CASBEE® for Cities

Comprehensive Assessment System for Built Environment Efficiency

●Technical Manual (2012 Edition)

The Committee for the Development of
an Environmental Performance Assessment Tools for Cities

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Indemnity

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Introduction

In view of the global trend in environmental issues and with the Conference of Parties (COP) “Countermeasures against greenhouse gases and promotion of a society-wide effort toward a low-carbon future” as a yardstick, many countries are facing serious policy challenges. In order to deal with these challenges, a method for a comprehensive assessment of environmental performance at the municipal level is considered effective, but such a method has yet to be established.

In Japan, the government-led Eco Model City Project began in 2008. In addition to the eco model cities, other motivated communities and related organizations have also participated in the establishment of the Promotion Council for the Low Carbon Cities in December 2008, in which individual cities and communities are seeking a way toward eco-friendly future development while demonstrating their own potential. Examples of such movements can be found in cities selected for the FutureCity Initiatives in December 2011.

In this regard, a framework for measuring and evaluating the effectiveness of the policies and activities taken by the individual cities would be very helpful for the many people who are involved in activities relating to citizens, public administration and other cities, in order to share a sense of purpose in creating the ideal future city.

Consequently, the Committee for the Development of an Environmental Performance Assessment Tools 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 among people engaged in construction-related businesses as an environmental performance assessment tool for buildings.

The new city assessment tool also focuses on evaluating cities from two perspectives; quality inside a city (Q = quality) and environmental load emitted from a city on the external environment (L = load), in accordance with the principle of the conventional CASBEE. Assessment items are carefully studied from various aspects in a comprehensive manner, whereas, in light of the urgent and important task of promoting a low-carbon society, L consists of items particularly focusing on a clear assessment of low-carbon policies of individual cities.

In developing this tool, the Committee has been working closely with the Working Group for Promotion of Measures for Low-carbon City or Region established under the aforementioned Promotion Council for the Low Carbon Cities in order to thoroughly review implementation issues (the council was renamed the Committee for the Promotion of the FutureCity Initiative in May 2012).

We have now compiled and released the “CASBEE-City (2012 Edition)” assessment manual to be used as a technical guideline.

Assessment indicators in this manual consist of publicly-available statistics by municipalities. While the manual focuses on cities in Japan, its basic concept 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.

July 2012
Shuzo Murakami
Chairman of the Committee for the Development
of an Environmental Performance Assessment Tools 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 building from the two aspects of environmental 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 assessment and CASBEE-City for environmental assessment at the urban scale. These are collectively known as the CASBEE Family.

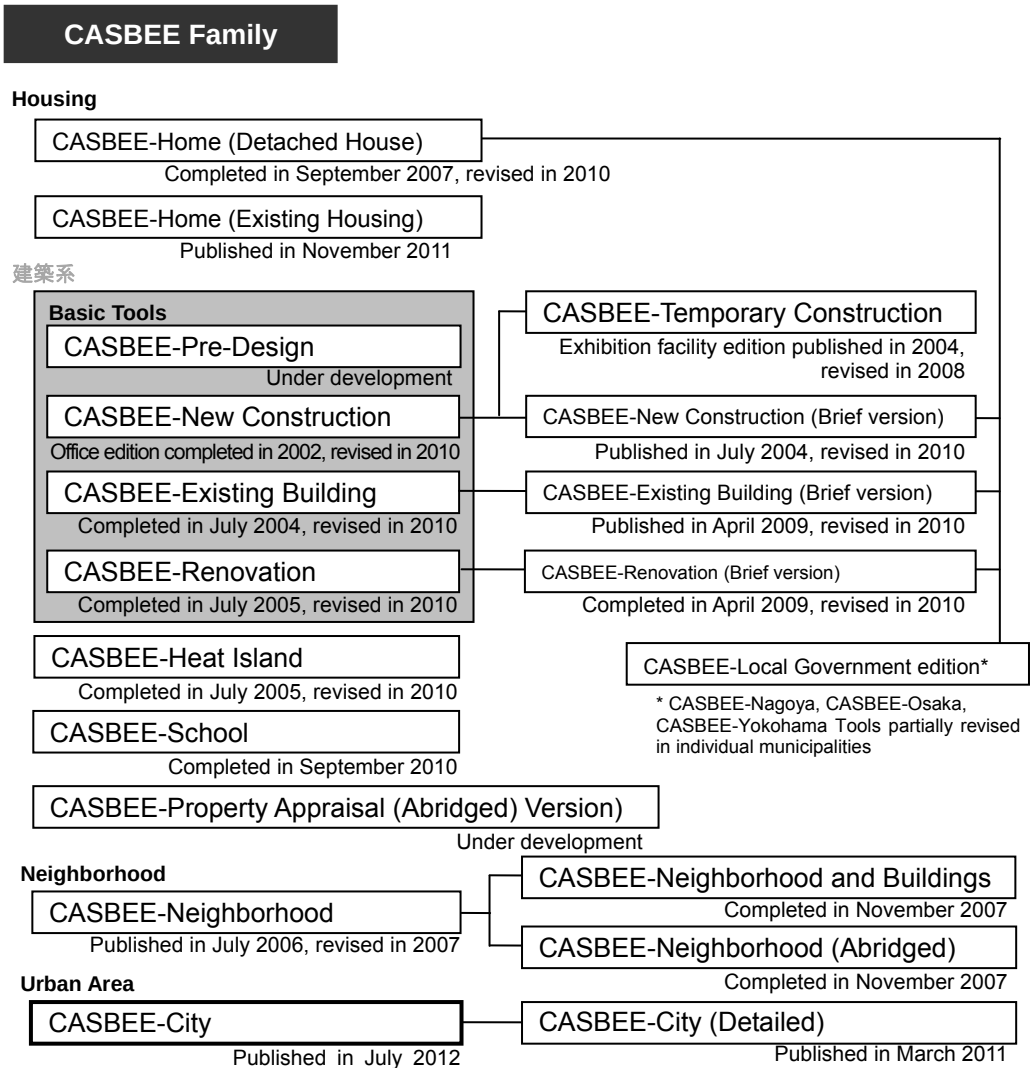


Figure Ⅰ.1.1 CASBEE Family

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.

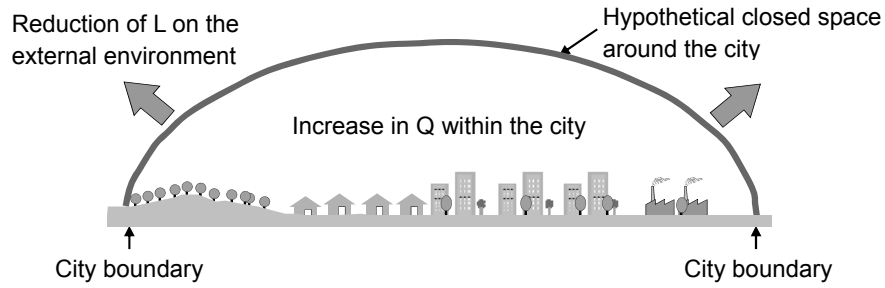


Figure Ⅰ.2.1 Concept of a hypothetical closed space in CASBEE-City

2.1.2 CASBEE-City Manuals: Standard Version and Detailed Version (published in March 2011)

Since the publication of the first CASBEE-City in March 2011, there has been a steady increase in users, such as municipalities participating in the Promotion Council for the Low Carbon Cities (administered by the Cabinet Secretariat Office for Promotion of Regional Revitalization). As a result, the following improvements have been implemented:

(1) Simplified administration through use of publicly-available statistics and database compilation
(2) Improved profiling of quality data analysis (ΔQ: changes in quality before/after an implementation of initiatives by the municipality)
(3) Accurate assessment of CO_2 reductions regardless of fluctuation in CO_2 absorption assessed under L performance

With these improvements, the new CASBEE-City manual is considered to be the standard version, and the existing 2011 manual is now used as the detailed version.

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 sides. 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 Q by L, in order to express the environmental performance of the city in a comprehensive manner. When starting calculation, total scores of L and Q 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 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.

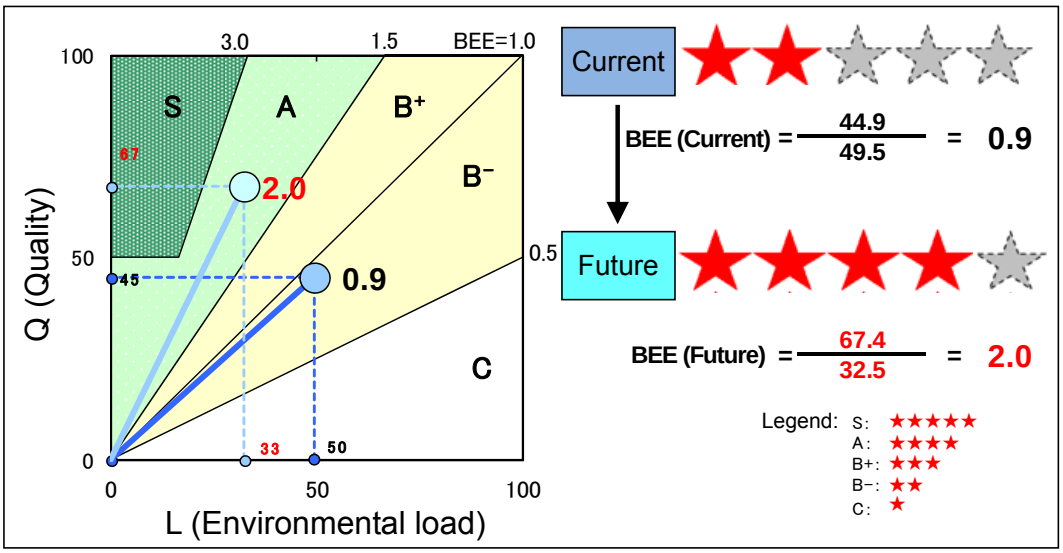


Figure Ⅰ.2.2 BEE chart

2.3 Current assessment and future assessment

As seen in arguments made in conferences including COP, individual countries have been seeking a way to substantially reduce CO_2 emissions over the medium and long term, while implementing measures having an immediate effect on the current situation. CASBEE-City adopts an assessment method focusing of future prediction in consideration of a proper response to arguments on the framework of the Kyoto Protocol and the Post-Kyoto Protocol. 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.

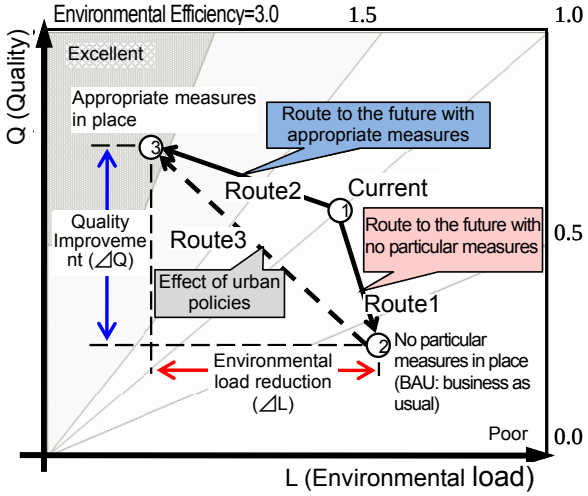


Figure Ⅰ.2.3 Positions of the current assessment and future assessment on a BEE chart

(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 (⊿Q) and reduction of environmental load (⊿L), which represent the policy assessment. Therefore, the two-dimensional 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 At 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, generally that of 2010. 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. The tool contains a statistical database in order to perform current assessment automatically.

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).

Note 1: Please refer to 3.3 regarding how to address current and future situations in terms of population data.

Note 2: Please refer to 3.4 and 3.5 regarding the BAU value. As methods to establish BAU values vary depending on assessment items, the operational procedures for the assessment tool should be followed (for further details, please refer to Commentaries and Information).

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,

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

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

Furthermore,

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

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

i : Number corresponding to minor items in Q

$\triangle Qi$: 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 items in L

⊿Lj : 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.

3.3.1 Adjusted population

When using an index on a per-capita basis, it is necessary to take account of the fact that, if the total population (= the nighttime population) is used, the values calculated per capita will be extremely high in inner urban areas of large cities with a large day and nighttime population ratio. On the other hand, the various activities of a city are obtained as a sum of economic activities mainly conducted during the day and everyday activities mainly in the nighttime. In order to define the amount of activities representing the day and nighttime activities in a simple manner, the daytime population and the nighttime population are obtained separately, and the adjusted population is defined as shown in the formula below, which is the basis of per-capita emissions.

[Adjusted population] = ([Daytime population] + [Nighttime population])/2

Daytime and nighttime (i.e. total) population figures are as per the national census.
Latest indices for the numerator in the calculation of per-capita value of the adjusted population may not be available for some items. In order to simplify the process, the adjusted population based on the most recent census data is used.

3.3.2 Estimated future population

Future nighttime population (i.e. total population) is estimated based on the estimated future population (the average variant) per municipality for specific years calculated by the Japanese National Institute of Population and Social Security Research. Future daytime population is estimated by multiplying the estimated future total population by the current daytime-to-nighttime population ratio of the most recent census data).

However, a unique calculation method of the city may be used under certain conditions including cases in which the city has set its own future population target.

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 only.

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 minor category 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 minor category items, the major category items, and all items, respectively, in order to derive assessment values. In cases where data for sub-category items are not available, national average values are applied.

Table Ⅰ.3. 1 Q Assessment Items

Major category	Minor category	Sub-category
Q1 Environmental aspects	Q1.1 Nature conservation	Q1.1.1 Ratio of green and water spaces
	Q1.2 Local environmental quality	Q1.2.1 Air
		Q1.2.2 Water
	Q1.3 Resources recycling	Q1.3.1 Recycling rate of general waste
	Q1.4 CO_2 absorption	Q1.4.1 CO_2 absorption by forests
Q2 Social aspects	Q2.1 Living environment	Q2.1.1 Adequate quality of housing
		Q2.1.2 Traffic safety
		Q2.1.3 Crime prevention
		Q2.1.4 Disaster preparedness
	Q2.2 Social services	Q2.2.1 Adequacy of education services
		Q2.2.2 Adequacy of cultural services
		Q2.2.3 Adequacy of medical services
		Q2.2.4 Adequacy of childcare services
		Q2.2.5 Adequacy of services for the elderly
	Q2.3 Social vitality	Q2.3.1 Rate of population change due to births and deaths
		Q2.3.2 Rate of population change due to migration
Q3 Economic aspects	Q3.1 Industrial vitality	Q3.1.1 Amount equivalent to gross regional product
	Q3.2 Financial viability	Q3.2.1 Tax revenues
		Q3.2.2 Outstanding local bonds
	Q3.3 Emission trading	Q3.3.1 Contribution in CO_2 reduction in other regions

3.4.3 Weighting coefficient

In the standard version of CASBEE-City, based on the universal concept that any city seeks a balanced, triple bottom line sustainability, weighting coefficients for the major assessment items (i.e. 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 specific circumstances of each city.

3.4.4 Scoring method

Minor 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 including the adjusted population and the population by age bracket, 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.

However, as for assessment items of Q2 expressed in an index on a per-capita basis, representing data related to the size of the facility, in the medium term, Q_{BAU} is calculated based on the idea that the size of the facility stays the same unless special measures are taken, which is realistic. In this case, the result of Q_{BAU} differs from the $Q_{Current}$ situation as the future population fluctuates depending on the forecast.

Some of the economic indices of Q3 calculate Q_{BAU}, reflecting the nationwide decreasing tendency of the working-age population, because the total amount is expected to decrease nationwide as the working-age population decreases toward the future.

3.4.6 Degree of Operability used in Future Q Assessment

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

Table Ⅰ.3.2 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.	0	0.5
(2)Simple and comprehensible explanatory materials regarding the credibility of the target values from the perspective of a third party are prepared.	1	1.0
	2	
(3)Target values have been or will be made public.	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. The adjusted population described in 3.3.1 is applied for this calculation.

Assessment items are selected in view of the policy trend of the government regarding GHG emissions including the following:

(1) Mid- to long-term targets for GHG emission reduction set by the Government
(2) Kyoto Protocol Target Achievement Plan
(3) Eco-Model City/FutureCity Initiatives led by the Cabinet
(4) The Ministry of the Environment "Action Plan Manual for Global Warming Initiatives for Local Govenments: Regional Policies, First Edition" published in June 2009 (hereinafter "New Action Plan Manual")
(5) The Ministry of Environment "Action Plan Manual for Global Warming Initiatives for Local Governments: Regional Policies, First Edition: Abridged Version" published in August 2010 (hereinafter "New Action Plan Manual: Abridged Version")

3.5.2 Structure of L Assessment Items

This tool is basically in accordance with the new action planning manual, as shown in Table I.3.3. Please refer to 3.5.3 regarding the “Redistribution type” in the Table.

Table Ⅰ.3.3 Assessment items for L

Major item	Middle item	Minor item	Redistribution -type item
L1 CO2 emissions from energy sources	L1.1 Industrial sector	-	○
	L1.2 Residential sector	-	
	L1.3 Commercial sector	-	
	L1.4 Transportation sector	-	
L2 CO2 emissions from non-energy sources	L2.1 Waste and others	-	

3.5.3 Emitter-pays Principle and Beneficiary-pays Principle

When evaluating environmental load (L) in terms of GHG emissions, industrial cities are likely to receive a low score. It is certainly important that these industrial cities accept this fact and work on further reducing such emissions. On the other hand, the output of industrial cities is indispensable, as it contributes to the benefit of not only the cities themselves, but also the whole country. As such, a combination of two methods are used for assessment in CASBEE-City: method by emitter-pays principle, emissions calculated by geographic source where the emissions occur, while method by beneficiary-pays principle, emissions calculated by the consumption source of the products/services Please refer to Part Ⅱ.2.2.3 Emissions of industry-related sectors.

3.5.4 BAU value of L (Tendency Value)

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

3.5.5 Degree of Operability for Future Environmental Load Assessment

The degree of operability for the future load target ΔL (Xj value described in 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 Figure I.3.4. 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 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 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.3.4 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 mid- and long-term vision for achieving mid- 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 (i.e. 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 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 (e.g. 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.3.5 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

Distribution of the original index values are used to draw a cumulative relative frequency curve for each minor Q item. A base score is determined based on the continuous curve. An individual score on a scale of 1.0 to 5.0 is calculated by multiplying the base score by 4 and then adding 1. Scores of mid-level and major items are each obtained by weighting the corresponding minor item scores. Finally, an overall Q score (SQ) on a scale of 1.0 to 5.0 is calculated by multiplying the base score by 4 and then adding 1.

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 (for details, refer to PART II 1.1).

3.6.2 Calculation of Environmental Load (L) Score

For all mid-level L items described in 3.5.2 (i.e. emission sectors and area), index values are obtained by calculating annual greenhouse gas emissions per capita (t-CO_2/person/year) using the adjusted population. However, adding all the mid-level item values as is may result in the total L scores becoming too wide according to the city's characteristics. As such, a total score on a scale of 0 to 100 is calculated by applying a logistic function where the national emission average per capita (10t-CO_2/person/per year) is represented as a median value of 50.

Scores of the L items are also calculated on a scale of 1.0 to 5.0 and represented in a radar chart along with the Q item scores. While the median value corresponds to the 3.0 score, the L scores are represented on the reverse axis so to ensure the high scores' superiority.

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.

$$BEE = \frac{Q}{L} = \frac{25 \times (SQ - 1)}{L}$$

3.7 CO_2 Emissions including Reduction Contributions in Other Regions

In addition to CO_2 emissions evaluated in L, the CASBEE-City assessment also uses CO_2 absorption and contributions to CO_2 reduction in other regions as index values (both represented in t-CO_2/person/year).

Total emissions, taking into account of such absorption and reduction, are calculated and included in the Assessment Results Sheet as additional information on local characteristics.

4. Assessment procedure

4.1 Structure of Assessment Tool

A general-purpose spreadsheet tool for CASBEE-City allows users to enter wide-ranging data easily 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.

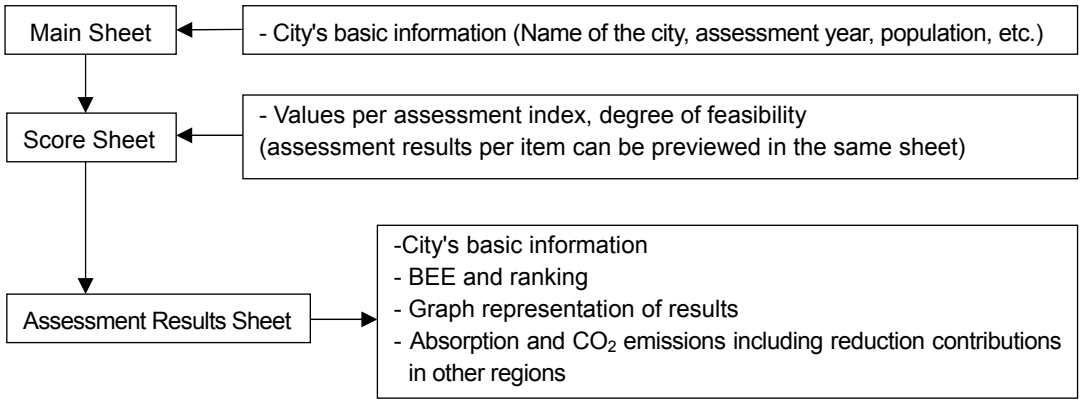


Figure Ⅰ.4.1 Overall configuration of Assessment Tool

4.2 Main sheet

The Main sheet is used to enter information required for the assessment including the city overview by the assessor, as shown in Figure 1.4.2.

After the appropriate prefecture is selected, the assessor selects the municipality to be assessed and enters the year of assessment. Once the assessment year is entered, a future population estimate is automatically filled in based on the forecast calculated by the Japanese National Institute of Population and Social Security Research. If needed, the appropriate corrections may be made.

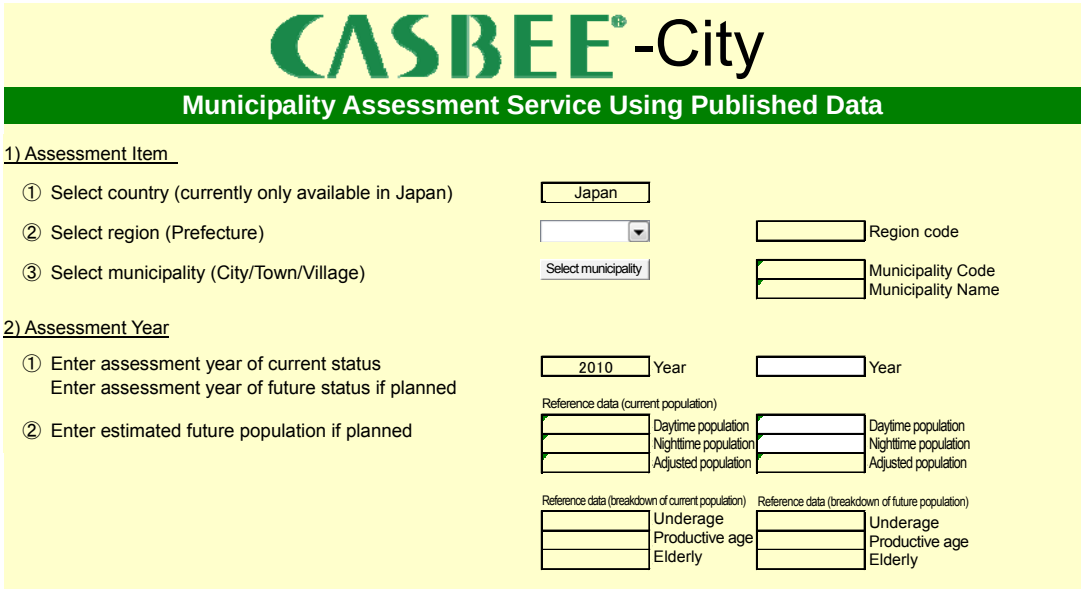


Figure Ⅰ.4.2 Main Sheet

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 which 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 are entered using current status values and automatically-calculated BAU (Business As Usual: no particular measure taken) values as reference. Furthermore, the future assessment also allows a degree of feasibility per item determined according to the check item list mentioned in 3.4.6 and 3.5.5.

CASBEE都市(2012年版)
Ver

スコア表示シート

評価項目	評価指標	現状（2010年度） 指標値	単位	スコア	重み係数	将来（2030年度） BAUの将来値	将来目標値	実現可能度	実現期待値	単位	スコア	重み係数
Q 都市の環境品質・活動度の総合スコア				44.9							67.4	
Q 都市の環境品質・活動度のスコア				2.8							3.7	
Q1 環境				2.57	0.33						3.45	0.33
Q1.1 自然保全				3.14	0.25						3.35	0.25
Q1.1.1 自然的土地比率	(林野面積+主要河川面積)／都面積	60.7	(%)	3.14	1.00	60.7	70.0	0.5	65.4	(%)	3.35	1.00
Q1.2 環境質				3.10	0.25						3.57	0.25
Q1.2.1 大気質	光化学オキシダント(年平均値)の昼間1時間値が0.12ppm以上の日数	0	(日)	5.00	0.50	-	0	0.5	0.0	(日)	5.00	0.50
Q1.2.2 水質	河川BODの日間平均値の75%値	9.9	(mg/L)	1.20	0.50	9.9	3.0	1.0	3.0	(mg/L)	2.13	0.50
Q1.3 資源循環				1.97	0.25						4.68	0.25
Q1.3.1 一般廃棄物のリサイクル率	ごみのリサイクル率	14.5	(%)	1.97	1.00	14.5	40.0	1.0	40.0	(%)	4.68	1.00
Q1.4 CO_2吸収源対策				2.06	0.25						2.20	0.25
Q1.4.1 森林によるCO_2吸収源対策	森林面積(ha)×吸収原単位(1.81t-CO_2/ha))／都正人口	0.1	(t-CO_2／人)	2.06	1.00	0.1	0.2	0.5	0.2	(t-CO_2／人)	2.20	1.00
Q2 社会				2.59	0.33						3.38	0.33
Q2.1 生活環境				1.91	0.33						2.41	0.33
Q2.1.1 住居水準充実度	1住宅あたり延べ床面積	80.5	(㎡)	1.67	0.25	80.5	82.0	0.5	81.2	(㎡)	1.68	0.25
Q2.1.2 交通安全性	交通事故発生件数／都正人口	4.9	(件／千人)	2.78	0.25	4.9	2.0	0.5	3.5	(件／千人)	3.71	0.25
Q2.1.3 防犯性	刑法犯認知件数／都正人口	14.5	(件／千人)	1.76	0.25	14.5	7.0	0.5	10.8	(件／千人)	2.42	0.25
Q2.1.4 災害対応度	二次医療圏内の災害拠点病院数／二次医療圏域人口	0.2	(箇所／10万人)	1.45	0.25	0.2	0.3	1.0	0.3	(箇所／10万人)	1.80	0.25
Q2.2 社会サービス				2.34	0.33						3.61	0.33
Q2.2.1 教育サービス充実度	小中学校生徒数／小中学校収容数	18.6	(人／人)	1.37	0.20	18.6	15.0	0.5	16.8	(人／人)	1.88	0.20
Q2.2.2 文化サービス充実度	(会員図書+開館図書)／都面積	0.1	(数／10km^2)	1.59	0.20	0.1	0.2	1.0	0.2	(数／10km^2)	1.94	0.20
Q2.2.3 医療サービス充実度	医師数／都正人口	3.0	(人／千人)	4.73	0.20	3.0	5.0	0.5	4.0	(人／千人)	4.89	0.20
Q2.2.4 保育サービス充実度	保育所数／5歳未満人口	0.3	(箇所／百人)	1.55	0.20	0.4	1.2	1.0	1.2	(箇所／百人)	4.42	0.20
Q2.2.5 高齢者サービス充実度	介護老人福祉施設数／65歳以上人口	0.4	(箇所／千人)	2.47	0.20	0.2	1.5	1.0	1.5	(箇所／千人)	4.91	0.20
Q2.3 社会活力				3.52	0.33						4.12	0.33
Q2.3.1 人口自然増減率	(出生数－死亡者数)／都人口	0.0	(%)	4.04	0.50	0.0	(0.2)	0.5	(0.1)	(%)	3.72	0.50
Q2.3.2 人口社会増減率	(都人口数－転出者数)／都人口	データ欠損	(%)	3.00	0.50	データ欠損	0.1	0.5	0.1	(%)	4.53	0.50
Q3 経済				3.23	0.33						4.26	0.33
Q3.1 産業力				3.81	0.33						3.77	0.33
Q3.1.1 1人あたりGRP相当額	(農業産出額+製造品出荷額等+商業年間商品販売額)／都正人口	5.0	(百万円／人)	3.81	1.00	4.2	4.8	0.5	4.9	(百万円／人)	3.77	1.00
Q3.2 財政基盤力				2.87	0.33						4.01	0.33
Q3.2.1 地方税収入額	地方税／都正人口	15.0	(万円／人)	3.89	0.50	12.8	14.0	0.5	14.5	(万円／人)	3.76	0.50
Q3.2.2 地方債残高	公債費比率	17.7	(%)	1.86	0.50	17.7	10.0	1.0	10.0	(%)	4.26	0.50
Q3.3 CO_2取引力				3.00	0.33						5.00	0.33
Q3.3.1 他地域でのCO2排出抑制支援	CO2取引の有無（有 or 無）	無	(一)	3.00	1.00	無	有	1.0	5.0	(一)	5.00	1.00
L 環境負荷の総合スコア				49.5							32.5	
L 環境負荷のスコア				9.9							7.0	
L1 エネルギー起因温室効果ガス排出量												
L1.1 産業部門	産業部門起因の温室効果ガス排出量／都正人口	3.3	(t-CO_2／人)			3.3	2.8	0.7	3.0	(t-CO_2／人)		
L1.2 民生家庭部門	民生家庭部門起因の温室効果ガス排出量／都正人口	2.1	(t-CO_2／人)			2.1	1.0	1.0	1.0	(t-CO_2／人)		
L1.3 民生業務部門	民生業務部門起因の温室効果ガス排出量／都正人口	2.0	(t-CO_2／人)			2.0	0.8	0.7	1.2	(t-CO_2／人)		
L1.4 運輸部門	運輸部門起因の温室効果ガス排出量／都正人口	1.4	(t-CO_2／人)			1.4	0.6	0.7	0.8	(t-CO_2／人)		
L2 エネルギー起因以外の温室効果ガス排出量												
L2.1 廃棄物分野その他	廃棄物部門起因の温室効果ガス排出量／都正人口	1.1	(t-CO_2／人)			1.1	1.0	0.5	1.0	(t-CO_2／人)		

Figure Ⅰ.4.3 Score Sheet

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. However, the assessment results of L require one sheet for each of the two different assessment methods; the “Emitter-pays principle” and the “Beneficiary-pays principle.” An overview of the Assessment results sheet is shown in Figure I.4.4

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 about the city”
The city’s overall information, such as the name of the municipality, population and land area, is automatically displayed.
(2) “2-1 Environmental efficiency of the city” and “2-2 Assessment results of the main item (BEE chart and radar chart)”
The current value and the future estimated value of BEE (the 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 2-1. 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 in 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.
A radar chart collectively representing the scores of Q1 to 3 and L is placed in section 2-2, in which features of the city’s environment-related efforts can be recognized immediately. The color scheme for the current and future values is same as that of section 2-1.
(3) “2-3 Breakdown of Q” and “2-4 Breakdown of L”
The environmental assessment results of the city are expressed by individual assessment items in sections 2-3 and 2-4. These sections show bar charts representing the results of individual rating items counted on the Score sheet. Both the current and future values are shown using the same color scheme as section 2-1.
The assessment results of Q (the quality inside the city) are expressed as bar charts, each representing one of the three assessment items. Total city emissions (total emissions with and without absorption and traded emissions) are shown on the left, while the breakdown per sector is shown on the right.
(4) “3 Environmental considerations in policymaking”
At the bottom of the Assessment Results Sheet, the city's unique quality improvement and load reduction policies and measures can be entered. The right half of the section is for arbitrary use, including drawings or pictures demonstrating the gist of such efforts.

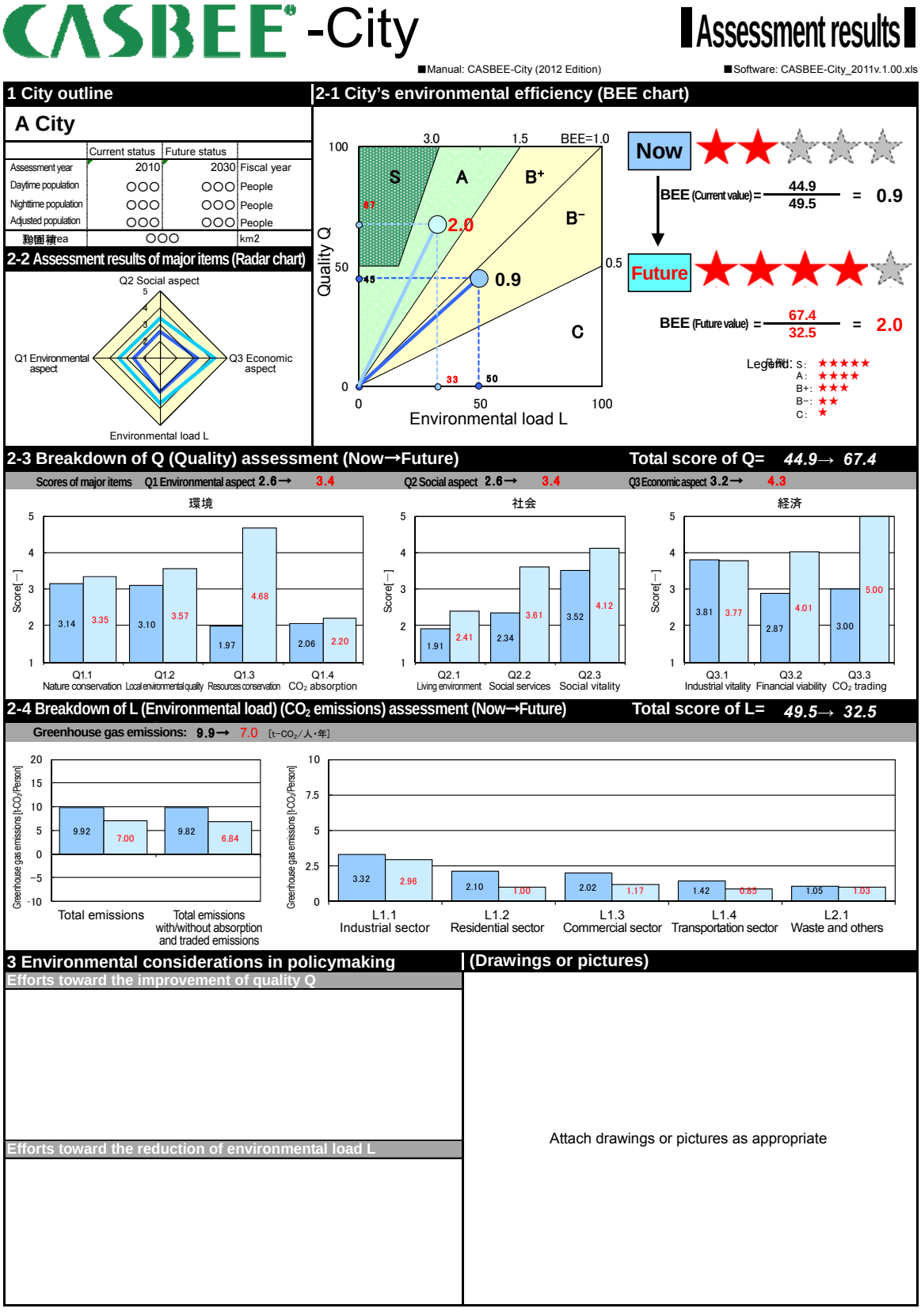


Figure Ⅰ.4.4 Assessment results sheet

PART Ⅱ Assessment Method and Criteria

1. City's Quality (Q)

1.1 Basic Principle of Q Assessment

Q Assessment Guideline

As the quality (Q) assessment requires a multi-faceted approach, CASBEE-City provides wide-ranging assessment points to ensure a comprehensive examination of municipality performance. In order to accurately reflect the outcome of various efforts made by a municipality, appropriate functions for each minor Q item, rather than a uniform, across the board rating function are set based on distribution of original index values.

As shown in Figure II.1.1, a histogram is created for each minor item, showing statistical data from all municipalities. The graph is used to obtain a cumulative relative frequency curve, which determines a base score per item on a scale of 0.0 to 1.0. An individual Q score on a scale of 1.0 to 5.0 is calculated by multiplying the base score by 4 and then adding 1.

Next, scores of mid-level and major items are each obtained by applying weight coefficients mentioned in 3.4.3 to the minor item scores in order to obtain an overall Q score (SQ). Lastly, the SQ on a scale of 1.0 to 5.0 is converted to the final figure on a 100-point scale by first subtracting 1, then multiplying by 25.

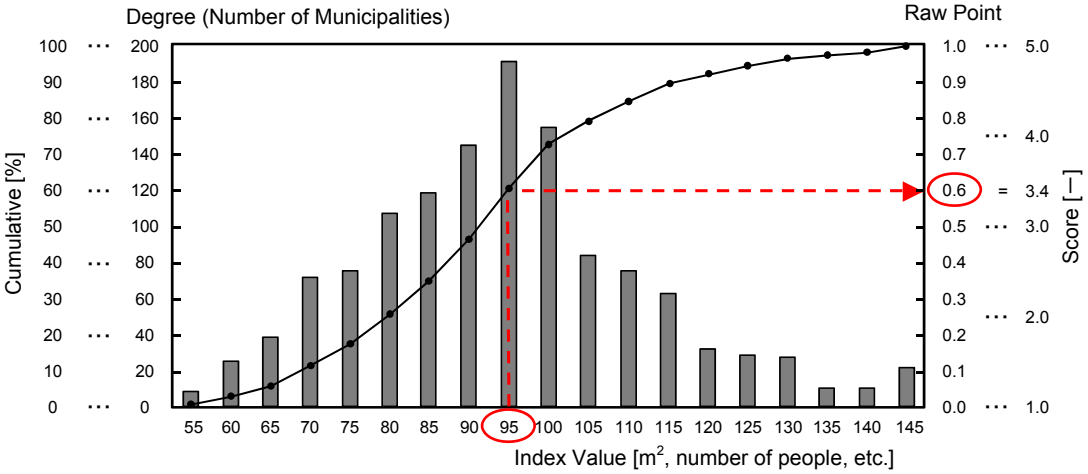


Figure Ⅱ.1.1 Individual Score Calculation of Minor Q Item

1.2 Assessment Approach per Item

In order to accurately and comprehensively evaluate multi-faceted efforts by municipalities, assessment items are organized into the three triple-bottom-line categories: environment, society and economy. Corresponding indices, reference data and assessment approaches for each item are explained in the following pages.

Q1 Environmental aspect

●1.1 Nature conservation

●1.1.1 Ratio of green and water spaces

Degree of nature conservation is evaluated by the percentage of green and water spaces of the total land area of the municipality.

☐Assessment index

(Forest area + Major lake area) / Total land area [%]

☐Reference data

(1) "Census of Agriculture and Forestry," the Ministry of Agriculture, Forestry and Fisheries

(2) Major lake area: "Land Survey of Prefectures, Shi, Ku, Machi and Mura," (municipality) the Geographical Survey Institute

(3) Total land area: "Land Survey of Prefectures, Shi, Ku, Machi and Mura," (municipality) the Geographical Survey Institute

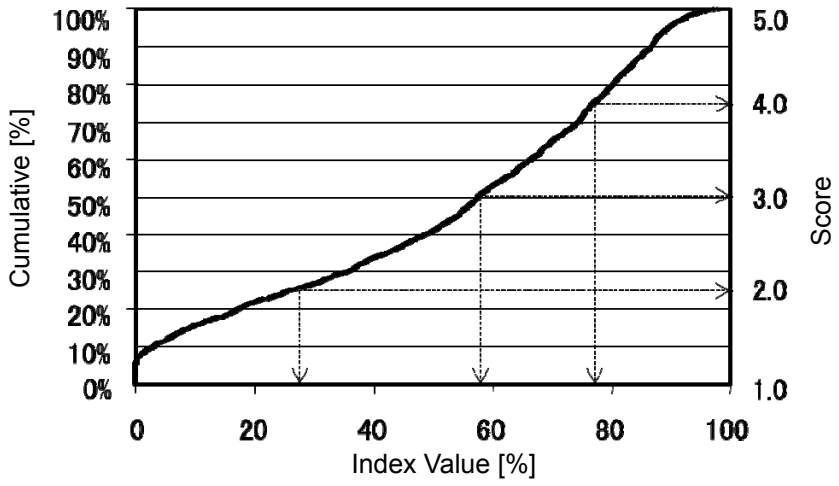
☐Explanation of index

- Green and water spaces are regarded as an index representing the degree of the nature conservation directly related to the natural water circulation, environmental purification and the green network.
- Natural land consists of forest area (the total area of current forest areas and native grassland other than forests) and aquatic environment including lake areas and mudflats serving as habitats for a variety of life forms.

☐Notes

- Nature conservation measures should preferably be evaluated by both quantity and quality aspects. However, a convenient method to objectively and accurately evaluate quality as applicable in the CASBEE-City assessment has not yet been established. Development of such a method is under ongoing review.

☐Q Score and Index Value



●1.2 Local environmental quality

The assessment is based on the following 2 indices representing the level of basic environmental elements.

●1.2.1 Air

Concentration level of photochemical oxidants (Ox), a key indicator of air quality, is evaluated.

☐Assessment index

The number of days which hourly photochemical oxidant concentrations during the day are 0.12ppm or higher (average) [day(s)]

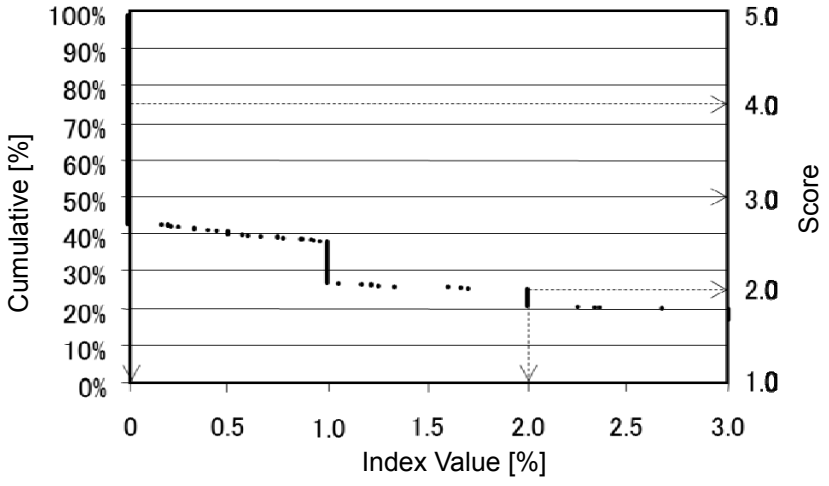
☐Reference data

Environmental GIS by the National Institute for Environmental Studies

☐Explanation of index

- For air quality management, continuous monitoring stations to measure target substances are installed in many municipalities. Photochemical oxidants are key indicators of air quality. In this assessment, air quality is determined by the number of days which the hourly oxidant concentration during the day is 0.12ppm or higher, one of the criteria for an oxidant alert issued under the Air Pollution Control Act.
- The hourly concentration is a per-hour value obtained at a continuous air-pollution monitoring station. In cases where multiple stations are located within a municipality, an average value indicates the averaged number of applicable days at all stations, and a maximum value indicates the maximum number of applicable days at all stations.

☐Q Score and Index Value



●1.2.2 Water

The biological oxygen demand (BOD) levels in rivers (public water) are evaluated.

☐Assessment index

75 percent of daily BOD average in a river [mg/L]

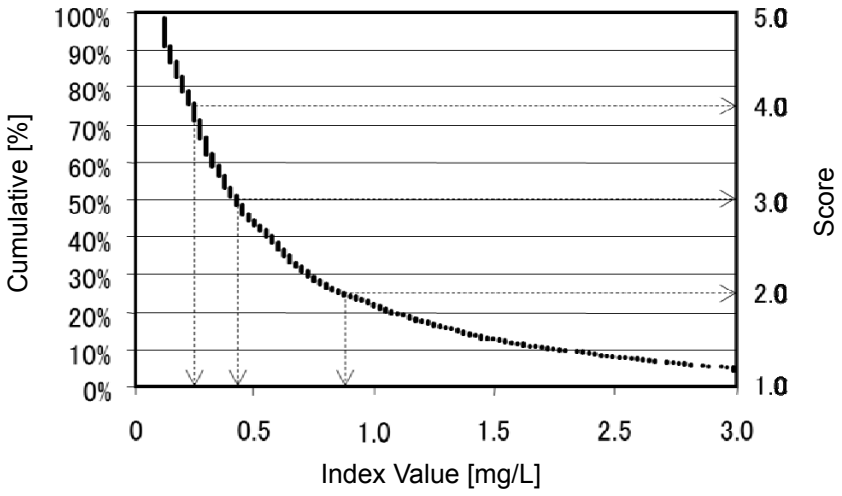
☐Reference data

Environmental GIS by the National Institute for Environmental Studies

☐Explanation of index

- The quality of public water such as rivers is measured annually by municipalities. Biochemical oxygen demand (BOD) values, which measure the degree of organic pollution in the water, are then reported to the Ministry of the Environment.
- A lower BOD indicates less pollution and healthier water quality.
- In this assessment, the water quality is determined by the 75% value of the daily BOD average (i.e. if 100 daily averages are obtained, counting from the smallest number until the 75th value of the 100 daily averages is used).

☐Q Score and Index Value



●1. 3 Resource recycling

●1.3.1 Recycling rate of general waste

The assessment focuses on the recycling rate of general waste representing the most basic resource recycling.

☐Assessment index

Recycling rate of general waste [%]

☐Reference data

Survey on General Waste Processing, Waste Management and Recycling Department, Ministry of the Environment

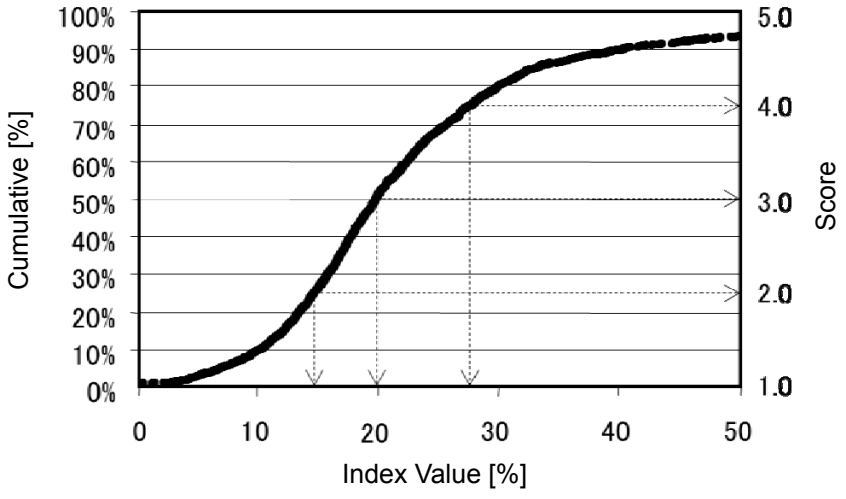
☐Explanation of index

- The assessment is based on the recycling rate of general waste representing the most basic resource recycling. The rate is defined as the percentage of processed waste and group collection to the total recycling volume (direct recycling + recycling after intermediate processing + group collection).
- The recycling after intermediate processing includes waste processed at facilities such as incineration plants, bulk waste disposal plants, composting plants, feed conversion plants, methane production plants and waste-derived fuel plants.

☐Notes

- Resource recycling is related to the “3R” elements, “Reuse,” “Reduce,” and “Recycle.” However, as the assessment index for “Reuse” has not yet been determined and “Reduce” is easier to understand when assessed in the L (Environmental load) section, assessment in this section currently considers only the recycling rate.

☐Q Score and Index Value



●1. 4 CO_2 Absorption

●1.4.1 CO_2 Absorption by Forests

CO_2 absorption is evaluated based on the total forest area of a municipality.

☐Assessment index

Current forest area X unit of absorption/adjusted population [t-CO2/person/year]

☐Reference data

(1) Forest area: Agriculture and Forestry Census, Ministry of Agriculture, Forestry and Fisheries of Japan

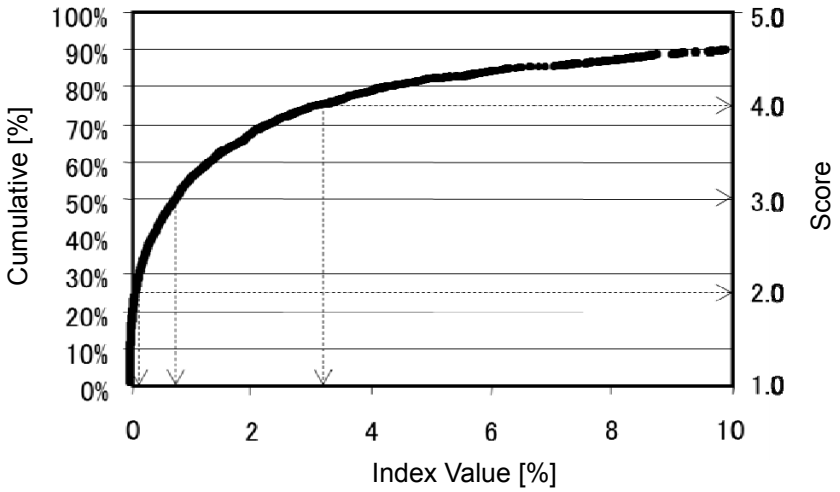
(2) Unit of absorption (2.92［t-CO2/year/ha]): National Greenhouse Gas Inventory Report of Japan 2010, National Institute for Environmental Studies

(3) Adjusted population (= (Total population + Daytime population) / 2): Census Report, Statistics Bureau of Ministry of Internal Affairs and Communications

☐Explanation of index

- CO2absorption by forests is evaluated by an estimated total absorption volume using a formula consisting of three values: forest area, absorption unit and adjusted population.

☐Q Score and Index Value



Q2 Social aspect

●2.1 Living environment

The assessment is based on the following 4 indices representing the degree of safety and security of the municipality and the basic living amenity.

●2.1.1 Adequate quality of housing standard

The assessment focuses on the level of the housing standard according to the size of the existing housing stock.

☐Assessment index

Total floor area per dwelling unit [m^2]

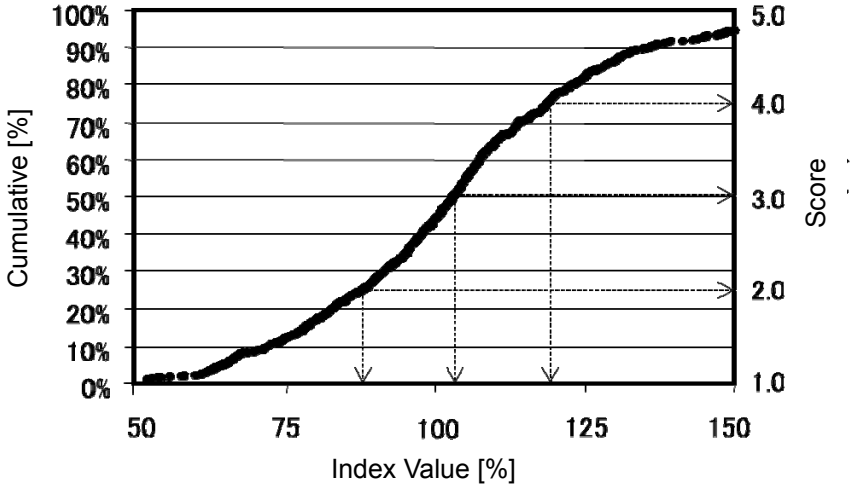
☐Reference data

Housing and Land Survey, Statistics Bureau of Ministry of Internal Affairs and Communications

☐Explanation of index

- The total floor area per dwelling unit, as shown in the Housing and Land Survey by the Statistics Bureau of the Ministry of Internal Affairs and Communications, is used as the assessment index.
- While the per-capita dwelling area depends on family structure, a higher index values indicate better dwelling standards and amenity levels.

☐Q Score and Index Value



●2.1.2 Traffic safety

The assessment focuses on the frequency of traffic accidents related to regional safety and security

☐Assessment index

Number of traffic accidents / Adjusted population [Number of cases/year/1,000 persons]

☐Reference data

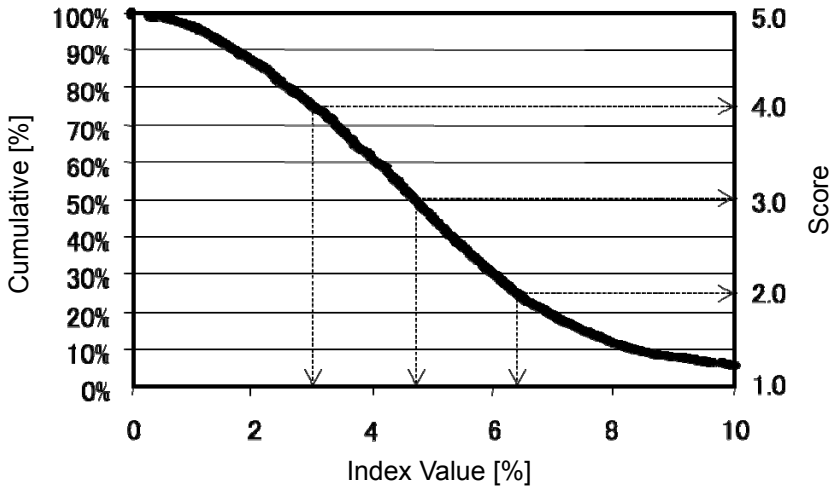
(1) Number of traffic accidents: “Traffic Statistics,” National Police Agency

(2) Adjusted population (= (Total population + Daytime population) / 2): “Census returns,” Statistics Bureau, Ministry of Internal Affairs and Communications

☐Explanation of index

- The index value is obtained by dividing the annual total number of traffic accidents, as shown in the Traffic Statistics by the National Police Agency, by the adjusted population.
- Traffic accidents in the Traffic Statistics refer to accidents on roads specified in the Road Traffic Act, caused by the traffic of vehicles (including lightweight vehicles such as bicycles), streetcars and trains, involving death or injury. Therefore, accidents involving only property damage are excluded.

☐Q Score and Index Value



●2.1.3 Crime prevention

The assessment focuses on the crime rate related to regional safety and security.

☐Assessment index

Number of crimes recorded / Adjusted population [The number of cases/year/1,000 persons]

☐Reference data

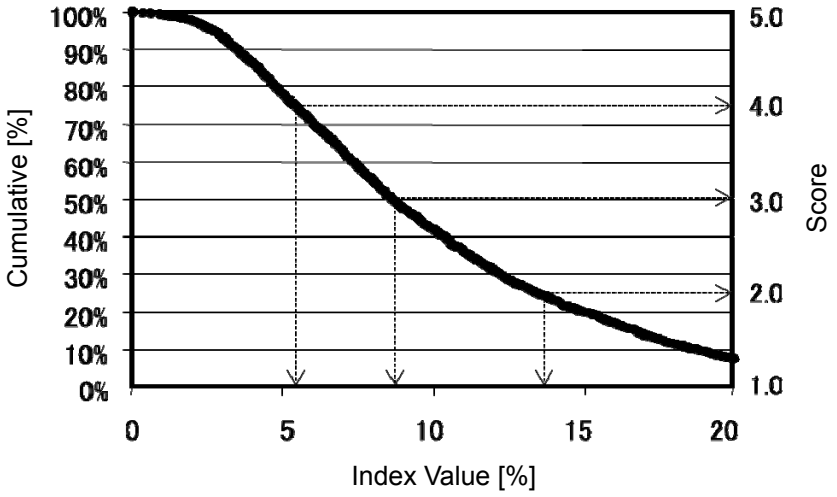
(1) Number of crimes recorded: “Criminal statistics,” National Police Agency

(2) Adjusted population (= (Total population + Daytime population) / 2): “Census returns,” Statistics Bureau, Ministry of Internal Affairs and Communications

☐Explanation of index

- The value of the annual total number of crimes as shown in the Criminal Statistics by the National Police Agency, divided by the adjusted population, is used as the assessment index.
- Crimes in the Criminal statistics refer to crimes specified under 13 laws and regulations including the Criminal Code (excluding those regarding road traffic accidents prescribed in Article 211 of the Criminal Code) and the Explosives Control Act. The number of crimes recorded is the number of committed crimes recognized by the police through offense reports, indictments, accusations and other related means.

☐Q Score and Index Value



●2.1.4 Disaster preparedness

Local disaster preparedness is evaluated based on the availability of local emergency medical facilities.

☐Assessment index

Number of disaster response hospitals per 100,000 persons based on adjusted population [Number of hospitals/100,000 persons]

☐Reference data

Disaster Response Hospital Database (Web version), National Research Institute for Earth Science and Disaster Prevention

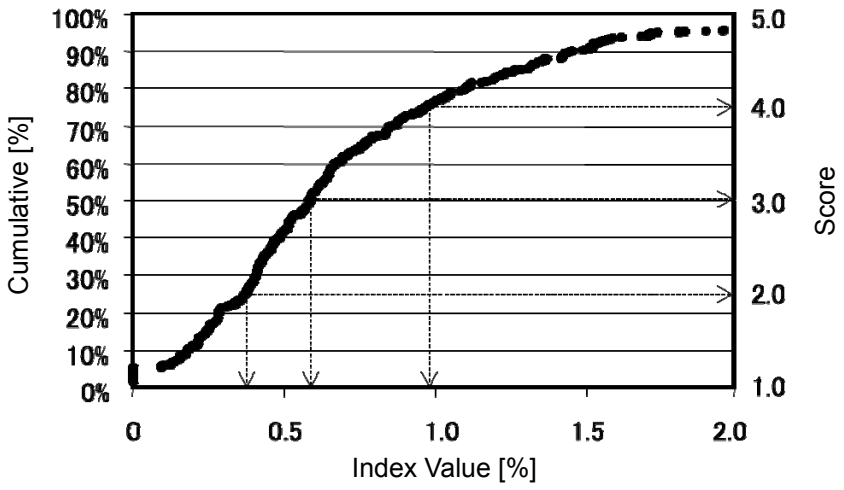
☐Explanation of index

- The value of the total number of disaster response hospitals within the secondary medical zone to which a municipality belongs, divided by 100,000 persons based on the adjusted population in the zone, is used as the assessment index.
- The secondary medical zone is a geographical unit designed to meet complete medical needs related to common diseases, excluding special needs such as psychiatric concerns, infectious diseases and tuberculosis. Under the Medical Service Act, the country is currently divided into 349 zones, established by the Ministry of Health, Labour and Welfare, based on area-specific concerns such as geographical networks and traffic systems. As a general rule, the primary medical zone is the area of a community (i.e. city/town/village) and the tertiary medical zone is that of a prefecture.
- Disaster response hospitals have been established based on the Notice on Implementation of Disaster Response Hospital System issued by the Ministry of Health, Labour and Welfare in May 1996. Taking lessons from the Great Hanshin Earthquake that occurred in January 1995, these hospitals are equipped to provide necessary medical services at the time of disaster. Such buildings must be built with seismic resistance, have ample infrastructure for a steady supply of water and electricity, and have a heliport.
- As a general rule, each prefecture must have a core disaster medical center, while each secondary medical zone must have a regional disaster medical center.

☐Notes

- In the CASBEE-City assessment, the number of disaster response hospitals is considered as the key index representing the level of preparedness in case of various disasters at a municipality level. This is due to the fact that the number can be improved through various efforts by a municipality and that the data on the number of such hospitals, where response to natural disasters such as earthquakes is critical, are readily available.

☐Q Score and Index Value



●2.2 Social services

The level of social services is evaluated based on the following five aspects, which reflect the levels of education, culture, medical care and welfare.

●2.2.1 Adequacy of education services

The assessment focuses on the enrichment of the compulsory education system based on the number of students per teacher at elementary and junior high schools.

☐Assessment index

The number of students at elementary and junior high schools / Number of teachers at elementary and junior high schools

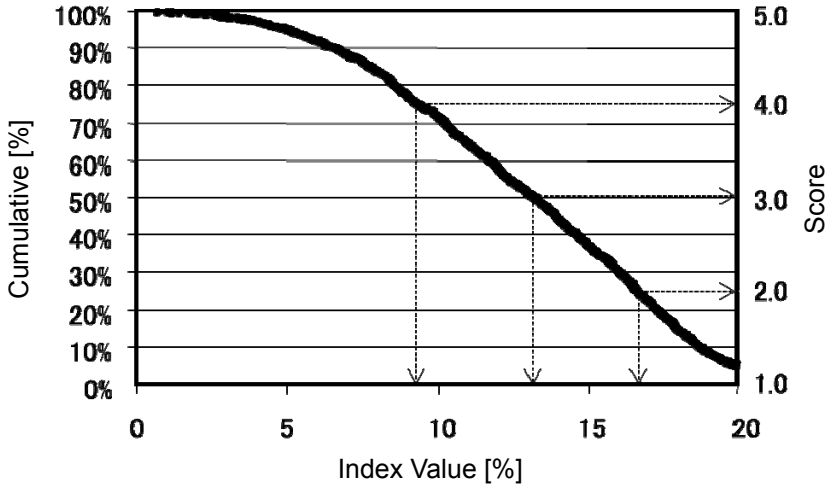
☐Reference data

The number of students and teachers at elementary and junior high schools: Basic School Survey, Lifelong Learning Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology

☐Explanation of index

- The value used as the index is obtained by dividing the total number of students at elementary and junior high schools shown in the report on the “School Basic Survey” prepared by the Ministry of Education, Culture, Sports, Science and Technology, by the number of teachers at elementary and junior high schools.

☐Q Score and Index Value



●2.2.2 Adequacy of cultural services

The adequacy of cultural services is evaluated based on the availability of community centers and libraries.

☐Assessment index

(Number of community centers + number of libraries) /Land area of municipality [Number of facilities/10km^2]

☐Reference data

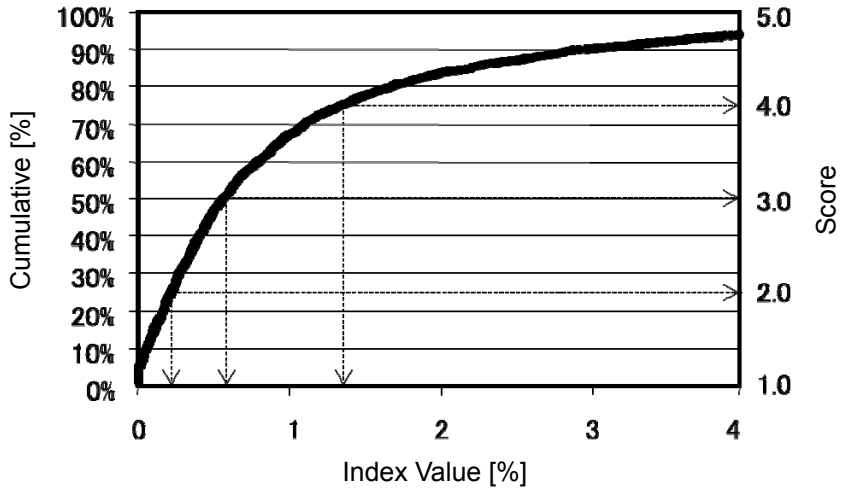
(1) Number of community centers/libraries: Survey on Social Education, Lifelong Learning Policy Bureau, Ministry of Education, Culture, Sports, Science and Technology

(2) Land area of municipality: Municipal and Prefectural Land Survey, Geographical Survey Institute

☐Explanation of index

- The value of the total number of public community centers and libraries, divided by the land area of a municipality, is used as the assessment index.
- Facilities owned or controlled by prefectures that are located within the municipality are included in the assessment.
- In order to evaluate accessibility to cultural services within the municipality, the physical distribution of such facilities is considered by dividing the total number of facilities by the land area.

☐Q Score and Index Value



●2.2.3 Adequacy of medical services

The adequacy of medical services is evaluated based on the number of physicians available per capita.

☐Assessment index

The number of physicians/adjusted population [Number of physicians/1,000 persons]

☐Reference data

(1) The number of physicians: Survey on Physicians, Dentists and Pharmacists, Statistics and Information Department, Ministry of Health, Labour and Welfare

(2) Adjusted population (= (Total population + Daytime population) / 2): “Census returns,” Statistics Bureau, Ministry of Internal Affairs and Communications

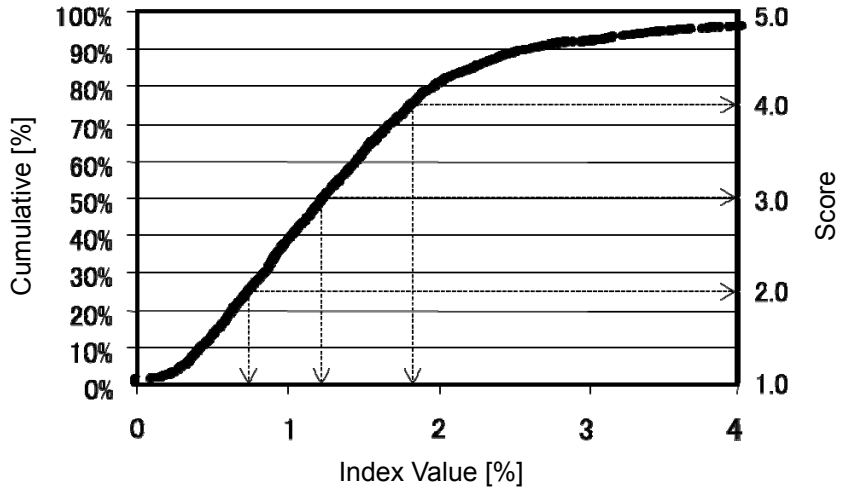
☐Explanation of index

- The value of the number of physicians shown in the Survey on Physicians, Dentists and Pharmacists published by the Ministry of Health, Labour and Welfare, divided by the adjusted population, is used as the assessment index.

☐Notes

- Preferably, adequacy of medical services should be assessed in terms of both the number of physicians and the level of preventive healthcare. However, an appropriate index to evaluate the latter has not yet been established. Inclusion of such a method is under ongoing review.

☐Q Score and Index Value



●2.2.4 Adequacy of childcare services

Adequacy of childcare services is evaluated based on the number of childcare facilities available per infant.

☐Assessment index

The number of childcare facilities/infant population (aged 0 to 4) [Number of facilities/100 persons]

☐Reference data

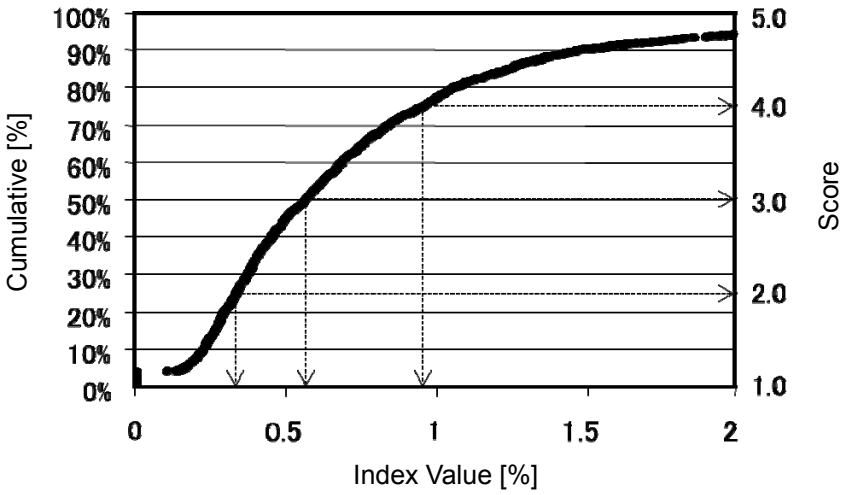
(1) The number of childcare facilities: Survey on Social Welfare Facilities, Statistics and Information Department, Ministry of Health, Labour and Welfare

(2) Infant population (aged 0 to 4): Census Report, Statistics Bureau

☐Explanation of index

- The value of the total number of childcare facilities shown in the Survey on Social Welfare Facilities by the Ministry of Health, Labour and Welfare, divided by the infant population (aged 0 to 4) shown in the Census, is used as the assessment index.

☐Q Score and Index Value



●2.2.5 Adequacy of services for seniors

Adequacy of senior services is evaluated based on the availability of senior care facilities.

☐Assessment indices

The number of senior care facilities/senior population (aged 65 and over) [Number of facilities/1,000 persons]

☐Reference data

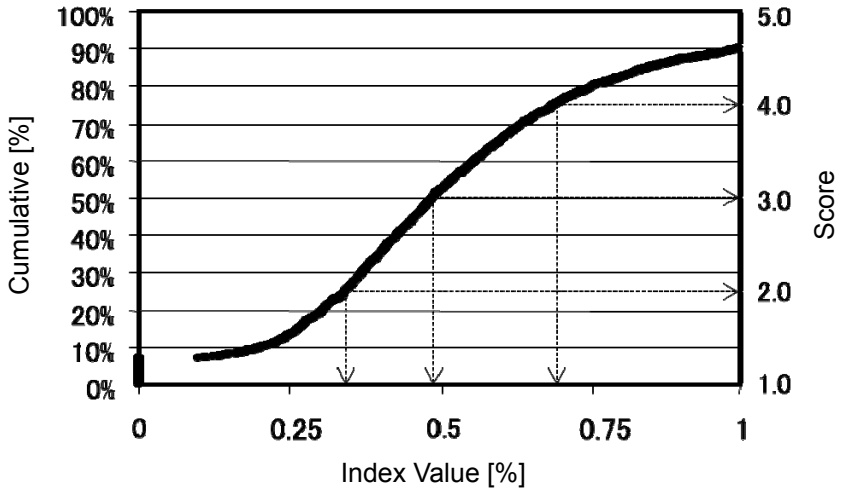
(1) Ratio of barrier-free railway stations: “Information on Barrier-Free Access by Prefectures: Development of Barrier-Free Facilities for Passenger Transport,” Ministry of Land, Infrastructure, Transport and Tourism

(2) Ratio of bus companies introducing low-floor buses: “Information on Barrier-Free Access by Prefectures: Introduction of Low-Floor Buses by Bus Companies,” Ministry of Land, Infrastructure, Transport and Tourism

☐Explanation of index

- The value of the total number of senior care facilities shown in the Survey on Care Service Institutions and Establishments by the Ministry of Health, Labour and Welfare, divided by the senior population (aged 65 and over) shown in the Census, is used as the assessment index.
- In contrast with other indices, the availability of senior services for residents of the municipality is evaluated using the senior population (aged 65 and over), rather than the adjusted population, as the denominator.

☐Q Score and Index Value



●2.3 Social vitality

The following two demographic indices, which are sources of social vitality, are evaluated.

●2.3.1 Rate of population change due to births and deaths

The rate of increase/decrease in the natural population, according to the difference between the numbers of births and deaths, to the total population, is evaluated as part of the demographic trend assessment.

☐Assessment index

Rate of increase/decrease in the natural population = increase/decrease of the natural population (number of births - number of deaths) / total population [%]

☐Reference data

(1) The number of the natural increase-decrease of population: "Vital Statistics," Statistics and Information Department, Ministry of Health, Labour and Welfare

(2) Total population: "National Census," Ministry of Internal Affairs and Communications

The rate of population change due to births and deaths of the national population is automatically calculated on the data entry sheet.

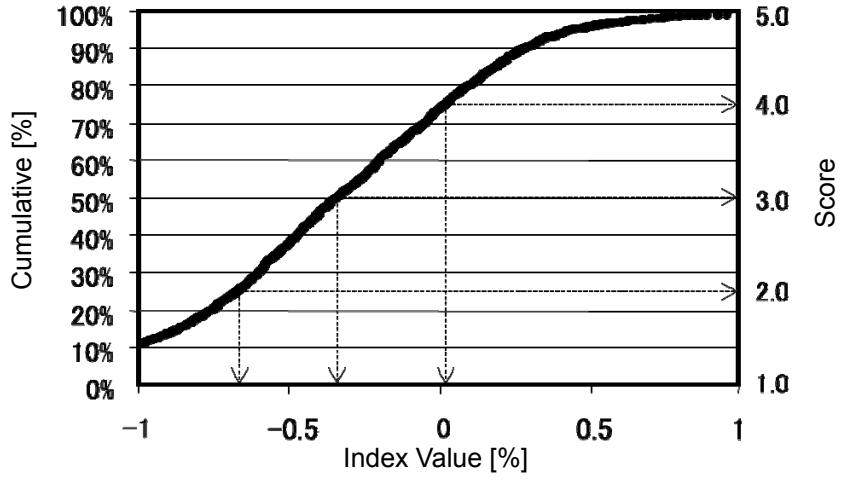
☐Explanation of index

- The rate of increase/decrease in the natural population (the difference between the number of births and deaths) shown in the Vital Statistics by the Statistics and Information Department of the Ministry of Health, Labour and Welfare, to the total population shown in the Census Report by the Statistics Bureau of the Ministry of Internal Affairs and Communications is used as the assessment index.
- The higher the value of the index is, the higher the rate of population change due to births and deaths becomes, which would lead to the improvement of social vitality.

☐Notes

- "Vital Statistics" represents only births and deaths of Japanese nationals living within the country, and excludes Japanese nationals living outside the country and foreign nationals living within the country. Therefore, separate consideration is required when the population of those excluded has a significant impact on the municipality.

☐Q Score and Index Value



●2.3.2 Rate of population change due to migration

The assessment focuses on the proportion of the social increase-decrease of population, the difference in the number of move-ins and move-outs, to the total population, as part of the demographic trend.

☐Assessment index

Rate of population change due to migration = Number of social increase-decrease of population
(Number of move-ins – Number of move-outs) / Total population

☐Reference data

(1) Number of move-ins and move-outs: “Annual Report on the Internal Migration in Japan Derived from the Basic Resident Registers,” Statistics Bureau, Ministry of Internal Affairs and Communications / Prefecture data compiled by Prefectural Offices

(2) Total population: “Census returns,” Statistics Bureau, Ministry of Internal Affairs and Communications

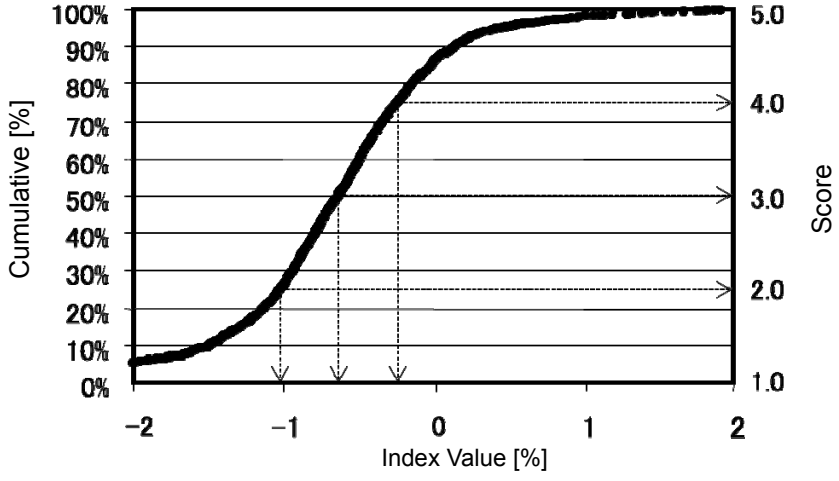
☐Explanation of index

- The value used as the index is the proportion of the social increase-decrease of population (the difference in the number of move-ins and move-outs) according to the “Annual Report on the Internal Migration in Japan Derived from the Basic Resident Registers” prepared by the Statistics Bureau of the Ministry of Internal Affairs and Communications and Prefecture data compiled by Prefectural Offices, to the total population shown in the “Census returns” prepared by the Statistics Bureau of the Ministry of Internal Affairs and Communications.
- The higher the value of the index is, the higher the rate of population change due to migration becomes, which would lead to the improvement of social vitality.

☐Notes

The number of move-ins and move-outs does not include Japanese nationals who lived overseas and have returned to Japan or those moving to another country. Those who changed addresses within the same municipality and foreign nationals are also excluded. Therefore, separate consideration is required when the population of those excluded has a significant impact on the municipality.

☐Q Score and Index Value



Q3 Economy

●3.1 Industrial vitality

The industrial vitality represented by industrial output is evaluated.

●3.1.1 Amount equivalent to gross regional product

The assessment focuses on the sum of the annual output of agriculture, manufacturing and commerce, selected from among the production output by industrial classification, as an alternative index to the GRP (output of all industries) of the municipality.

☐Assessment index

(Agricultural output + Value of manufactured goods shipments + Annual sales of commercial goods) / Adjusted population [Million yen/person]

☐Reference data

(1) Agricultural output: “Statistics of Agricultural Income Produced,” Statistics Department, Ministry of Agriculture, Forestry and Fisheries

(2) Value of manufactured goods shipments: “Census of Manufactures,” Economic and Industrial Policy Bureau, Ministry of Economy, Trade and Industry

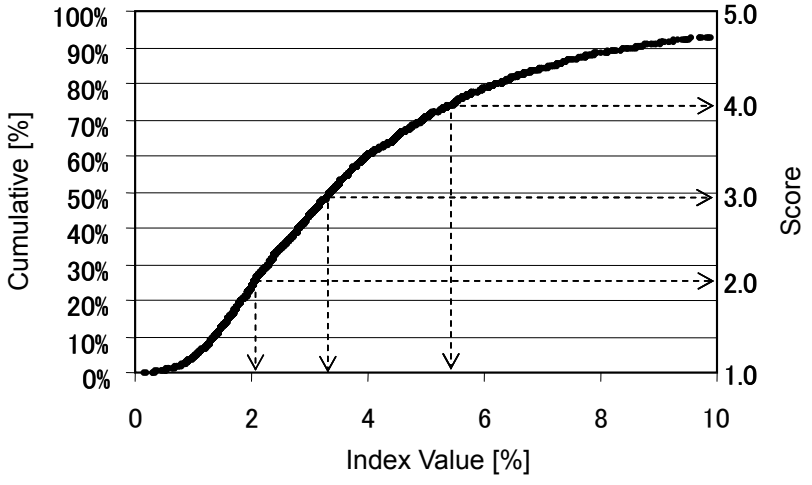
(3) Annual sales of commercial goods: “Census of commerce,” Economic and Industrial Policy Bureau, Ministry of Economy, Trade and Industry

(4) Adjusted population (= (Total population + Daytime population) / 2): “Census returns,” Statistics Bureau, Ministry of Internal Affairs and Communications

☐Explanation of index

- The sum of the annual total output of agriculture, manufacturing and commerce per municipality based on the industry classification is used as a gross regional product (GRP) alternative. For the assessment, the value is divided by the adjusted population in order to obtain the production/sales values per capita.
- The adjusted population is used for the denominator instead of total population in view of the fact that the daytime population is associated with creating added value.
- A higher value indicates healthier economic activities of the municipality.

☐Q Score and Index Value



●3.2 Financial viability

The assessment of the financial viability of the municipality is based on the following indices representing the financial situation

●3.2.1 Tax revenues

The assessment focuses on the scale of the annual revenue of the municipality according to per-capita tax revenues for local governments in the adjusted population.

☐Assessment index

Tax revenues of the local government / Adjusted population [10,000 yen/person]

☐Reference data

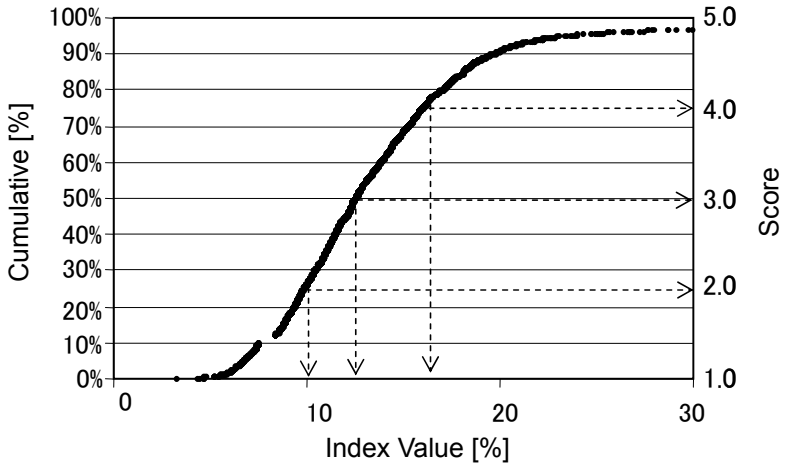
(1) Tax revenues for local governments: “Annual Statistics on Local Government Finance” and “State of Account Settlement by Municipalities,” Local Public Financial Bureau, Ministry of Internal Affairs and Communications

(2) Adjusted population (= (Total population + Daytime population) / 2): “Census returns,” Statistics Bureau, Ministry of Internal Affairs and Communications

☐Explanation of index

- Tax revenues of the local government refer to the taxation paid by residents and companies registered in the municipality, which hold a key position in the annual revenue of the local government, in terms of sharing expenses of the local government. They also account for a major part of the annual revenues and the use is left up to the discretion of the local government.
- A higher index value, obtained by dividing the tax revenues by the adjusted population, indicates better economic infrastructure and wide-ranging measures, resulting in healthier economic activity generated mainly by the daytime population.
- Local tax revenues are the total of the annual municipal taxes paid by individuals and corporations, property tax and city planning tax. The per capita value is used as the assessment index.
- The local taxation system in the special wards of Tokyo differs from that of other municipalities, making comparisons difficult. Thus, the score for these wards is adjusted to 5.0.

☐Q Score and Index Value



●3.2.2 Outstanding local bonds

The financial impact of outstanding municipal loans is evaluated.

☐Assessment index

Real debt service ratio

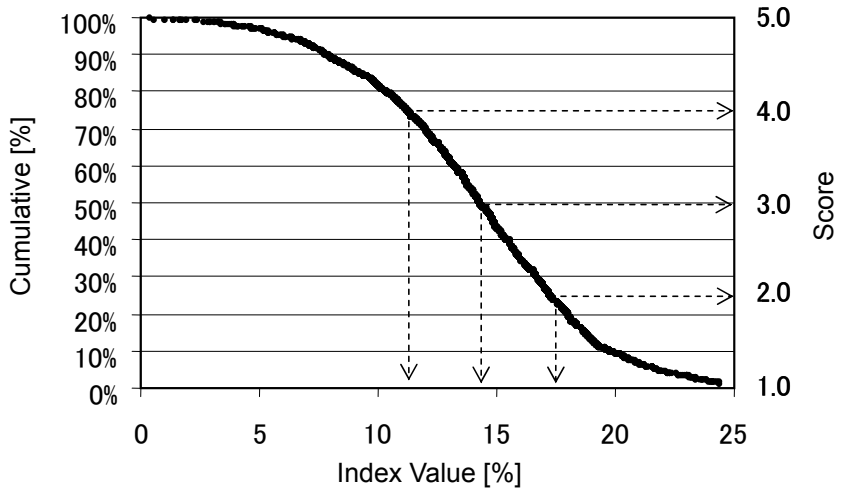
☐Reference data

(1) Real debt service ratio: Survey on Finance Results per Municipality, Local Public Finance Bureau, Ministry of Internal Affairs and Communications

☐Explanation of index

- The index is generally calculated as the past three-year average of the percentage of general revenue sources appropriated for annual repayment (expenditures) of municipality debts (local loans).
- A lower figure indicates a stronger financial structure and thus a greater likelihood of achieving economic improvements within the municipality.

☐Q Score and Index Value



●3.3 CO_2 trading

●3.3.1 CO_2 reduction contributions in other areas

☐Assessment index

Based on the New Action Plan Manual, a 5.0 score is given in cases where a measure that contributes to CO_2 reduction in other areas is in place. A 3.0 score is given where no particular measure is taken.

☐Notes

- The New Action Plan recommends calculation of GHG emissions by adding together a municipality's emissions, absorption and reduction contributions in other areas. Contributions to CO_2 reduction in other areas for this calculation is obtained according to the following methods.

(1) Given that international carbon trading at the municipality level is unlikely, and that domestic systems such as CDM credits are well developed, the following programs that focus on domestic trading are evaluated.

(2) Purchase of these credits is commonly done by business entities, and is therefore difficult to reflect as municipality-based figures. Although some data are published, comprehensive figures are unlikely to become available. A calculation guideline for GHG trading is not currently established. While carefully avoiding double or triple counting of the figures of sellers (i.e. emission right holders) and buyers (i.e. municipalities that purchase credits or where actual reduction occurs), the following factors should be considered.

○ Credit-purchasing municipality

Include all emissions in the calculation of CO_2 absorption and CO_2 emissions including reduction contributions in other areas (do not include reduction in the L assessment)）

○ Credit-selling municipality

Include sold emissions in the calculation of CO_2 absorption and CO_2 emissions including reduction contributions in other areas only

(3) Industrial cities are expected to have measures to promote local production of low-carbon products. Such measures can be evaluated based on the condition that quantitative assessment of the impact and effectiveness is available and also that products from other cities can be assessed in the same manner. While carefully avoiding double counting, this can be included in the calculation of CO_2 absorption and CO_2 emissions including reduction contributions in other areas.

(4) Efforts conducted by an organization based in the municipality but has a wide area of operation outside of the municipality can be included, according to the availability of a quantitative assessment of impact. While carefully avoiding double counting, this can be included in the calculation of CO_2 absorption and CO_2 emissions including reduction contributions in other areas.

(5) On the assumption that the above considerations are met, based on notifications to such municipality, the following assessment conditions should be confirmed.

a. Credits are certified as part of Emissions Trading and J-VER programs.

b. In intercity trading, half of the traded emissions is applied to each city.

c. Credit holders are corporations/organizations that operate only within the municipality , with the exception of the following organizations:

- Governmental or auxiliary organization
- Corporation or NPO with offices only in the municipality
- Community-based association or organization

- The 2012 edition of CASBEE-City does not include awarding a score (1.0 to 5.0) based on the amount of CO_2 reduction contributions in other areas, as applicable municipal statistics for such an evaluation are not currently available. Reviews for future revision of the assessment tool based on target values, and performance data established by municipalities as part of the New Action Plan Manual, are expected.

2. Environmental Load of Cities (L)

2.1 Basic principle of L assessment

2.1.1 L assessment guideline

The following methodologies provided in the New Action Plan Manual (both complete and abridged versions) are applied as a common means of practical and reasonable assessment at the municipal level.

(1) Estimate of current GHG emissions
GHG emissions obtained in accordance with the Action Plan Manual for Global Warming Initiatives for Local Governments: Regional Policies, First Edition: Abridged Version
(2) Target setting in an action plan
(3) Method of estimating future GHG emissions
(4) Countermeasure options required for formulating discharge control measures and policies

2.1.2 Reduction measures, policies and efforts led by organizations other than the city's public administration

Reduction measures, policies and efforts led by organizations other than the city's (municipality's) public administration, such as state regulations and voluntary efforts by private businesses, will be handled as appropriate.

(1) In view of reducing GHG emissions, reduction targets are set for individual fields including industry, business and households, and even for individual industrial sectors and products. Sectoral approaches – efforts toward achieving the targets – are also being studied and promoted in various areas. These efforts are dealt with in the L assessment, when they are regarded as the city's efforts.
(2) The reduction of GHG emissions through measures led by organizations other than the city's public administration, such as the direct effect of state regulations, improvement in the efficiency of equipment and the reduction of the system power consumption rate are excluded from the L assessment.

2.2 Individual assessment items

The structure of assessment items for L is basically in accordance with the new action planning manual, as shown in Table II.2.1. The gross annual emissions of the city ((t-CO_2/Year) for each item is first calculated, followed by the calculation of per-capita CO_2 emissions of the adjusted population (t-CO_2/People/Year).

Table Ⅱ.2.1 Assessment items for L (same as Table Ⅰ.3.3)

Major item	Middle item	Minor item	Redistribution -type item
L1 CO_2 emissions from energy sources	L1.1 Industrial sector	－	○
	L1.2 Residential sector	－	
	L1.3 Commercial sector	－	
	L1.4 Transportation sector	－	
L2 CO_2 emissions from non-energy sources	L2.1 Waste and others	－	

Outlines of individual items are described in the following paragraphs:

2.2.1 L1: CO_2 emissions from energy sources

CO_2 emissions attributed to energy consumption account for the majority of human-caused greenhouse gases, which are evaluated in four mid-level categories.

L1.1 Industrial sector

The industrial sector addresses CO_2 emissions attributed to energy consumption through production activities in various industries, such as manufacturing, agriculture, forestry and fisheries, mining and construction.

L1.2 Residential sector

This sector addresses CO_2 emissions for home energy use other than for transportation purposes such as private cars.

L1.3 Commercial sector

This sector addresses CO_2 emissions attributed to energy consumption in office buildings and other business premises in which corporate administration departments are located, and that of the tertiary industries including hotels, department stores and other service businesses.

L1.4 Transportation sector

This sector addresses CO_2 emissions attributed to energy consumption in office buildings and other business premises in which corporate administration departments are located, and that of the tertiary industries including hotels, department stores and other service businesses.

In accordance with the New Action Plan Manual (both complete and abridged versions), the following conditions apply when calculating local emissions. As a general rule, emission redistribution between municipalities is not applicable.

○Cars: Emissions are recorded at the place where the car is registered.

○Railways: Emissions are recorded at the place where the train passes through.

○Ships: Emissions are recorded where the ship arrives.

○Airplanes: Emissions are recorded where the plane lands..

2.2.2 L2: CO2 emissions from non-energy sources

GHGs which are not attributed to energy consumption (i.e. CO2, CH4, N2O and HCFC) are evaluated in the following mid-level category, according to classification by the New Action Plan Manual (both complete and abridged versions).

L2.1 Waste and others

GHG emissions in the waste disposal sector fall roughly into four categories; waste incineration, waste landfill, effluent treatment and the utilization of waste as an alternative fuel, the details of which are described as follows:

- CO_2, CH_4, and N_2O emissions attributed to the incineration disposal of general waste including waste plastic and waste synthetic fabric, and industrial waste including waste oil, various types of waste plastic and specially controlled industrial waste
- CH_4 generated at waste landfill sites
- CH_4, N_2O generated during the effluent treatment process
- CO_2, CH_4, and N_2O generated through the utilization of waste as an alternative fuel.

2.2.3 Emissions from industrial sector

GHG emissions tend to be higher in cities where many industrial offices and facilities are located. In assessing emissions, consideration must be given to the fact that products and services supplied from such areas provide significant benefits to other cities.

Therefore, CASBEE-City adopts the following two indices to reflect a city's environmental load more accurately. For both indices, emissions related to electricity, city gas and district heat are counted at the point of consumption in line with criteria commonly used in guidelines including the New Action Plan Manual.

○Point-of-origin emissions: CO_2 emissions from the industrial sector are considered as belonging to the place of production (the point of origin) and applied to the city where industry activities take place. Emissions are calculated in accordance with the New Action Plan Manual.

○ Point-of-demand emissions: CO_2 emissions from the industrial sector are considered as belonging to the place of final consumption (the point of demand). In this assessment, emissions from the industrial sector for each city are deducted and replaced with a national average of industrial-sector emissions.

In terms of the point-of-demand emissions, the national average of industrial-sector emissions is used because, unlike electricity, city gas and district heat, consumption data per municipality for products from the industrial sector (including agricultural products) is not available. The average value is applied as a practical method to equally distribute the overall impact of emissions from the industrial sector to the whole population.

There was an idea in which the redistribution applies to certain industries with particularly high CO_2 emissions, and a preliminary study thereon as a replacement was conducted. However, as the results of the study show that it is necessary to understand emissions of the industry in every city nationwide, data of which are difficult to obtain, and that it is also hard to select certain industries to which the redistribution applies. Consequently, the idea was not adopted as a replacement. (For details of the

preliminary study, please refer to the Commentaries and Data.)

Calculation procedure for L (Beneficiary-pays principle)
[L (Beneficiary-pays principle) (t-CO_2/Person/Year)]
= [L (Emitter-pays principle) (t-CO_2/Person/Year)]
- [Emissions of industry-related sectors in the city (t-CO_2/Year)] / [Adjusted population of the city (Person)][*1]
+ [Total national emissions of industry-related sectors (t-CO_2/Year)][*2]/ [Total population (Person)]

*1 Adjusted population (Person) = {[Total population] + [Daytime population]} / 2
*2 Total of estimated emissions from industrial sectors nationwide as per Action Plan Manual for Global Warming Initiatives for Local Governments: Regional Policies, First Edition: Abridged Version published by Ministry of the Environment

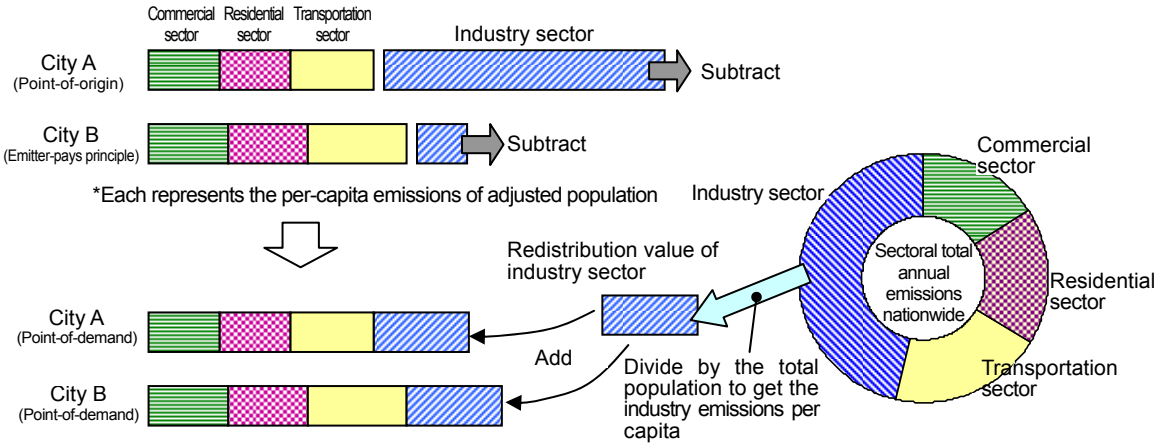


Figure Ⅱ.2.1 Calculation of Pont-of-Demand Emissions

2.3 L assessment standards

2.3.1 Total L score

For BEE calculation (Q/L) where the actual per-capita CO2 emissions (t-CO2/person/year) of a municipality are applied as the total L score, the point-of-origin scenario results show large variation in per-capita CO2 emissions among cities, while the point-of-demand scenario results show most cities performing similarly near the national average. In many cases, municipal environmental measures are conducted based on the performance of the latter. In this assessment, therefore, the following logistic function is applied to calculate the total L score in order to reflect local BEE with more accuracy. In this method, instead of the actual value of per-capita CO2 emissions per year, which varies widely, the total L score on a scale of 0 to 100, with values near the average (50) being a more accurate representation, is applied. Values are rounded up to the nearest whole number.

$$L = 100 * \frac{1}{1 + \exp(-a * (X - m))}$$

X: Annual CO_2 emissions per capita in the city (t-CO_2/Person/Year)

m: National average of the annual CO_2 emissions per capita, Japan (t-CO_2/Person/Year)

・・・ 10 t-CO_2/Person/Year

a: Gain (A coefficient that increases the sensitivity of near-average values)

・・・ 0.2432 (= 1/8*ln(7))

When the X value is 2 (t-CO_2/person/year), the gain value is set with a reference point of L=12.5, which is the point when a city achieves an 80-percent reduction over the current national average in accordance with the long-term reduction target for developed countries.

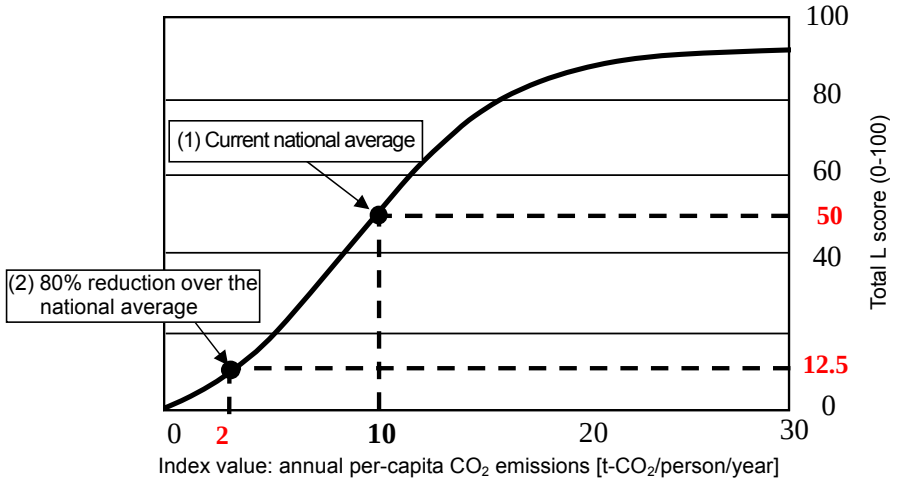


Figure Ⅱ.2.2 Assessment and conversion of L

2.3.2 L score conversion for radar charts

The L score represented in radar charts is the value obtained when the following formula is applied to the converted value of the total L score as described above (0 to 100), which is further rounded off to one decimal place.

L score for radar charts = 5 - L / 25

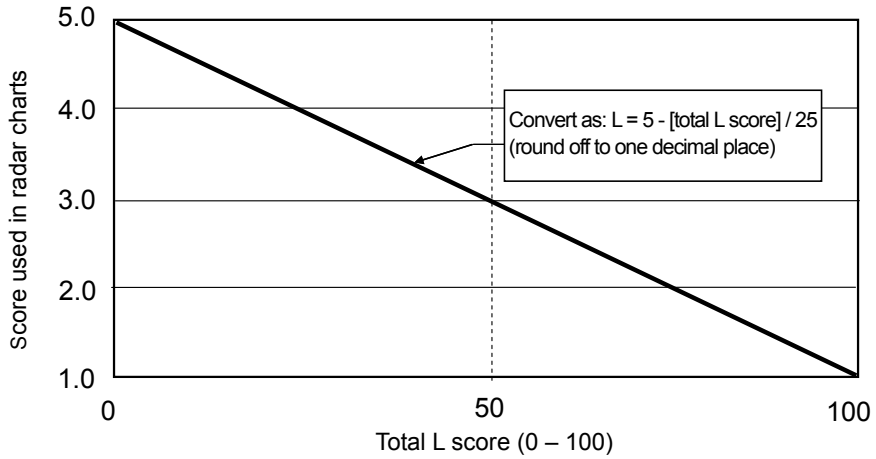


Figure Ⅱ.2.3 Total L score and converted L score for radar charts

2.3.3 CO_2 absorption and emissions including reduction contributed in other regions

The New Action Plan Manual calculates GHG emissions by adding together a municipality's emissions, absorption and reduction contributions in other areas. In accordance with the manual, CO2 emissions are calculated as the sum of the values obtained in the following categories:

1) L: actual CO_2 emissions (t--CO_2/person/year)
2) Q1.4.1: CO_2 absorption by forests (t-CO_2/person/year)
3) Q3.3.1: CO_2 reduction contributions in other regions (t-CO_2/person/year)

[Commentaries and Data]

Information on Q (Quality)

Calculation methods for Q items are described below:

(1) Indices not in the form of "Numerator / Denominator"

⇒The BAU is same as the current value.

Major item	Middle item	Minor item	Corresponding index
Q1 Environmental aspect	Q1.2 Local environmental quality	Q1.2.1 Air	Number of days which hourly photochemical oxidant concentrations during the day are 0.12ppm or higher (average)
Q1 Environmental aspect	Q1.2 Local environmental quality	Q1.2.2 Water	75 percent of daily BOD average in a river
Q1 Environmental aspect	Q1.3 Resource recycling	Q1.3.1 Recycling rate of general waste	Recycling rate of general waste
Q2 Social aspect	Q2.1 Living environment	Q2.1.1 Adequate quality of housing standard	Total floor area per dwelling unit
Q3 Economic aspect	Q3.2 Financial viability	Q3.2.2 Current balance of municipal bonds	Debt expenditure ratio
Q3 Economic aspect	Q3.3 CO2 trading	Q3.3.1 CO2 reduction contributions in other regions	Carbon trading (traded/not traded)

(2) Indices for which the denominator is something other than population-related figures

⇒The BAU is same as the current value. (Neither the numerator nor denominator is a variable.)

Major item	Middle item	Minor item	Corresponding index
Q1 Environmental aspect	Q1.1 Nature conservation	Q1.1.1 Ratio of natural land	(Forest area + Major lake area) / Total land area
Q2 Social aspect	Q2.2 Social services	Q2.2.1 Adequacy of education services	The number of students/Number of teachers at elementary and junior high schools
Q2 Social aspect	Q2.2 Social services	Q2.2.2 Adequacy of cultural services	(The number of community centers + number of libraries) /Total land area

(3) The index is obtained by using population data as the denominator and data not related to size of facilities as the numerator

⇒The BAU is same as the current value. (The denominator representing the population varies depending on the future estimate, and the numerator also varies in proportion thereto.)

Major item	Middle item	Minor item	Corresponding index
Q2 Social aspect	Q2.1 Living environment	Q2.1.2 Traffic safety	The number of traffic accidents / adjusted population
Q2 Social aspect	Q2.1 Living environment	Q2.1.3 Crime prevention	The number of crimes / adjusted population
Q2 Social aspect	Q2.2 Social services	Q2.2.3 Number of beds at medical facilities	The number of physicians / adjusted population
Q2 Social aspect	Q2.3 Social vitality	Q2.3.1 Rate of population change due to births and deaths	(The number of births - number of deaths) / total population
Q2 Social aspect	Q2.3 Social vitality	Q2.3.2 Rate of population change due to migration	(The number of move-ins - move-outs) / total population

(4) The index is obtained by using population data as the denominator and data related to size of facilities as the numerator

⇒The numerator of the BAU is same as the current value. The denominator varies depending on the future estimate.

Major item	Middle item	Minor item	Corresponding index
Q1 Environmental aspect	Q1.4 CO_2 absorption	Q1.4.1 CO_2 absorption by forests	Forest area x absorption unit / ajusted population
Q2 Social aspect	Q2.2 Social services	Q2.2.4 Adequacy of childcare services	The number of childcare facilities / population aged less than 5*
Q2 Social aspect	Q2.2 Social services	Q2.2.5 Adequacy of services for the elderly	The number of senior care facilities / population aged 65 and over

(5) Economy-related indices

⇒The numerator used in the BAU calculation is obtained by multiplying the current value by [estimated future population of productive age / current population of productive age]. The denominator is subject to variation depending on future estimates.

Major item	Middle item	Minor item	Corresponding index
Q3 Economic aspect	Q3.1 Industrial vitality	Q3.1.1 Amount equivalent to gross regional product	(Agricultural output + value of manufactured goods shipments + annual sales of commercial goods) / adjusted population
Q3 Economic aspect	Q3.2 Financial viability	Q3.2.1 Tax revenues for local governments	Local tax revenues / adjusted population

(6) Other

The BAU is represented by the current value, and is considered more appropriate than estimating future value based on complex hypothesis

Major item	Middle item	Minor item	Corresponding index
Q2 Social aspect	Q2.1 Living environment	Q2.1.4 Disaster preparedness	The number of disaster response hospitals in the secondary medical zone / population in secondary medical zone

Information on L (Environmental Load)

1. Review of deduction methods for emissions by specific high-carbon businesses when calculating total redistributed CO_2 emissions from the industrial sector

CASBEE-City (Low-carbon Edition) redistributes the emissions of all sectors in industry. During the process of preliminary studies, a method of deducting the CO_2 emissions of specific manufacturers with a high degree of carbon aggregation from the total emissions of the municipality was discussed. Outlines of the studies are described below.

1) Methods discussed

(Method 1) Deducting CO_2 emissions attributed to specific sectors of the manufacturing industry from the total emissions of the municipality

(Method 2) Classifying sectors of the manufacturing industry nationwide into 2 groups in a unified manner (1: High-aggregation sectors; 2: Low-aggregation sectors), and calculating CO_2 emissions from the difference in the basic unit according to the structure of the manufacturing industry in the municipality

2) Conditions for calculation (Common to 1 and 2)

(1) Assessment year: Fiscal 2003

The top 5 sectors (steel, chemicals, ceramics and soil/stone, petroleum and coal products, pulp and paper) account for 86%.

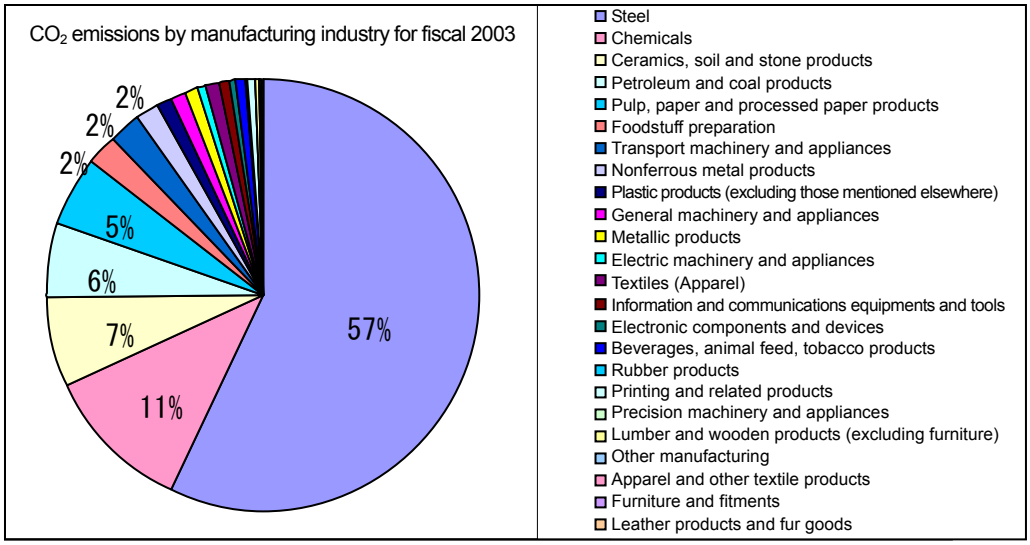


Figure1: CO_2 emissions of the manufacturing industry nationwide by sector for fiscal 2003

(2) Municipalities subject to the assessment: 19 cities

- 13 Eco model cities (A preliminary calculation has not been conducted in some cities due to the difficulty in obtaining data.)
- 6 cities other than the above, with heavy industries as the major industries

(3) Both methods are based on the premise that data, obtained in accordance with the “Manual for planning local government’s action plan to address the issue of global warming (Regional

policies), First edition" prepared by the Ministry of Environment, are available, upon the practical application to municipalities. (Provisional data prepared for preliminary studies are used in the preliminary calculations described below.)

3) Understanding the difference in CO_2 emissions per basic unit by sector of the manufacturing industry

CO_2 emissions per basic unit (CO_2 emissions per unit of raw materials used) by sector of the manufacturing industry were calculated and the results are shown in Figure2.

(1) Calculating the national average of CO_2 emissions per unit of raw materials used by medium industrial classifications

＜Example: Steel Industry＞

[National average of CO_2 emissions per unit of raw materials used in the steel industry (t-CO_2/Yen)]
= [Total CO_2 emissions in the steel industry nationwide (t-CO_2)] / [Total national amount of raw materials used in the steel industry (Yen/Year)]

Statistics of the consumption structure of oil, etc. (Fiscal 2001)*1 [Petroleum consumption (kl)] × [Basic unit of petroleum (t-CO_2/kl)] + [Town gas consumption (m^3)] × [Basic unit of town gas (t-CO_2/m^3)] + adding fuels used in the steel industry by type*2)	Census of manufactures (Fiscal 2003) Adding the amount of raw materials used in the steel industry by municipality

∗1 As the “Statistics on the consumption structure of oil, etc.” report has not been prepared since 2001, the data used above are from the 2001 survey.

∗2 The basic units of individual fuels are in accordance with the calculation of GHG emissions and report manuals by the Ministry of Environment.

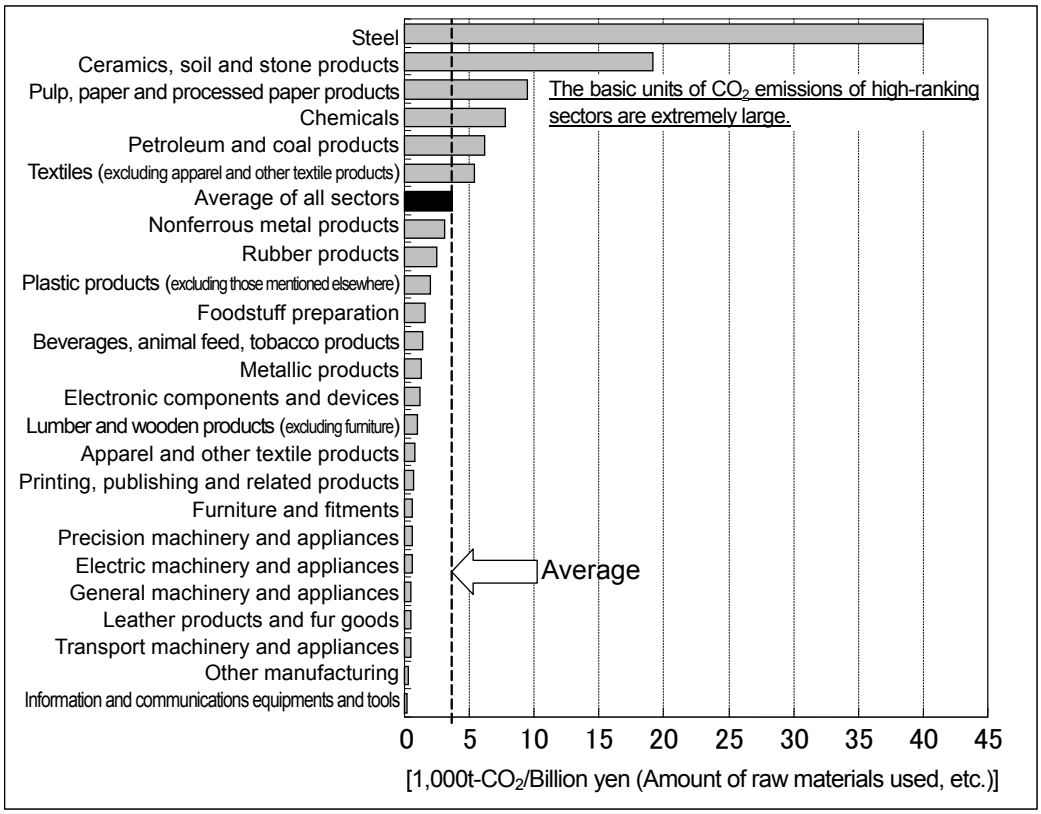


Figure2: Basic unit of CO_2 emissions by sector of the manufacturing industry

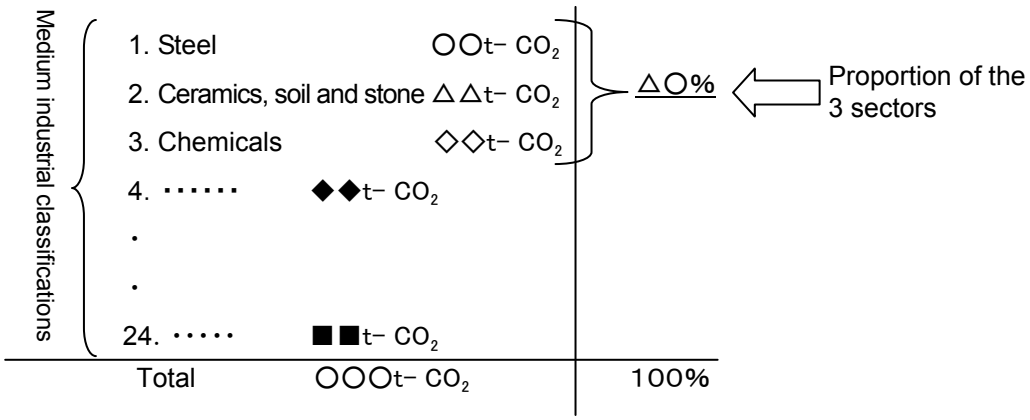
4) Calculation methods and results of preliminary calculation

[Method 1: Deducting CO_2 emissions attributed to specific sectors of the manufacturing industry from the total emissions of the municipality]

The following is the procedure proposed during the study for deducting CO_2 emissions of the top 3 sectors in the emissions ranking such as steel, ceramics and soil/stone and chemicals. (The same applies to cases in which the number of sectors subject to the deduction increases.)

(1) Estimating CO_2 emissions for individual municipalities by the medium industrial classifications
＜Example: Steel Industry＞
[CO_2 emissions attributed to the steel industry in the municipality (t-CO_2/Year)]
= [Amount of raw materials used in the municipality (Yen/Year)] × [National average of CO_2 emissions per unit of raw materials used (t-CO_2/Yen)]
∗CO_2 emissions in the steel industry are classified into 2 groups; CO_2 emissions of municipalities with a shaft furnace and those of municipalities without a shaft furnace. The calculation of CO_2 emissions is conducted using the basic unit of CO_2 emissions in terms of the “Steel industry with a shaft furnace” and the “Steel industry without a shaft furnace,” respectively.

(2) Calculating the proportion of CO_2 emissions of the 3 sectors to those of the municipalities (2) calculated by the medium industrial classifications
Example: CO_2 emissions by the medium industrial classifications in a municipality



(3) Multiplying CO_2 emissions of the manufacturing industry listed in the “Environmental White Papers of Local Governments 2007” by the proportion calculated in the previous section(2), then deducting them from the total emissions of the municipality

[CO_2 emissions of the municipality after deducting those of the 3 sectors (t-CO_2/Year)]
= [CO_2 emissions of the manufacturing industry of the municipality listed in the Environmental White Papers of Local Governments (t-CO_2/Year)] × (1-[Proportion calculated in (3)])

[Result of preliminary calculation based on Method 1]

Table1: CO_2 emissions, deduction rates and adjustment results of the manufacturing industries according to Method 1

	A	B			C＝－B/A	D	E＝A/D	E＊(1+C)
	Total of the Manufacturing industry	Chemicals	Ceramics, soil and stone	Steel	Deduction rate	Adjusted population in 2005	Per-capita CO_2 emissions of the adjusted population (Before adjustment)	Per-capita CO_2 emissions of the adjusted population (After adjustment)
	(t-CO_2)	(t-CO_2)	(t-CO_2)	(t-CO_2)	%	People	(t-CO_2/People)	(t-CO_2/People)
City A	5,517,296	36,459	64,513	5,326,536	−98.4%	102,459	53.8	0.9
City B	138,620	6,270	34,412	22,710	−45.7%	174,080	0.8	0.4
City C	−	−	−	−	−	4,149	−	−
City D	31,453	3,082	0	0	−9.8%	447,580	0.1	0.1
City E	7,723,293	387,758	839,637	1,352,676	−33.4%	3,392,386	2.3	1.5
City F	17,276,356	3,908,316	419,634	9,400,390	−79.5%	1,240,724	13.9	2.9
City G	1,827,122	508,029	136,409	463,091	−60.6%	433,914	4.2	1.7
City H	189,353	0	36,449	0	−19.2%	110,911	1.7	1.4
City I	6,457,116	7,964	154,446	2,507,579	−41.3%	428,697	15.1	8.8
City J	4,949,900	2,712,502	243,202	104,576	−61.8%	308,626	16.0	6.1
City K	1,689,199	234,997	239,387	104,197	−34.3%	1,528,896	1.1	0.7
City L	10,944,627	572,541	265,662	7,395,907	−75.2%	801,273	13.7	3.4
City M	4,874,884	747,681	79,576	3,458,111	−87.9%	383,172	12.7	1.5
City N	19,684,023	3,117,294	211,951	12,217,879	−79.0%	464,017	42.4	8.9
City O	1,815,312	815,549	345,830	452,522	−88.9%	180,009	10.1	1.1
City P	−	−	−	−	−	4,678	−	−
City Q	11,316,563	641,040	807,745	9,244,171	−94.5%	1,006,986	11.2	0.6
City R	119,655	74,066	2,320	21,707	−82.0%	29,665	4.0	0.7
City S	−	−	−	−	−	53,512	−	−

N/B) "-" indicates "Not applicable"

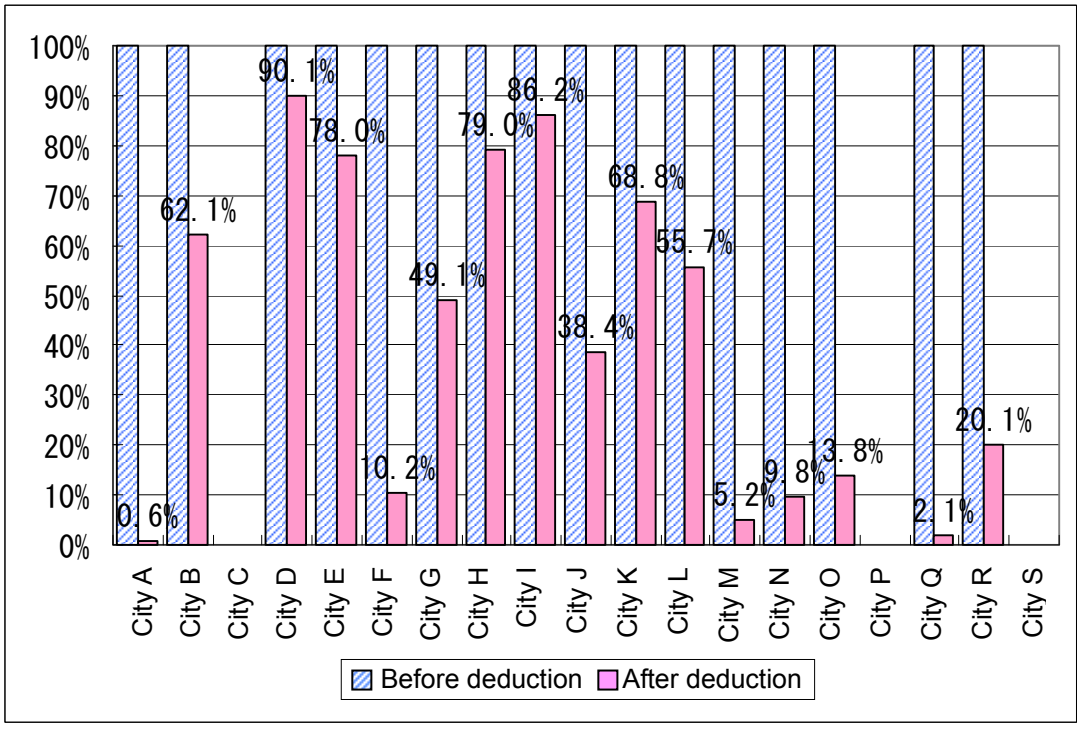


Figure3: Adjustment rate of L in individual municipalities according to Method 1

[Method 2: Classifying the manufacturing industry nationwide into 2 groups in a unified manner (1: High-aggregation sectors; 2: Low-aggregation sectors), and calculating CO_2 emissions from the difference in the basic unit according to the structure of the manufacturing industry in the municipality]

The method of calculating CO_2 emissions attributed to the manufacturing industry by municipality is shown in Figure2. In this preliminary calculation, the top 4 sectors in the ranking of CO_2 emissions per amount of activity (Steel, ceramics and soil/stone, pulp/paper/paper processing and chemicals) are classified as high-aggregation sectors, and sectors other than the top 4 are low-aggregation sectors. Per-capita CO_2 emissions of the adjusted population from the manufacturing industry in the municipality were calculated using weighted average basic unit 1 according to the amount of activity in the top 4 sectors, and weighted average basic unit 2 according to the amount of activity in sectors other than the top 4.

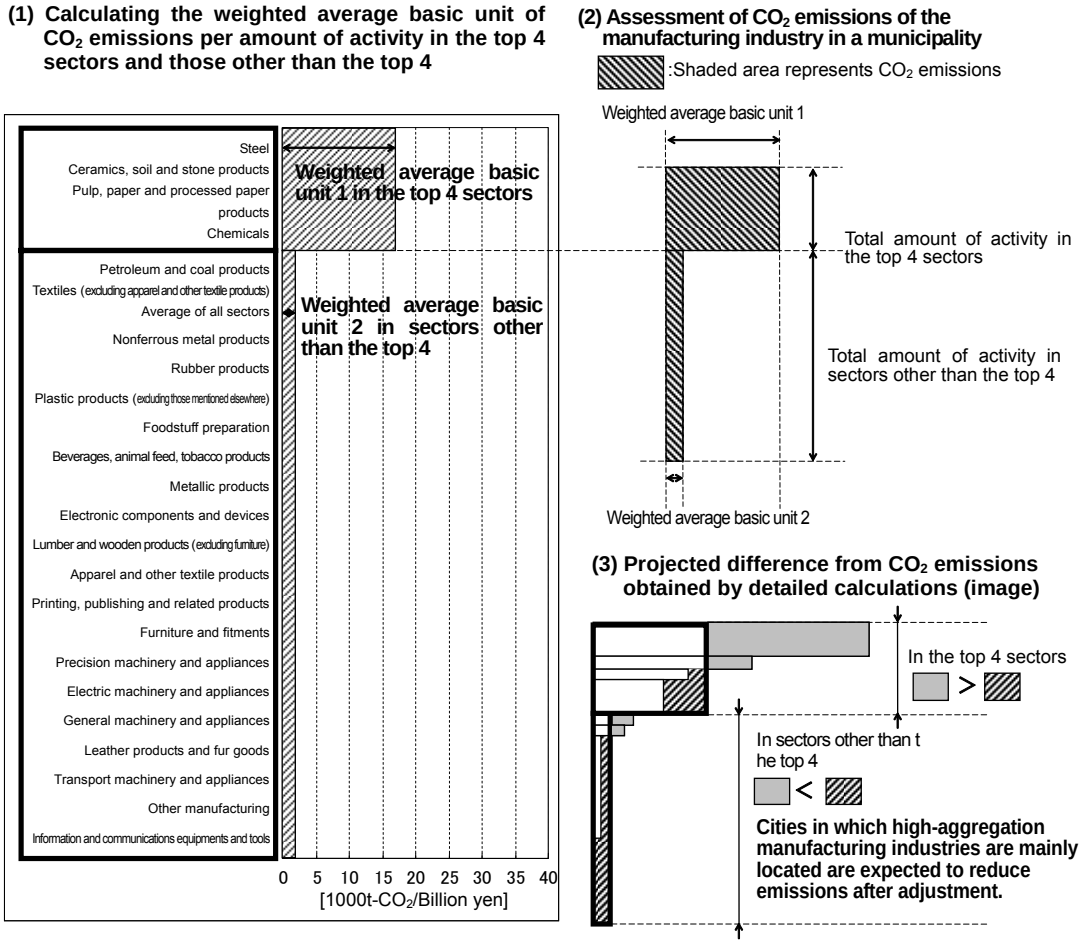


Figure4: Proposed method of calculating per-capita CO_2 emissions of the adjusted population in individual municipalities according to Method 2

[Result of preliminary calculation based on Method 2]

Table2: Result of preliminary calculation of CO_2 emissions in individual municipalities according to Method 2

	A	B			(B-A)/A	C	D=A/C	E=B/C
	Total emissions of the manufacturing industry (Before adjustment)	Total emissions of the manufacturing industry (After adjustment)	Top 4 sectors	Sectors other than the top 4	Increase-decrease rate by adjustment	Adjusted population in 2005	Per-capita CO_2 emissions of the adjusted population (Before adjustment)	Per-capita CO_2 emissions of the adjusted population (After adjustment)
	(t-CO_2)	(t-CO_2)	(t-CO_2)	(t-CO_2)	%	People	(t-CO_2/People)	(t-CO_2/People)
City A	5,517,296	2,745,617	2,703,643	41,974	−50.2%	102,459	53.8	26.8
City B	138,620	140,070	83,263	56,807	1.0%	174,080	0.8	0.8
City C	–	–	–	–	–	4,149	–	–
City D	31,453	59,665	24,687	34,978	89.7%	447,580	0.1	0.1
City E	7,723,293	6,067,569	3,571,136	2,496,423	−21.4%	3,392,386	2.3	1.8
City F	17,276,356	16,437,847	14,743,583	1,694,264	−4.9%	1,240,724	13.9	13.2
City G	1,827,122	2,078,965	1,726,065	352,901	13.8%	433,914	4.2	4.8
City H	189,353	268,737	123,552	145,185	41.9%	110,911	1.7	2.4
City I	6,457,116	9,376,029	1,393,817	7,982,212	45.2%	428,697	15.1	21.9
City J	4,949,900	7,910,824	7,092,692	818,132	59.8%	308,626	16.0	25.6
City K	1,689,199	2,193,303	1,178,218	1,015,086	29.8%	1,528,896	1.1	1.4
City L	10,944,627	6,386,107	5,352,736	1,033,371	−41.7%	801,273	13.7	8.0
City M	4,874,884	3,907,770	3,640,147	267,624	−19.8%	383,172	12.7	10.2
City N	19,684,023	15,446,444	13,816,767	1,629,647	−21.5%	464,017	42.4	33.3
City O	1,815,312	2,791,170	2,696,819	94,351	53.8%	180,009	10.1	15.5
City P	–	–	–	–	–	4,678	–	–
City Q	11,316,563	7,471,875	6,940,247	531,628	−34.0%	1,006,986	11.2	7.4
City R	119,655	213,901	195,818	18,083	78.8%	29,665	4.0	7.2
City S	–	–	–	–	–	53,512	–	–

N/B) "-" indicates "Not applicable"

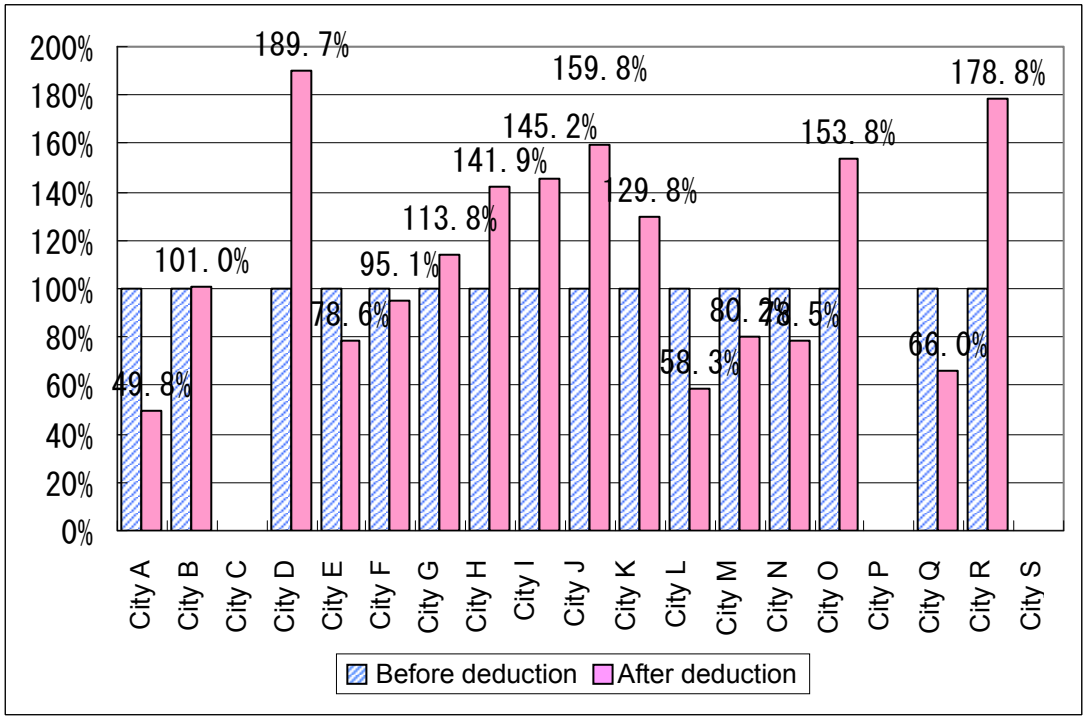


Figure5: Adjustment rate of L in individual municipalities according to Method 2

2. Advisability of emissions redistribution in commercial sectors

Activities in commercial sectors, especially those in cities with a concentration of businesses, provide benefits not only to the city subject to assessment, but also to other cities through governmental organizations and business activities in a wide area. Therefore, some people think that CO_2 emissions attributed to the activities in commercial sectors should be redistributed just like those in industrial sectors. However, in view of the effectiveness in the practical utilization of this assessment tool, the redistribution will not apply to commercial sectors in the CASBEE-City (2011 Edition) for the following 3 reasons.

(1) Unlike CO_2 emissions in industrial sectors, which are basically linked to the quantity of the production output, those in commercial sectors are regarded as mainly being linked to the daytime population expressed by the number of people who commute to work or school in the municipality. Therefore, CO_2 emissions in commercial sectors are counted at the place of emission, instead of being redistributed. The calculation of per-capita CO_2 emissions is based on the adjusted population, expressed as [(Nighttime population + Daytime population) / 2], taking into account the daytime population, instead of the permanent population (the nighttime population) of the municipality, in which reasonable corrections are presumably made.

(2) Regardless of the location, the company-wide efforts of individual companies or activities of the industry group for reducing CO_2 emissions make a large contribution in industrial sectors. On the other hand, efforts and policies implemented in all parts of the municipality, including individual areas, city blocks and buildings, have a great impact in commercial sectors. Therefore, rather than counting the reduction effect of these efforts in other municipalities due to the redistribution, counting it in the same municipality, the source of the emissions, is considered appropriate, as it will serve as an incentive for the municipality to further reduce CO_2 emissions.

(3) Based on actual estimated figures of municipalities designated as Eco model cities, per-capita CO_2 emissions in commercial sectors were studied and the results indicated that there would be no major problems in the overall findings without redistribution.

【Analysis based on actual city data】

1) CO_2 emissions of Eco cities by sector

Estimated per-capita figures of CO_2 emissions in individual municipalities from fiscal 2004 to 2007 are shown in the figure below.

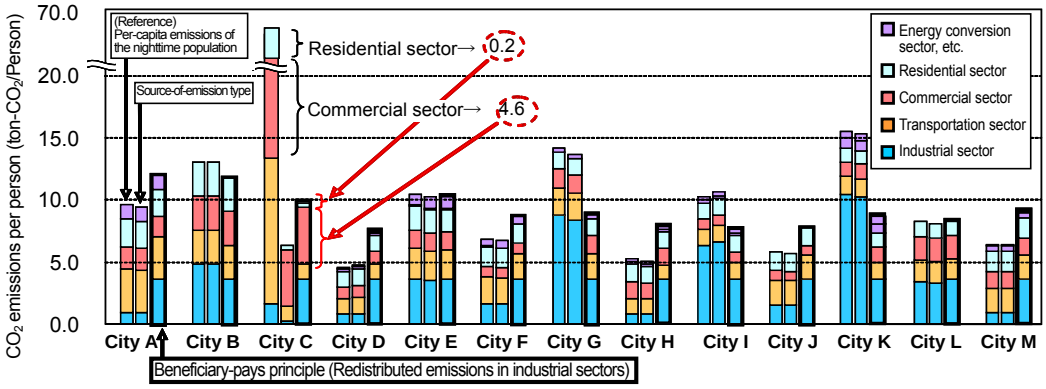


Figure6: Assessment and CO_2 emissions of Eco model cities by sector (Per-capita emissions of the adjusted population, redistributed emissions in industrial sectors)

2) Study about cities with a high percentage of daytime population

In Chiyoda ward where CO_2 emissions in commercial sectors account for 74% of all emissions, the percentage of the daytime population is expressed as “Daytime population / Nighttime population (Total population) = 20.5 (times).” Per-capita CO_2 emissions in commercial sectors (t-CO_2/Person) are greatly reduced by using the adjusted population in the calculation as in “49.4 (Per person of the nighttime population)→4.6(t-CO_2/Person Per person of the adjusted population).”

In the same manner, regarding residential sectors in which the connection with the daytime population is relatively tenuous, per-capita CO_2 emissions decrease (“2.6→0.2” in Chiyoda ward), which may be a gross underestimation. However, it is regarded acceptable in terms of the entire residential and commercial sector or all emissions, as CO_2 emissions in commercial sectors account for the majority (74%) of the total emissions.

As shown in Table 3, cities with a high ratio of day-night population to nighttime population are basically business accumulation areas. As is the case in Chiyoda ward described above, by using the value of per-capita emissions of the adjusted population in the calculation, the overall assessment becomes reasonable.

Table3: Cities with a high ratio of daytime population to nighttime population (Top 10 cities)

	Ratio of daytime population to nighttime population (times)
Tokyo Chiyoda	20.5
Osaka Chuo	7.6
Tokyo Chuo	6.6
Nagoya Naka	4.9
Tokyo Minato	4.9
Osaka Kita	4.3
Aichi Tobishima	3.1
Osaka Nishi	2.7
Tokyo Shibuya	2.7
Tokyo Shinjuku	2.5

∗Calculated using the total population and the daytime population shown in the “Census returns” (2005), Statistics Bureau, Ministry of Internal Affairs and Communications

3) National institutions

In cases in which test and research institutions classified into commercial sectors are concentrated, and CO_2 emissions are not reduced despite the use of the adjusted population, emissions will not be redistributed.

This is because the test and research institutions located in one area actually form a framework of the municipality, which indicates that the municipality itself cannot function without them. In some cases, the existence of these institutions has a rather good influence on the municipality’s environment.

However, when deducting CO_2 emissions attributed to these institutions from the total emissions of the municipality at the discretion of the assessor, regardless of the above principle, corresponding Q should require certain adjustments as appropriate according to the L deduction (i.e. Q3.1.1: Reducing per-capita GRP equivalent, Q3.2.1: Reducing exchange population equivalent index).

Afterword

This publication is developed by the Committee for the Development of Environmental Performance Assessment Tools 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 Japan Sustainable Building Consortium. We hope this information will be used in a wide range of fields and make an important contribution in building a sustainable society.

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