks.
(5) Other (Special efforts utilizing characteristics of the local area)	- To be specified if available (shown in "Environmental considerations in policymaking" on the Assessment Results Sheet included in the tool)

Table Ⅰ.5. Correspondence table of the number of measures, policies, efforts and the degree of operability (Xj)

Number of actions implemented (Plans which are not yet implemented are given 0.5; the total number is rounded to the first decimal place)	Xj
Implementing 9 or more actions in the relevant section	1.0
Implementing 7 actions in the relevant section	0.7
Implementing 5 actions in the relevant section	0.5
Implementing 3 actions in the relevant section	0.3
Number of actions implemented is less than 3	0

3.6 Calculations of Q and L scores and BEE

3.6.1 Calculation of quality (Q) score

CASBEE adopts a “relative assessment system” and a city is assessed by each indicator on a 1-5 points scale. 1 point is given to the city with the worst level in the world, 3 points for the city with an average level and 5 points for the city with the best level in the world. These scores are then multiplied by a weighting coefficient and SQ (Score for Q, 1-5 points scale) is obtained. Calculation of the total built environmental efficiency (BEE) score requires Q scores on a scale of up to 100 for the numerator and the denominator. To do this, the SQ value is first subtracted by 1 and then multiplied by 25.

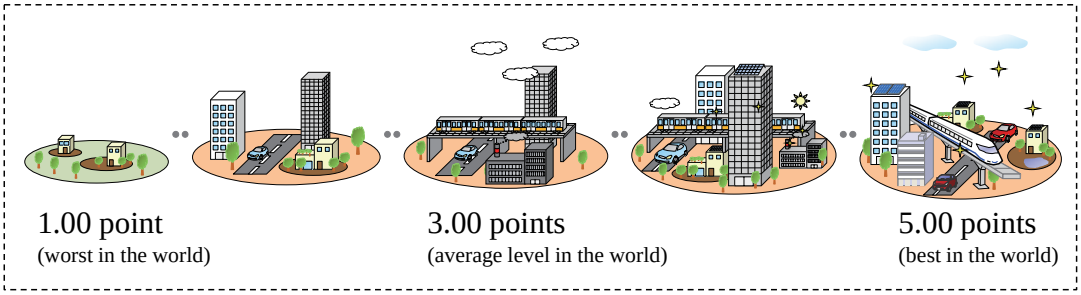


Figure Ⅰ.7 Calculation of quality (Q) score

3.6.2 Calculation of environmental load (L) score

Index values are obtained by calculating annual greenhouse gas emissions per capita (t-CO_2/person/year). Then a total score for L on a scale of 0 to 100 is calculated by applying a logistic function where the global emissions average per capita (approximately 5t-CO_2/person/per year) is represented as a median value of 50.

The score for LR (Load Reduction=100-Score for L) is also calculated on a scale of 1.0 to 5.0 and represented in a bar chart along with the Q item scores.

3.6.3 Calculation of built environmental efficiency (BEE)

Built environment efficiency (BEE) is calculated using the following formula containing the aforementioned total Q and L scores on a 100-point scale.

$$\mathrm{BEE} = \frac{\text{Score for Q}}{\text{Score for L}}$$

4. Assessment procedure

4.1 Structure of assessment tool

A general-purpose spreadsheet tool for CASBEE-City allows users to easily enter wide-ranging data and then automatically generates assessment results. The Main Sheet, Score Sheet and Assessment Results Sheet are some of the key sheets included in the tool.

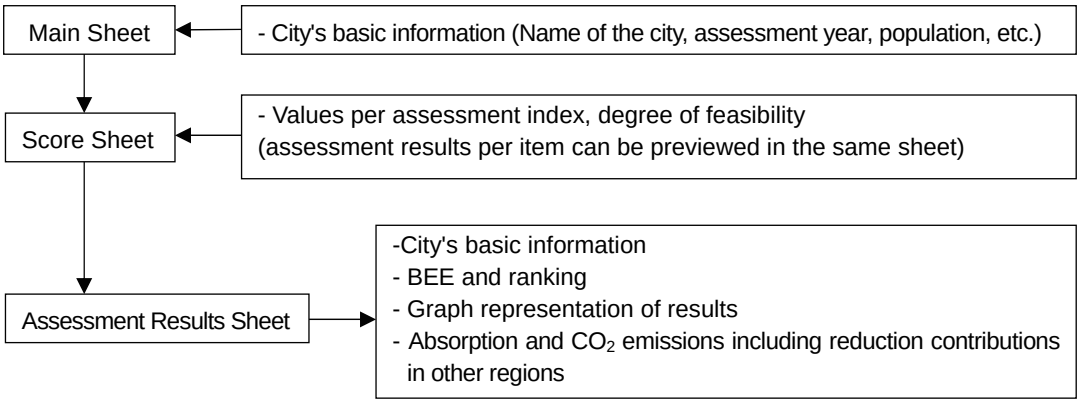


Figure Ⅰ.8. Overall configuration of Assessment Tool

4.2 Main sheet

The Main sheet is used to enter information required for the assessment including the city overview by the assessor. After the appropriate region is selected, the assessor selects the municipality to be assessed and enters the year of assessment.

4.3 Score sheet

The Score Sheet is used to enter various data and assessment results for Q1 to Q3 and to preview L by the assessor. Index values entered in white cells are used to calculate scores per item.

The tool is linked to a statistical database that contains publicly available figures. To perform a current status assessment, various index values are automatically filled by selecting a municipality. The assessor may modify such default values in white cells if necessary. For future status assessment, target values and BAU (Business As Usual: no particular measure taken) values should be inputted.

4.4 Assessment results sheet

The Assessment results sheet shows figures and graphs representing the assessment results of Q (the quality inside the city), L (the environmental load of the city) and BEE (the Built Environment Efficiency of the city). The assessment results of CASBEE-City can be easily recognized at a glance, as all the related information about the city subject to assessment is condensed into one sheet.

Under the top section, the outline of the city subject to assessment and its assessment results are shown, which is divided into the following four blocks of (1) to (4):

(1) “1 Basic information including location of the city”
The city’s overall information, such as the name of the municipality, location, population and land area, is automatically displayed.
(2) “2 Built Environment efficiency”
The current value and the future estimated value of BEE (Built Environment Efficiency) derived from the assessment results of Q (the quality inside the city) and L (the environmental load of the city) are shown in section 2. The graph represents the BEE value by plotting Q on the y axis and L on the x axis, the value of which is expressed by the gradient of the straight line connecting the origin (Q＝0, L ＝0) and the coordinate point of the Q value and L value. The higher the total Q score and the lower the total L score, the steeper the gradient becomes, which reflects the city's high propensity for sustainability.
Dividing the graph area into five zones, CASBEE ranks the city's overall environmental efficiency as S (excellent), A, B+, B- or C (Poor). Each of the five ranks has the corresponding number of □ symbols, and the current value written in black on a dark blue background and the future value written in red on a light blue background are arranged one above another so that the information on the screen can be easily recognized at a glance.
(3) “3 Assessment results for main items”
A bar chart collectively representing the scores of Q1 to Q3 and L is placed in section 3, in which features of the city’s environment-related efforts can be recognized immediately. The color scheme for the current and future values is the same as that of section 2.
(4) “4 Assessment results for each goal”
Assessment results are aggregated for each of the UN’s 17 SDGs (Sustainable Development Goals) and presented on a radar chart, so that the assessors can easily understand the progress of their cities toward achieving a real sustainable future.

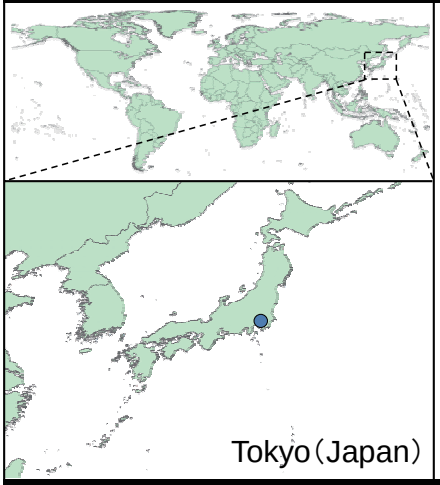
Assessment Result

Tokyo

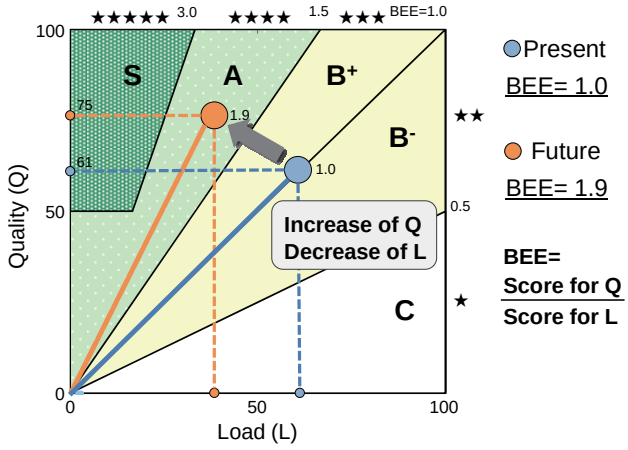
CASBEE-City
- Pilot version for worldwide use -

Population: 9,077,177

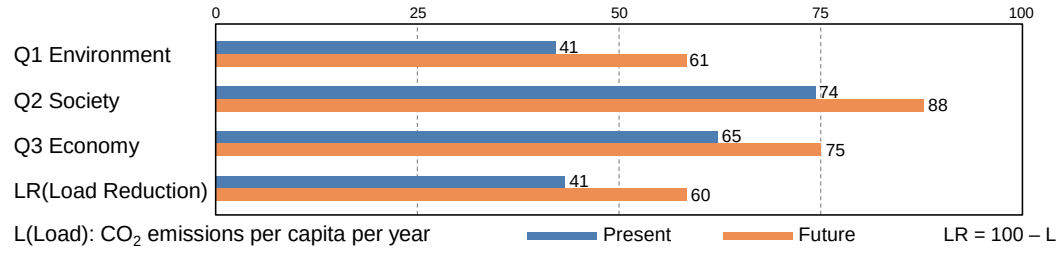
1. Location



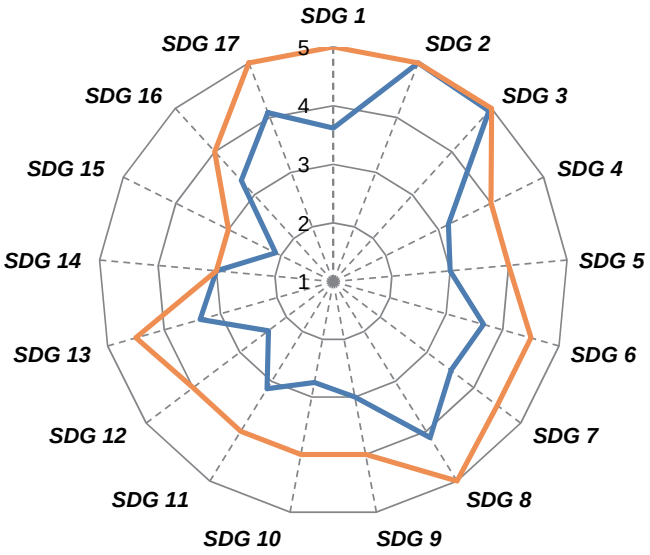
2. Built Environment Efficiency (BEE chart)



3. Assessment results for main items (bar chart)



4. Assessment results for each SDG (radar chart)



SDG 1. NO POVERTY
SDG 2. ZERO HUNGER
SDG 3. GOOD HEALTH AND WELL-BEING
SDG 4. QUALITY EDUCATION
SDG 5. GENDER EQUALITY
SDG 6. CLEAN WATER AND SANITATION
SDG 7. AFFORDABLE AND CLEAN ENERGY
SDG 8. DECENT WORK AND ECONOMIC GROWTH
SDG 9. INDUSTRY, INNOVATION AND INFRASTRUCTURE
SDG 10. REDUCED INEQUALITIES
SDG 11. SUSTAINABLE CITIES AND COMMUNITIES
SDG 12. RESPONSIBLE CONSUMPTION AND PRODUCTION
SDG 13. CLIMATE ACTION
SDG 14. LIFE BELOW WATER
SDG 15. LIFE ON LAND
SDG 16. PEACE AND STRONG INSTITUTIONS
SDG 17. PARTNERSHIPS FOR THE GOALS

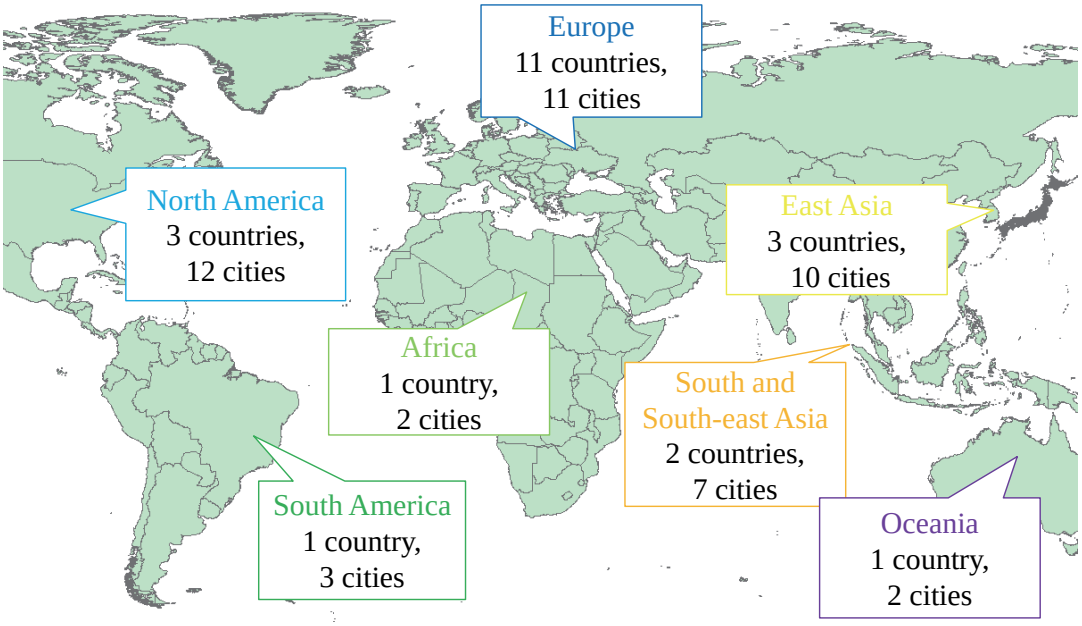
Note: Each SDG corresponds to UN's Sustainable Development Goals

Figure Ⅰ.9 Assessment results sheet

PART Ⅱ Case study

1. Assessments of major world cities

Assessments of major world cities were conducted using CASBEE-City (Pilot version for worldwide use) to validate the tool's effectiveness and its feasibility. The following figure shows the assessed cities and the results. Assessors can use the tool to understand the actual condition of their cities in comparison with other cities in the world.



▷ World 47 cities (22 countries) are assessed using CASBEE-City

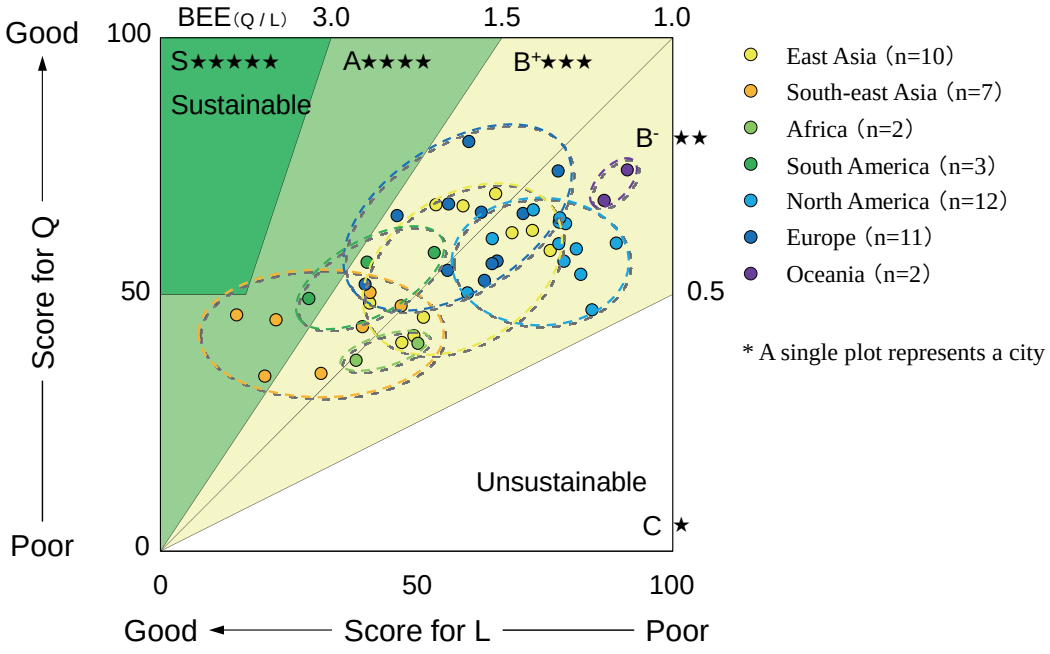


Figure Ⅱ.1 Assessment results of cities around the world using CASBEE-City (Worldwide use version)

2. Assessment of entire municipalities in Japan

CASBEE-City (Pilot version for worldwide use) can be customized (localized) to reflect local context. The following figure shows an example of assessing entire municipalities in the country using CASBEE-City (localized version for Japanese cities). Such assessment supports assessors in identifying which parts of their country are facing difficulties and require support for sustainable development.

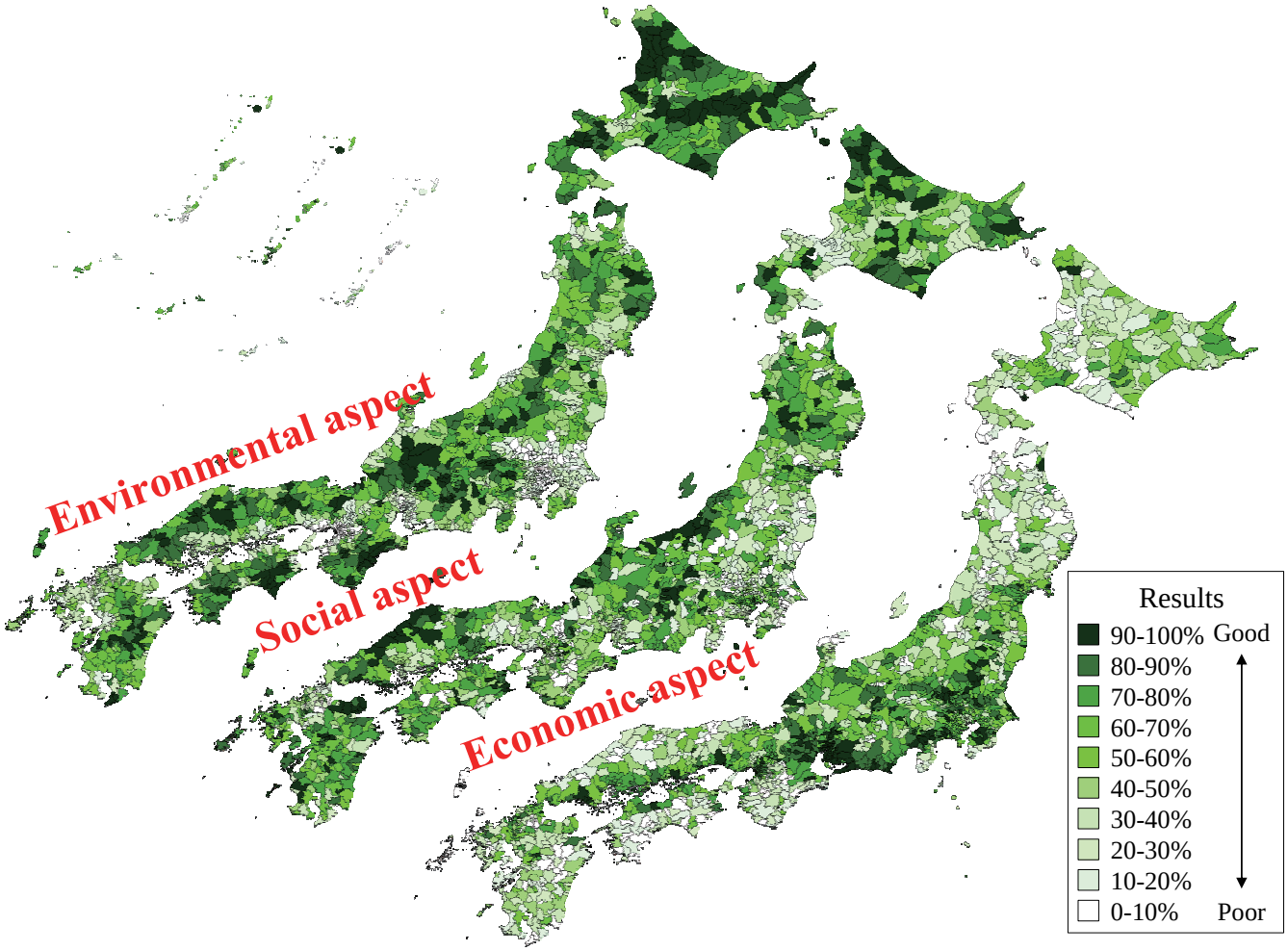
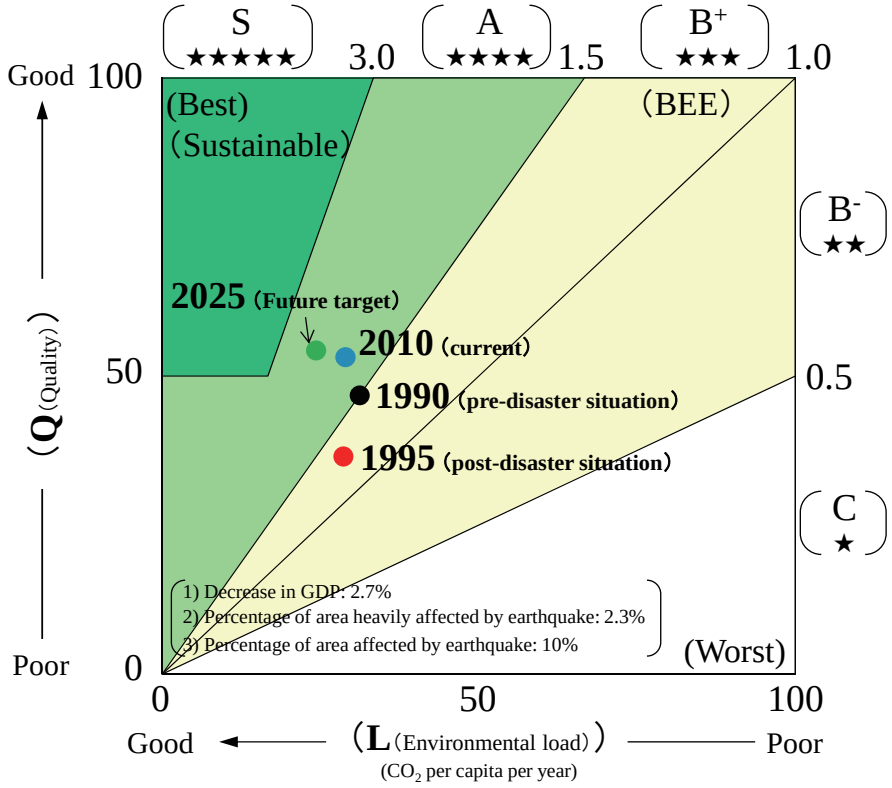
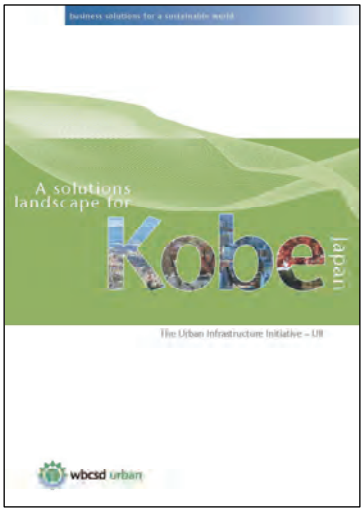


Figure Ⅱ.2 Assessment results of entire municipalities in Japan using CASBEE-City (Japanese standard version)

3. Assessment of Kobe after huge disaster in 1995

CASBEE-City can be used to monitor the effort and progress toward achieving a sustainable future by enabling assessors for time series assessment. The following figure shows the example time series assessment by using the CASBEE-City tool. A catastrophic earthquake, the Great Hanshin-Awaji Earthquake, hit Kobe in 1995 and caused widespread damage to the city. However, the city of Kobe implemented various recovery measures soon after the earthquake and achieved a great recovery. This recovery process was assessed and visualized by using CASBEE-City tool. Assessors can use the tool to monitor the change in city conditions in this manner as shown in the case study.





English report available at:

http://www.wbcsd.org/uiikobereport.aspx

Figure Ⅱ.3 Results of time series assessment for Kobe city using CASBEE-City (Japanese standard version)

Afterword

This publication is developed by the Committee for the Development of an Environmental Performance Assessment Tool for Cities (chaired by Shuzo Murakami, Chief Executive of the Institute of Building Environment and Energy Conservation), established with the support of the Ministry of Land, Infrastructure and Transport and led by the Institute for Building Environment and Energy Conservation (IBEC). We hope this information will be used in a wide range of fields and makes an important contribution in building a sustainable society.

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